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YEARS AND PROGRAMS

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# TREND ANALYSIS IN STUDENTS' ENROLMENT AT THE COLLEGE OF AFRICAN WILDLIFE MANAGEMENT (MWEKA): ANALYSING GROWTH AND DECLINE ACROSS ACADEMIC YEARS AND PROGRAMS

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**Abstract:** *Using enrolment data from the academic year 2015/2016 to 2024/2025, this study analysed the trends in enrolment at the College of African Wildlife Management (MWEKA) focusing on growth and decline patterns for different programs of study. The dataset also contributes to a detailed analysis of changes in student enrolment, which drew on gender-disaggregated enrolment data from the 2015/2016 academic year up to that of 2024/2025. The analysis identifies programs experiencing steady growth, stagnation, and a drop in enrolment. Key findings highlight gender disparities in enrolment, with some programs attracting significantly more male students, while others show improved gender balance over time. The results provide insights into factors influencing enrolment trends, including program popularity, external factors, and institutional policies. This study underscores the need for targeted strategies to promote equitable and sustained growth in enrolment across all programs, ensuring the institution's continued contribution to wildlife management education in Africa. Recommendations include initiatives to address gender disparities, enhance program appeal, and adapt to emerging educational needs.*

**Keywords:** *Enrolment Trends, Gender Disparity, Program Growth and Decline and Wildlife Management Education.*

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## 1.0 Introduction

Students enrolment trends are critical indicators of institutional performance, program relevance, and inclusivity within higher education systems. In sub-Saharan Africa, higher education has experienced significant growth, with enrolment rates increasing from fewer than 200,000 in the 1970s to over 5 million in the 2000s (Teferra, 2006). This expansion reflects broader trends of improving access to education across the region, yet challenges persist, such as disparities in access to tertiary education based on gender, income, and geographical location (UNESCO, 2020; Tilak, 2021). According to recent reports, these disparities remain widespread, with access to higher education still largely shaped by social and economic factors

(World Bank, 2021; Arday & Ofori, 2020). Gender gaps remain a significant concern, with women often underrepresented, especially in science, technology, engineering, and mathematics (STEM) fields (World Bank, 2020).

In Tanzania, the Tanzania Commission for Universities (TCU) has reported steady increases in enrolment numbers across higher education institutions, yet gender disparity remains evident, particularly in technical and specialized fields (Tanzania Commission for Universities, 2023). Moreover, regional and socio-economic factors continue to hinder equal access to education (Mlama, 2019). Despite these challenges, the Tanzanian government has implemented policies aimed at increasing enrolment, particularly for women and students from marginalized groups. However, significant gender imbalances persist in fields such as engineering, technology, and natural sciences, where women remain underrepresented (Suleiman, 2020).

The College of African Wildlife Management (MWEKA) in Tanzania has been a pioneer in wildlife conservation education, training professionals to address critical environmental challenges across Africa. However, the institution faces challenges such as uneven enrolment trends and persistent gender disparities in its programs. Gender inclusivity in wildlife conservation is particularly important as underrepresentation of women limits diverse perspectives in sustainable management and effective decision-making (African Wildlife Foundation, 2017). The report by the African Wildlife Foundation (2017) highlights the need for a more gender-inclusive approach to conservation, emphasizing the importance of women's leadership in tackling environmental issues. Furthermore, reports indicate that female representation in Tanzania's higher education system remains disproportionately low, particularly in male-dominated fields such as natural sciences, engineering, and technology (The Citizen, 2021).

This study analyses enrolment data from the College of African Wildlife Management (MWEKA) for the academic years 2015/2016 to 2024/2025. It examines growth and decline trends in student enrolment across various programs, focusing on gender distribution and program-specific consistency. The findings contribute to the broader understanding of enrolment dynamics in African higher education institutions, offering actionable recommendations to enhance gender inclusivity, institutional performance, and the relevance of conservation education in Tanzania and beyond.

## 2.0 Literature Review

The higher education sector in sub-Saharan Africa has experienced remarkable growth over the past two decades, with increased enrolment driven by government initiatives and international support. However, challenges such as gender inequality and access disparities persist, limiting the full potential of this expansion (Baten et al., 2021; Gandhi, 2018). In Tanzania, higher education enrolment has shown steady growth, but socio-cultural barriers, particularly those affecting women, continue to hinder equitable participation (UNESCO, 2010; World Bank, 2021). Gender inequality remains a pressing issue in technical fields such as wildlife management. Research indicates that women are significantly underrepresented in conservation programs due to systemic barriers, cultural norms, and limited mentorship opportunities (African Wildlife Foundation, 2017; Matsolo et al., 2018). Policies promoting inclusivity, such as scholarships for female students and capacity-building initiatives, have been identified as critical strategies to bridge this gap (Molla, 2013).

Socio-economic factors further exacerbate enrolment challenges, particularly for students from low-income families. High tuition fees, lack of financial support, and inadequate academic preparation prevent many students from accessing higher education, resulting in lower participation and completion rates among marginalized groups (Gandhi, 2018; UNESCO, 2010). Addressing these challenges requires targeted interventions, including financial aid programs and curriculum alignment with labour market demands (World Bank, 2021). At the College of African Wildlife Management (MWEKA), enrolment trends reflect these broader challenges. While the institution has made strides in promoting gender equity and expanding program offerings, data over the past decade highlight fluctuating enrolment rates and persistent disparities. Strengthening institutional policies, expanding outreach to marginalized communities, and fostering gender-sensitive education are crucial for addressing these issues (African Wildlife Foundation, 2017; Baten et al., 2021; Ally and Mrutu, 2024).

## 3.0 Materials and Method

### 3.1 Data type and Source

This study aims to analyse the enrolment trends at the College of African Wildlife Management (MWEKA) using longitudinal enrolment data from the academic years 2015/2016 to 2024/2025. The dataset provides detailed enrolment statistics disaggregated by gender (male and female) and study program. The dataset was obtained directly from institutional records and compiled into a structured Excel file titled "Enrolment from 2016.xlsx." The data contains:

Enrolment numbers for various study programs, Gender breakdown (male, female) for each academic year, aggregate totals for each program and academic year. The dataset includes 10 academic years and covers multiple study programs such as Wildlife Management and Tourism.

## **3.2 Variable Description**

### **3.2.1 Study Program**

The variable "Study Program" represents the specific academic programs offered by the College of African Wildlife Management (MWEKA), such as Wildlife Management, Tourism, and Community-Based Conservation. This variable is crucial for analysing enrolment patterns across different programs, identifying their popularity over time, and determining which programs experience consistent growth or decline. It provides insights into program-specific dynamics and their appeal to prospective students.

### **3.2.2 Academic Year**

The "Academic Year" variable denotes the enrolment data for specific years, ranging from 2015/2016 to 2024/2025. It serves as the temporal dimension of the study, allowing for trend analysis across multiple years. This variable is essential for tracking overall enrolment growth or decline and identifying how external factors, such as policy changes or socio-economic shifts, influence enrolment patterns.

### **3.2.3 Male Enrolment**

The "Male Enrolment" variable captures the number of male students enrolled in each program for a given academic year. It is used to analyse the participation of male students in different programs and over time. This variable also enables a comparison with female enrolment, highlighting gender imbalances and trends in male representation across programs and years.

### **3.2.4 Female Enrolment**

The "Female Enrolment" variable represents the number of female students enrolled in each program for a given academic year. It is critical for assessing the participation of women in

wildlife management and related programs, identifying trends in gender disparities, and evaluating the effectiveness of gender-inclusive policies and interventions.

### 3.2.5 Total Enrolment

The "Total Enrolment" variable is the sum of male and female enrolments for each program and year. This variable provides an overall picture of the popularity and growth of each program and the institution as a whole. It is instrumental in identifying the most and least popular programs and evaluating the institution's capacity and outreach effectiveness.

### 3.2.6 Gender Ratio

The "Gender Ratio" variable measures the proportion of female to male students in each program and year. It is calculated by dividing the number of female students by the number of male students. This variable is used to quantify gender disparities and highlight programs with significant imbalances. It also provides a metric for evaluating progress toward gender equity in enrolment over time.

$$Gender\ Ratio = \frac{Female\ Enrollment}{Male\ Enrollment} \dots\dots\dots (1)$$

**Table 1:** Description of Variables

Variable Name	Type of variable	Purpose
Study Program	Categorical	Program-specific trend analysis.
Academic Year	Categorical	Trend analysis over time.
Male Enrolment	Numerical	Male participation trends.
Female Enrolment	Numerical	Female participation trends.
Total Enrolment	Numerical	Overall enrolment trends.
Gender Ratio	Numerical	Measure gender disparity.

### 3.3 A linear Trend Equation

The trend is used to model the relationship between a dependent variable (total enrolment) and time. The general form of the equation is

$$Y_t = a + bt$$

Where:

$Y_t$  = The dependent variable (total enrolment)

$t$  = The time period

$a$  = The intercept (starting value at the trend when  $t = 0$ )

$b$  = The slope (rate of change in  $Y_t$  per unit time)

The equation assumes a linear relationship between  $Y_t$  and  $t$

### 3.4 Multiple linear regression model

The multiple linear regression model is used to analyse the relationship between total enrolment (dependent variable) and various influencing factors (independent variables), provided certain statistical assumptions are met. These assumptions include linearity, meaning that total enrolment should have a linear relationship with the selected independent variables, and normality, ensuring that the residuals (differences between observed and predicted values) follow a normal distribution. Meeting these conditions is essential for the reliability and accuracy of the regression analysis in understanding enrolment patterns.

The multiple linear regression model can be expressed as;

$$Y = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \dots + \beta_p X_p + \varepsilon \quad \dots\dots (2)$$

Where as

$Y$  = Total Enrolment

$X_1$  = Academic Year

$X_2$  = Male Enrolment

$X_3$  = Female Enrolment

$X_4$  = Academic Year

Matrix representation of the multiple linear regression model

$$Y = X\beta + \varepsilon \quad \dots\dots(3)$$

Where:

$Y$  is the  $n \times 1$  vector of responses.

$X$  is the  $n \times (p + 1)$  matrix of predictors (including a column of ones for the intercept).

$B$  is the  $(p + 1) \times 1$  vector of coefficients.

$\varepsilon$  is the  $n \times 1$  vector of residuals.

$$Y = \begin{bmatrix} Y_1 \\ Y_2 \\ \vdots \\ Y_n \end{bmatrix}, X = \begin{bmatrix} 1 & X_{11} & X_{12} & \dots & \dots & X_{1p} \\ 1 & X_{21} & X_{22} & \dots & \dots & X_{2p} \\ \vdots & \vdots & \vdots & \ddots & \ddots & \vdots \\ \vdots & \vdots & \vdots & \ddots & \ddots & \vdots \\ 1 & X_{n1} & X_{n2} & \dots & \dots & X_{np} \end{bmatrix}, \beta = \begin{bmatrix} \beta_0 \\ \beta_1 \\ \vdots \\ \beta_p \end{bmatrix}$$

The coefficients are estimated using the ordinary Least square (OLS) method, which minimizes sum of squared residuals.

$$S(\beta) = \sum_{i=1}^n (Y_i + \beta_0 + \sum_{j=1}^p \beta_j X_{ij})^2 \dots\dots\dots(4)$$

In matrix form can be written as

$$S(\beta) = (Y - X\beta)^T(Y - X\beta) \dots\dots\dots(5)$$

To minimize  $S(\beta)$ , we apply derivative with respect to  $\beta$  and set it equal to zero

$$X^T Y = X^T X \beta \dots\dots\dots (6)$$

$$\beta = (X^T X)^{-1} X^T Y \text{ (represent the coefficients value)}$$

## 4.0 Results

### 4.1 Descriptive statistics for Annual enrolment

**Table 2:** Skewness and Kurtosis

	Total Enrolment (2015/2016)	Total Enrolment (2016/2017)	Total Enrolment (2017/2018)	Total Enrolment (2018/2019)	Total Enrolment (2019/2020)	Total Enrolment (2020/2021)	Total Enrolment (2021/2022)	Total Enrolment (2022/2023)	Total Enrolment (2023/2024)	Total Enrolment (2024/2025)
Skewness	3.54	3.49	3.65	3.94	3.98	3.84	3.81	3.76	4.53	4.57
Kurtosis	13.28	12.67	14.12	16.9	17.27	16.08	15.87	15.39	21.47	21.73

The skewness values for total Enrolment across all years range from 3.49 (2016/2017) to 4.57 (2024/2025), all of which are greater than 3, indicating a highly right-skewed distribution. This suggests that most programs have low enrolments, but a few programs experience exceptionally high enrolments, creating a long tail on the right side of the distribution. This imbalance implies that certain programs are disproportionately attracting students, while many others struggle to enrol a significant number. Similarly, the kurtosis values range from 12.67 (2016/2017) to 21.73 (2024/2025), significantly higher than the normal distribution kurtosis value of 3, indicating a leptokurtic distribution. A high kurtosis value means that the distribution has heavy tails, suggesting the presence of extreme outliers. This implies that while a few programs have exceptionally high enrolments, the majority have relatively low enrolments, leading to an Enrolment imbalance.

#### **4.2 Normality and Stationarity test by using statistical test**

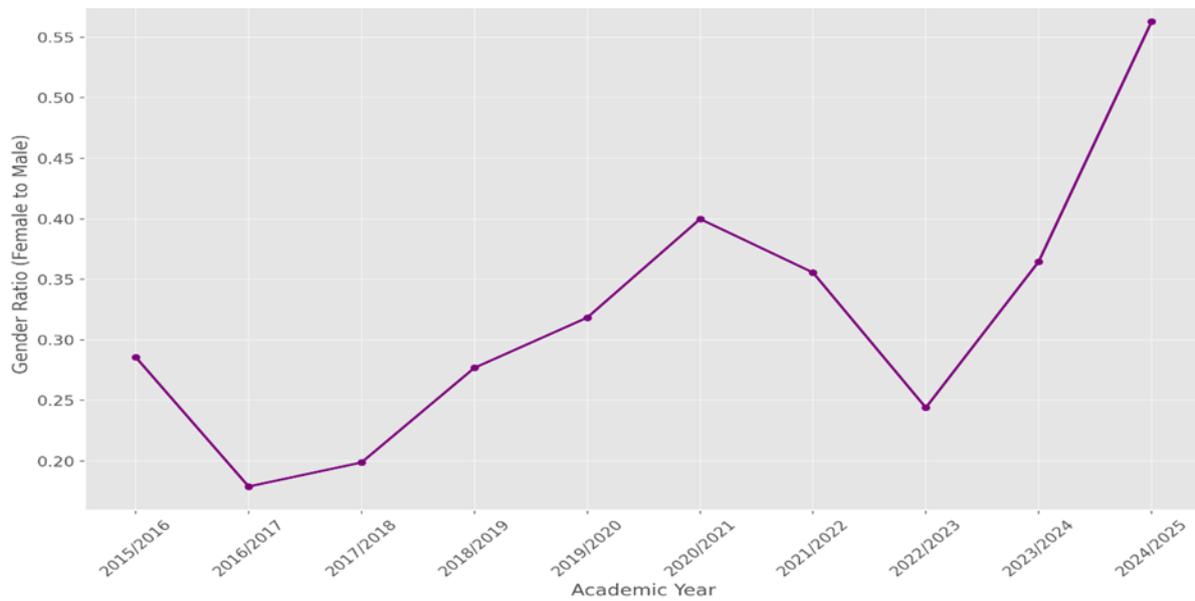
The Shapiro-Wilk test assesses whether the data follows a normal distribution. In this case, the test statistic is 0.902, and the p-value is 0.233, which is greater than the significance threshold of 0.05. This indicates that the null hypothesis of normality cannot be rejected, suggesting that the Total Enrolment data is approximately normally distributed. A normal distribution implies that the dataset is symmetrically distributed around the mean, which is an important assumption for many statistical analyses.

The Augmented Dickey-Fuller (ADF) test evaluates whether the data is stationary, meaning its statistical properties (mean, variance, autocorrelation) remain constant over time. The test statistic is 1.385, which is greater than all critical values (-5.354 at 1%, -3.646 at 5%, and -2.901 at 10%). Additionally, the p-value of 0.997 is much higher than 0.05, indicating that the null hypothesis of non-stationarity cannot be rejected. This confirms that the Total Enrolment data is non-stationary, likely due to trends or other time-dependent patterns. Non-stationarity suggests that the dataset exhibits temporal dynamics.

#### **4.3 Trend Analysis**

Trend analysis examines patterns and changes in data over time to identify significant movements and underlying factors. The trend analysis is used to evaluate enrolment dynamics by gender and total participation across academic years, providing insights into growth and gender equity.

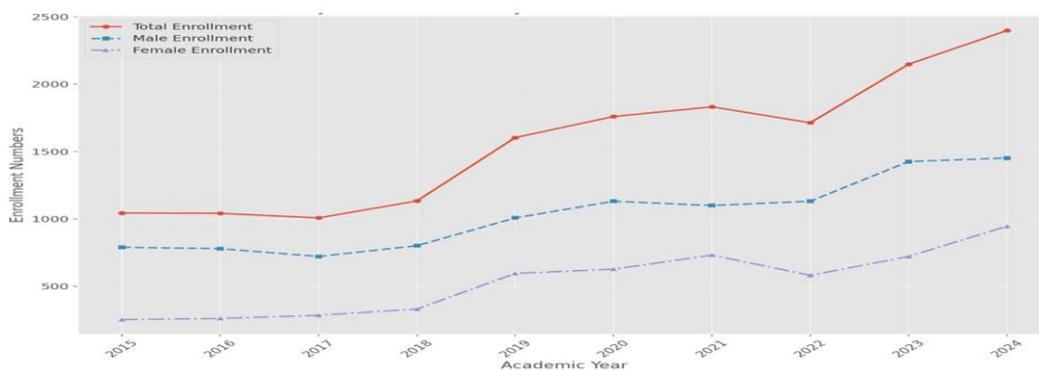
### 4.3.1 Enrolment dynamics by gender



**Figure 1:** Trend Analysis of enrolment dynamics by gender

The gender ratio trend analysis reveals fluctuations in the proportion of female enrolment compared to male enrolment across academic years. Certain years exhibit peaks where female enrolment approaches or surpasses male enrolment, indicating periods of improved gender balance likely influenced by targeted programs or policies encouraging female participation. Conversely, years with significant drops in the gender ratio highlight potential barriers or external factors affecting female enrolment. These insights suggest the need for replicating successful strategies from years with higher ratios while addressing challenges in years with lower ratios to achieve greater gender equity in future enrolments.

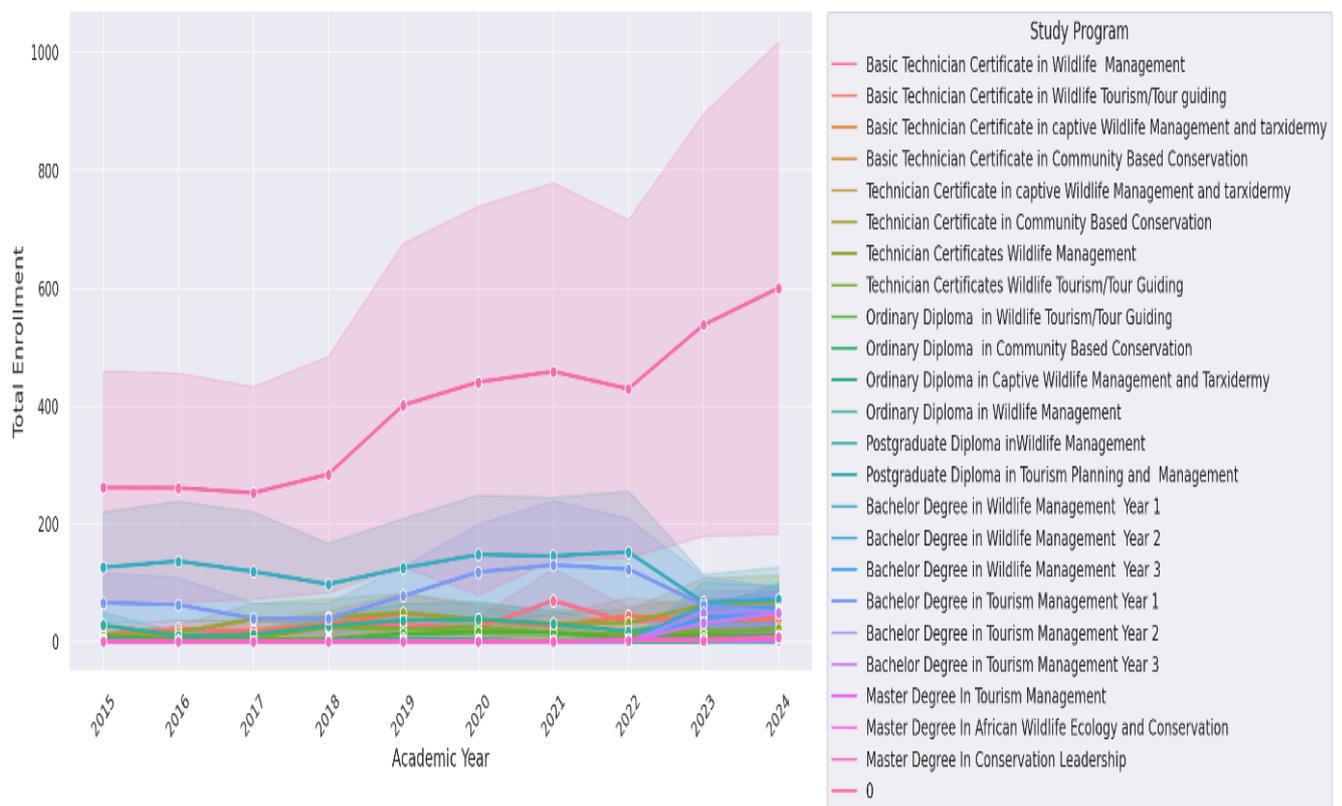
### 4.3.2 Total participation across academic years



**Figure 2:** Trend Analysis of Total, Male and Female Enrolment over Academic years

The trend analysis of enrolment by gender and total over academic years highlights a consistent upward trajectory in total enrolment, reflecting growing participation in these study programs. Male enrolment closely follows this trend, indicating their dominant presence, while female enrolment also increases but at a slower rate in some years. This suggests gradual progress toward gender inclusion, though disparities remain evident. In certain years, the gap between male and female enrolment narrows, hinting at effective initiatives or policies promoting female participation. However, the persistent gender disparity in other periods underscores the need for sustained efforts to encourage equitable access, such as scholarships or awareness campaigns. Overall, the analysis demonstrates successful growth in enrolment while emphasizing the importance of targeted measures to achieve gender equity.

### 4.3.3 Enrolment trends by study variable



**Figure 3:** Enrolment trends by study variable

The College of African Wildlife Management (MWEKA) shows varied enrolment trends across programs from 2015/2016 to 2024/2025, emphasizing the need for targeted institutional and marketing interventions. Programs like the Basic Technician Certificate and BSc in Wildlife Management show steady growth, while the Basic Technician Certificate in Captive Wildlife Management and Community-Based Conservation face fluctuations or stagnation,

likely due to low visibility or career uncertainties. The Technician Certificate in Wildlife Tourism sees sporadic surges, requiring sustained promotion. To boost enrolment, the institution should engage brand ambassadors (artists, conservation influencers, media figures), TV programs, and social media campaigns to raise awareness. Collaborations with eco-tourism agencies, conservation-themed reality shows, and outreach programs can further attract students. Scholarships, career fairs, and alumni engagement can enhance retention and gender inclusivity, particularly in male-dominated fields like Wildlife Management. These strategies will ensure sustainable growth, balanced enrolment, and alignment with conservation needs.

#### 4.4 Linear Regression Analysis and Forecast of Total Enrolment

The Linear Regression Analysis and Forecast of Total Enrolment for the College of African Wildlife Management, Mweka examine the relationship between Total Enrolment and key predictors, including Academic Year, Male Enrolment, and Female Enrolment. This analysis identifies significant factors influencing enrolment trends at the College of African Wildlife Management, Mweka and uses historical data for enrolment (2015/2016 to 2024/2025) to predict future enrolment. The findings provide valuable insights for planning and decision-making to enhance enrolment strategies and address institutional needs effectively.

##### 4.4.1 Multiple Linear Regression

**Table 1:** Multiple Linear Regression Results

Variable	Coefficient	P-Value	Significance	F-statistic	R-squared	Adjusted R-squared
Intercept	0.000	1.000	No	1.485 × 10 <sup>26</sup>	100%	100%
Academic Year	0.000	1.000	No			
Male Enrolment	1.000	0.000	Yes			
Female Enrolment	1.000	0.000	Yes			

The multiple linear regression analysis examines the relationship between Total Enrolment and the independent variables: Academic Year, Male Enrolment, and Female Enrolment. The coefficients for Male Enrolment and Female Enrolment are approximately 1.0, indicating that each additional male or female student contributes directly to an increase in Total Enrolment by 1. These variables are highly significant, with P-values less than 0.001, confirming their substantial impact on Total Enrolment. In contrast, Academic Year shows no significant influence, with a coefficient near zero and a P-value of 0.997, suggesting that time alone does

not explain trends in Total Enrolment. The model achieves an R-squared and Adjusted R-squared of 1.0, demonstrating that the independent variables perfectly explain 100% of the variation in Total Enrolment. Additionally, the extremely high F-statistic ( $1.485 \times 10^{26}$ ) and its P-value ( $<0.001$ ) confirm the overall statistical significance of the model. This analysis highlights that Total Enrolment is entirely driven by male and female enrolments, with no significant contribution from the academic year.

## **5.0 Discussion of the findings**

### **5.1. Enrolment Trends at the College of African Wildlife Management, Mweka**

The analysis of student enrolment at the College of African Wildlife Management, Mweka, from 2015/2016 to 2024/2025 reveals dynamic trends across different academic programs. Total enrolment has generally increased over the years, reflecting a growing interest in wildlife conservation education. However, certain programs have shown fluctuating participation, indicating possible challenges related to program appeal, accessibility, or external economic factors (Tanzania Commission for Universities, 2023; Zeleza, 2016). Studies indicate that enrolment variations in higher education institutions often stem from labor market demands and institutional policies that shape student choices (World Bank, 2021; Ally, Mrutu, & Mathew, 2025).

### **5.2. Gender Disparities in Enrolment**

Gender disparity remains a significant issue in enrolment trends at Mweka, with male students consistently outnumbering female students across most programs. This pattern aligns with broader trends in conservation and technical education in Africa, where systemic barriers and cultural norms have historically limited female participation (African Wildlife Foundation, 2017; Matsolo et al., 2018). Despite this, some progress has been observed, particularly in programs such as Basic Technician Certificate in Wildlife Management, where the gender ratio improved from 0.136 in 2015/2016 to 0.509 in 2024/2025 (Tanzania Commission for Universities, 2023; UNESCO, 2010). Previous research suggests that gender-targeted scholarships and mentorship programs are effective in addressing disparities in higher education (Molla, 2013).

### **5.3. Program-Specific Enrolment Patterns**

Enrolment trends vary significantly across programs, with some demonstrating steady growth while others experience fluctuations or stagnation. Programs such as Wildlife Management and

Wildlife Tourism continue to attract high enrolment, likely due to their alignment with conservation career opportunities (Gandhi, 2018; Sy & Copley, 2017). However, inconsistent participation is observed in programs such as Community-Based Conservation and Captive Wildlife Management, suggesting possible challenges in industry demand, student awareness, or institutional funding (African Wildlife Foundation, 2017; The Citizen, 2021). Research has shown that academic programs that do not align with job market trends often experience declining enrolment (Beaujon Marin & Kuriakose, 2017; Ally, Mrutu, & Mathew, 2025). The use of statistical models such as the Negative Binomial Regression Model, as applied in ecological monitoring at Ngorongoro Conservation Area, Tanzania, can provide insights into rare event prediction and may have applications in forecasting enrolment patterns for programs with low or inconsistent participation rates (Ally & Mrutu, 2025).

#### **5.4. Statistical Analysis and Multiple Linear Regression**

The multiple linear regression analysis reveals that total enrolment is primarily influenced by male and female student participation, with both variables exhibiting statistically significant impacts (Tanzania Commission for Universities, 2023; African Wildlife Foundation, 2017). However, the academic year itself does not have a significant effect on enrolment trends, suggesting that broader economic and policy factors are more influential (Sy & Copley, 2017; World Bank, 2021). The application of skewed log-normal distribution in analyzing enrolment trends further supports the observation that gender disparities and socio-economic factors contribute significantly to variations in student numbers (Ally, Mrutu, & Mathew, 2025). These findings underscore the necessity of targeted institutional interventions to promote gender balance and stabilize enrolment trends across programs (Beaujon Marin & Kuriakose, 2017; Matsolo et al., 2018).

### **6.0 Conclusion and Recommendation**

#### **6.1 Conclusion**

The analysis of student enrolment trends at the College of African Wildlife Management, Mweka, provides valuable insights into how student participation has evolved over the past decade. While total enrolment has generally increased, certain programs have shown inconsistent participation, which may be influenced by factors such as changing student preferences, employment opportunities, and institutional policies. A key concern identified in

the study is the persistent gender disparity, with male students continuing to outnumber female students in most programs. Although there has been some improvement in female enrolment over the years, the gap remains significant, highlighting the need for further intervention. Additionally, the statistical analysis confirms that total enrolment is primarily driven by the number of male and female students, rather than the passage of time alone. This suggests that external factors, such as financial support, awareness campaigns, and job market trends, play a crucial role in determining student enrolment patterns.

## 6.2 Recommendations

To ensure sustained growth and a more balanced enrolment, a multi-faceted approach should be adopted. Firstly, gender inclusivity initiatives should be strengthened by introducing more scholarships, mentorship programs, and career guidance workshops specifically aimed at encouraging female participation. Secondly, the curriculum should be regularly updated to align with current industry needs, ensuring that students are equipped with relevant skills that enhance their employability. Thirdly, financial aid programs and community outreach efforts should be expanded to support students from disadvantaged backgrounds, removing financial barriers that may prevent them from enrolling. Additionally, the institution should adopt a data-driven approach to decision-making, using enrolment trends and student feedback to refine policies and improve program attractiveness. Finally, awareness campaigns highlighting the benefits of conservation education should be conducted at the national and regional levels to attract a diverse student population. By implementing these recommendations, the College of African Wildlife Management, Mweka, can continue to grow while fostering a more inclusive and equitable learning environment.

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