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Villain or scapegoat? Elephants and academic achievement of pupils and schools in Trans Mara District, Kenya

Tobias Ochieng Nyumba[1,2,3,4] | **Nigel Leader-Williams**[3]

[1]African Conservation Centre, Nairobi, Kenya

[2]Institute for Climate Change and Adaptation, University of Nairobi, Nairobi, Kenya

[3]Department of Geography, University of Cambridge, Cambridge, UK

[4]Department of Environment and Geography, University of York, York, UK

Correspondence
Tobias Ochieng Nyumba, African Conservation Centre, Nairobi, Kenya.
Email: tnyumba@uonbi.ac.ke

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Abstract

Improving human capital through quality education remains a global and national priority, particularly for developing countries. Academic performance is the standard indicator of a successful acquisition of the knowledge, skills, and attitudes for improving human capital. However, recent data, particularly in wildlife areas shows that pupils often perform poorly on academic tests in low-income countries. This study aims to determine the impact of elephants on academic performance in Trans Mara District, Kenya. We use data from 137 schools and 749 pupils who wrote the Kenya Certificate of Primary Education between 2010 and 2014, and 15 key informants. We used descriptive statistics to analyze and interpret our data. Results show that locating a school outside the elephant range positively contributed to higher mean scores compared to ethnicity, pupil–teacher ratio and gender. Whereas day facilities only strongly contributed to lower scores compared to examination entry, age of the pupil, and ethnicity. The study places elephants on both ends of the villain-scapegoat continuum since their presence alone does not make a major contribution to poor academic performance in the Trans Mara District. We recommend providing cheaper and accessible transport to pupils, expanding both day and boarding facilities, establishing additional schools closer to pupils within elephant range to reduce the distances to school. These initiatives must be linked to the conservation of elephants as a suit of direct incentives for coexisting with elephants.

KEYWORDS

elephants, elephant range, KCPE, school mean score

1 | INTRODUCTION

There is a growing need to improve human capital by investing in knowledge and skills development through quality education to foster economic growth and human well-being, especially in low-income countries (Barro, 1991; Fukuda-Parr, 2003; Glewwe et al., 2011; Hanushek, 1995; Lance, 2011; Lucas, 1988; Mankiw et al., 1992). Goal 4 of the 17 United Nations Sustainable Development Goals (UN SDGs) envisions inclusive and equitable quality education and the promotion of lifelong learning opportunities for all. Consequently, many countries have attempted to

improve the quality of education, especially in Latin America, the Middle East, Asia, and sub-Saharan Africa.

Over the past two decades, the Kenyan government has prioritized strengthening educational opportunities to meet the UN SDGs through the introduction of free primary education (FPE) and progressively, developing the Vision 2030 whose educational goal is "*to provide globally competitive quality education and training and research for development by reducing illiteracy*" (Government of the Republic of Kenya and the National Economic and Social Council, 2007), and aligns with the fourth goal of the UN SDGs. Ironically, these government efforts also came with an upsurge in the number of privately owned and operated schools targeting families who could afford to pay school fees and have their children taught in small groups. The growth in private schools, especially in the rural areas can be contributed to the difference in academic performance as they provide better facilities and support that can enable such pupils to overcome social and environmental barriers to academic performance (Mulinya & Orodho, 2015). Consequently, school enrolment has increased in Kenya. For example, between 2009 and 2014, pupil enrolment increased from 5.9 to 7.2 million. During this period, the Ministry of Education Science and Technology (MOEST) (2014) estimated an increase in gross national preprimary school enrolment of 18% and a net enrolment rate of 28%. Similar trends were reported in secondary school enrolment with a 16% and 14% increase in gross and net enrolment rates, respectively. However, regional disparities persist especially at the county level with nearly 50% of the counties, particularly those from the arid and semi-arid (ASAL) regions, such as Narok, Samburu, and Kajiado reporting below the national average (MOEST, 2014).

Academic performance has long been used as an indicator of a successful acquisition of the knowledge, skills, and attitudes necessary for personal socioeconomic development (Abagi & Odipo, 1997). However, academic scholars and education professionals have raised concerns that pupils who finish primary school often perform poorly on academic tests (Glewwe & Kremer, 2006). This raises the question of what are the reasons for poor academic performance among pupils and schools despite considerable efforts to improve the quality of and access to education?

2 | FACTORS AFFECTING ACADEMIC PERFORMANCE

Academic scholars and education professionals have cited different factors leading to the poor academic performance of schools and pupils. Studies across sub-Saharan African rural communities have identified factors relating to pupils themselves, their parents, the school environment, government policies, and objectives and the surrounding environment (Abagi & Odipo, 1997; Bommier & Lambert, 2000; Heyneman, 1977; Kasirye, 2009; Liddell et al., 1997; Simmons & Alexander, 1978). Consequently, factors such as students' parental background, geographic location of schools, prevailing circumstances both at home and school, class attendance, hereditary and environmental factors have been studied and remedial measures suggested based on the resulting knowledge (e.g., Abagi & Odipo, 1997; Piaget, 1977; Romer, 1993). Other studies have identified socioeconomic status, family size (Liddell et al., 1997; Simmons & Alexander, 1978), education achieved by fathers (Heyneman, 1977; Kasirye, 2009), belonging to the dominant ethnic group (Heyneman, 1977), pupils' self-motivation and how far the child travels to school (Bommier & Lambert, 2000).

In rural areas, children walk long distances, and have much closer interactions with nature, when going to school. Under these circumstances, environmental factors are thought to influence their cognitive development by providing a variety of stimuli that influence their behavior and academic potential (Andrewartha, 1961; Mbithi, 1982; Piaget, 1995). For example, nomadic hunting and food gathering activities in a stable and healthy environment can greatly contribute to the development of spatial concepts (Mwamwenda, 2004). In contrast, sedentary and agricultural lifestyles can facilitate the acquisition of quantitative reasoning power (Mbithi, 1982). In addition, natural resource-based conflict and competition with wildlife is one example of an environmental factor that can greatly affect the academic performance of both pupils and schools (e.g., Nyamwaro et al., 2006; Nyumba, 2018; Sitati et al., 2012).

3 | WHY ELEPHANTS?

Rural African communities, especially those coexisting with wildlife, have raised concerns about a possible interference with pupils' academic activities by elephants and other large mammals (Lusaka Times, 2009; Mackenzie & Ahabyona, 2012; Mukami, 2015; Mutuku, 2016; Nyumba, 2018; Sitati, 2003; Sitati et al., 2012; Wanja, 2015). A study around Kibale National Park, Uganda established that children from villages closer to the park tended to have lower grade averages than their peers from other villages, and this was linked to the perceived threats from elephants (Mackenzie & Ahabyona, 2012). The study further established that distance traveled by pupils to school and gender of the pupil was among the most influential factors of scholastic achievement for children around the park. Keeping children out of school

to guard crops or herd livestock is commonly reported especially adjacent to protected areas (e.g., Haule et al., 2002; Mackenzie & Ahabyona, 2012). Data collected from schools near Kilombero Game Controlled Area in Tanzania revealed that 88.4% of pupils guarded crops and 60.0% missed classes to guard crops mainly during the day (Haule et al., 2002).

In Kenya, wildlife ranges such as Trans Mara (TM) have both resident and migratory wildlife that roam across large areas in search of food, water, shelter and salt licks, and that can all result in negative interactions with locals (Nyumba et al., 2020; Sitati, 2003; Sitati et al., 2012). For example, Sitati (2003) found that pupils within the elephant range in TM scored lower grades than those from outside the elephant range. Another study in the same site by Nyumba (2018) established that pupil absenteeism was more prevalent within the elephant range in TM and that the temporal pattern of absenteeism was consistent with crop planting, harvesting and raiding by elephants in June, July, and September. This provides a strong indication that pupils could be participating in crop farming, harvesting and guarding or staying away due to elephant presence, thereby denying them adequate time to study, complete school assignments, and even to sleep. The studies and other reports identified incidents of elephants blocking passage routes, forcing school children to either wait for them to return into the forest or travel by longer but safer routes or wait to be escorted to and from school by a parent or guardian have been reported. Subsequently, habitual lateness and absenteeism among children and early school closures to avoid encountering dispersing elephants are common thereby reducing teaching and learning time as well as disrupting cocurriculum activities like games and clubs in schools (Nyamwaro et al., 2006; Nyumba, 2018; Sitati et al., 2012). Such situations can frustrate pupils and reduce their academic potential (Mbithi, 1982).

These incidents have historically placed elephants at the center of controversies with communities attracting fear and detestations (Barnes (1996), ingrained hostility and animosity (Wunder, 1997) and bitter complaints (Naughton-Treves, 1997). Today, communities losing valuable opportunities invested in knowledge and skills development through quality education to foster economic growth and human well-being, as a result of interferences by elephants are undoubtedly inclined to consider elephants the villain, if not a scapegoat. Conservationists and education professionals are faced with the question of whether elephants are the villain or mere scapegoat in accounting for the possible increasing disparity in the academic performance of schools and pupils within and outside the elephant range. This paper aims to determine the impact of elephants on the academic performance of primary schools and pupils in TM district. Under the 8-4-4 system, the primary school level is the longest and the first phase of the system serving mainly children between 6 and 14 years of age. The primary level is meant to prepare pupils to participate in the social, political, and economic well-being of the country, as well as to be global citizens (Amutabi, 2003). Therefore, its major goal is to develop self-expression, self-discipline, and self-reliance, and provide a rounded educational experience. At the end of the eighth year, pupils take the Kenya Certificate of Primary Education (KCPE) examinations, and the results are used to determine placement at secondary school based on merit.

We focus on primary schools for the following reasons: (i) primary education is the foundation and cornerstone of all forms of formal education, (ii) most children in developing countries terminate their education at the primary school level, so factors that promote its accessibility, both in terms of quality and equity, are of great importance (UNESCO, 2016), (iii) most schools in the rural areas of Kenya are public primary schools with day pupils, and (iv) day pupils in wildlife dispersal areas may experience added problems, for example, encounters with dangerous wild animals like elephants and buffaloes when traveling between their homes and schools.

4 | METHODS

4.1 | Study area and schools

TM district is located in partially ASAL pastoral rangelands in Southern Kenya. Lying adjacent to the world-famous Masai Mara National Reserve, the district has both resident and migratory elephants that stray into the communal areas increasing incidents of human–elephant conflict (HEC) (Nyumba et al., 2020; Sitati, 2003; Sitati et al., 2012). HEC is frequently reported in the district but is more concentrated in central TM with forest remnants that provide refuge for elephants (Figure 1) (Nyumba et al., 2020). Incidents of crop raids, attacks on livestock and people, damage to property and general disturbance including blocking passage routes to school, disruption of learning activities are some of the common forms of HEC in TM (Nyamwaro et al., 2006; Nyumba, 2018; Sitati et al., 2012). In response, locals have been reported retaliating on the offending elephants threatening the survival of the species and their habitat with serious implications for the conservation and management of the elephants in TM (Nyumba, 2018).

The peculiar features of TM include a strong cultural orientation that revolves around cattle and ceremonial ritual life, symbolism, and language idioms, which are

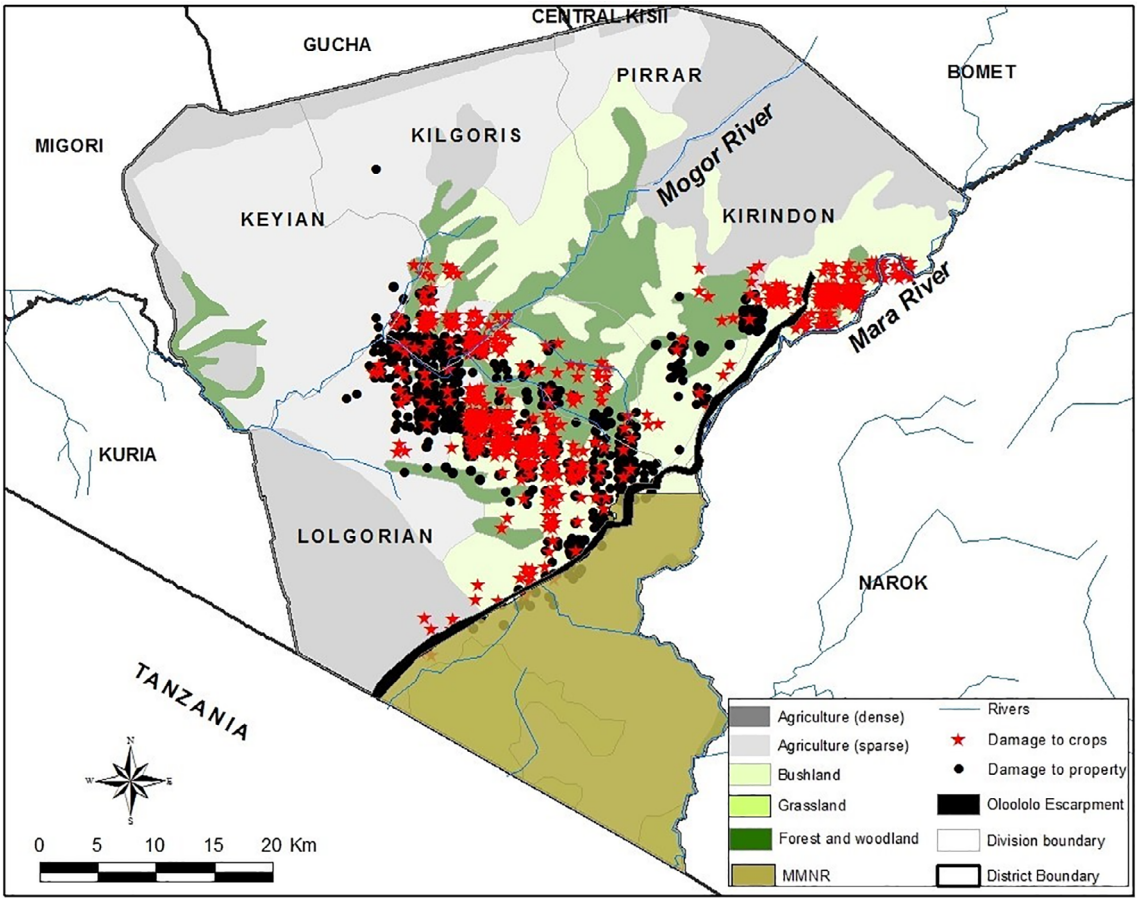

FIGURE 1 Trans Mara District showing the spatial distribution of HEC. HEC, human–elephant conflict. *Source*: Nyumba et al. (2020)

also linked to cattle (Mbithi, 1982). The predominantly Maasai community has been considered to place a higher and immediate premium on their cattle compared to education or wildlife conservation in a manner reflective of the Xhosa of South Africa, and the Basotho of Lesotho (Mbithi, 1982).

By the year 2014, TM had 137 public primary schools mainly within the central parts of the district dominated by the Maasai ethnic group. Most of these schools had modest infrastructure compared to the national standards (Republic of Kenya, 2008) and the standards in the neighboring districts. The infrastructure has been developed through a collaboration between the parents, the government and various development partners. The schools provided both day and boarding facilities to pupils supported by the constituency development fund and each school accommodated between 150 and 1000 pupils per year depending on the availability of space in classrooms, and dining and dormitory facilities. However, many more schools still have inadequate facilities and pupils take their meals under the trees.

Primary school enrolment in TM experienced a steady increase between 2010 and 2014, in a manner consistent with the national trends aligned with the government's goals of provision of FPE. However, these schools ranked poorly in terms of the age of the pupils at the time of enrolment (Figure 2a), the average age of pupils by school level or grade, and gross and net school enrolment, transition rates and examination performance (Figure 2b) compared to national rates (Education Policy and Data Center, 2014; MOEST, 2014). Such poor ranking in TM is reminiscent of other schools especially in the ASAL areas where learning is frequently interrupted by social, economic and cultural activities. Consequently, education professionals should be concerned since it leads to the wastage of potential young people who would otherwise be instrumental in the attainment of Vision 2030 and the SDGs in TM.

4.2 | Sampling of schools and pupils

Our population included all schools in the TM that were registered for the KCPE ($N = 137$) between 2010 and 2014. We conducted a stratified random sampling of study schools by dividing the schools ($N = 137$) into two

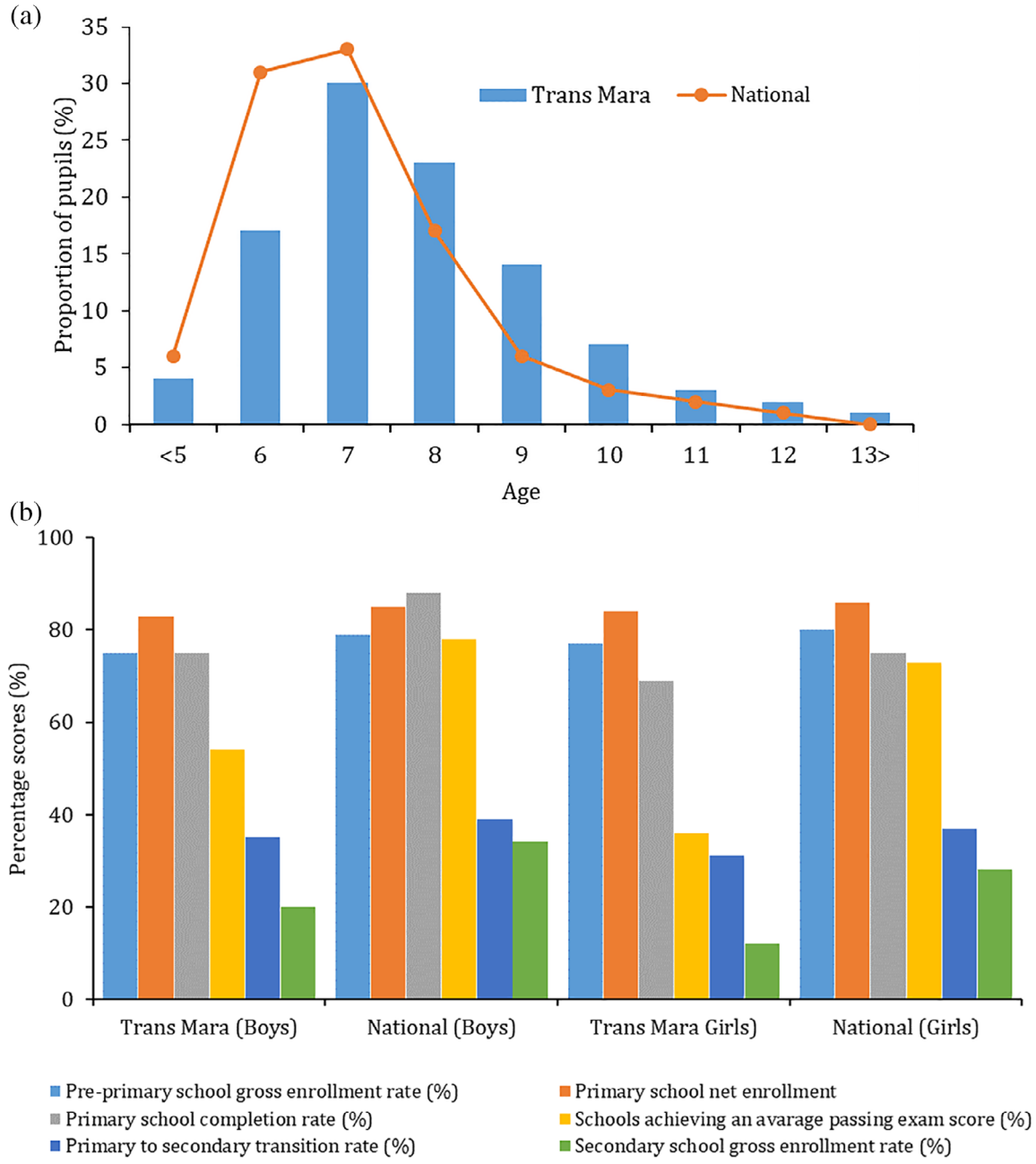

FIGURE 2 Standard one level entry by age (a); and school enrolment, transition rates, and performance between 2009 and 2014 (b). *Source*: from MOEST (2014)

groups: those within the elephant range and those outside the elephant range based on Figure 3. This resulted in 23 (17%) schools within the elephant range, and 114 (84%) schools outside the elephant range. The two groups were further divided into subgroups of schools based on accessibility through the few available access roads in TM. Some schools were located in areas separated by deep valleys and thick forests and were not easily accessible to the research team. Figure 3 shows the breakdown of schools that fell into each category. We then used a random number generator to randomly select 16 schools 8 from each of the 2 subgroups. The final schools were: Olmotonyi; Sitoka; Mutenkwar; Olopikidong'oe; Esoit Naibor; Emurtoto; Olesentu; and Oloonkolin from within elephant range, and Nkararo; Ildolisho; Ilkarian, Olkiloriti, Ang'ata Barrikoi, Sosio, Olalui, and Siteti from outside elephant range as mapped in Figure 3.

4.3 | Data collection

We obtained KCPE mean scores for all the 137 public primary schools in TM between 2010 and 2014 from the school records and the District Education Office.

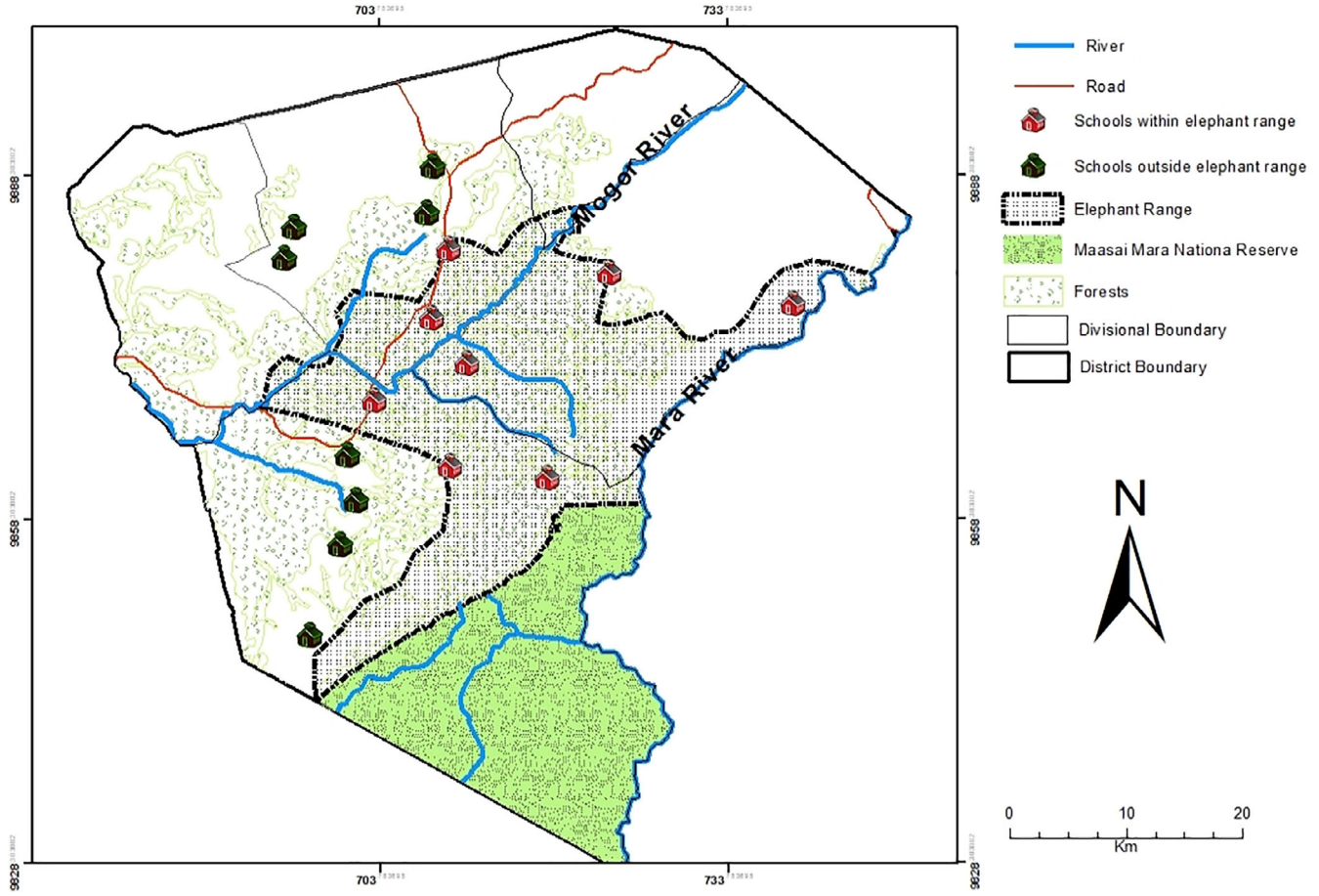

FIGURE 3 Study schools within and outside elephant range in TM. TM, Trans Mara

Under the 8-4-4 system, KCPE candidates are examined in five subjects: (1) Kiswahili; (2) English; (3) Mathematics; (4) Science and Agriculture; and (5) Social studies (Ministry of Education, 2008). The KCPE exams are standardized and marked by the Kenya National Examinations Council (KNEC) out of a total of 500 marks. The schools and pupils are expected to score 250 marks and above to reach the average pass mark. The data were collected at two levels: (i) School mean scores for all the 137 schools for a period of 5 years, between 2010 and 2014 and (ii) pupil mean scores from the selected 16 schools for the examination year 2014 for which records were readily available at the school and school attendance register.

The first set of data included other variables, such as division, school size, the number of teachers, whether the school offered day or day and boarding facilities and exam entry for each of the years, and was used to determine trends in the performance of schools ($N = 137$) from within and outside the elephant range and factors that determined school performance. Meanwhile, the second set of data was primarily on the KCPE scores for individual pupils from the 16 schools, who wrote the exams in 2014 alongside other details such as age, ethnicity, sex, school attendance, distance and pupil–teacher ratio (PTR) for the year 2014 only.

Finally, we conducted key informant interviews to gain deeper insights into the nature of human–elephant interactions in TM. We used purposive sampling to enlist individuals knowledgeable on human–elephant interaction, or in a position of authority to influence decisions regarding resource use and/or shape the regime of interaction with elephants in TM. Consequently, we interviewed 16 individuals including education officials, local leaders, and selected community members in the district using a set of categories for the interview content and roles. The interviews were recorded using a digital voice recorder upon receiving consent from the interview respondent. The interview data was transcribed and used to help expound and cross-check the quantitative analyses presented.

4.4 | Statistical analysis

Data were numerically coded in Microsoft Excel and transferred to SPSS 23 for statistical analysis (IBM Corp, 2013). The Shapiro–Wilk statistics was used to

check assumptions of normality. In addition, descriptive statistics such as mean, skewness (a measure of symmetry) and kurtosis (a measure of "peakedness") were used to detect the type of distribution. We applied χ^2, Tukey post hoc tests, independent-samples *t*-test (using Levene's test for equality of variances), univariate analysis of variance and general linear regression modeling to determine which factors, singly or in combination, best explained differences in school and pupil performance. Furthermore, a 95% confidence interval (CI) was calculated to determine whether or not there were differences in mean scores between schools and among pupils. All tests were two-tailed and significance was defined as $p < .05$ and $p < .1$.

5 | RESULTS

5.1 | School and pupil characteristics

5.1.1 | Public primary schools profile

The majority of the schools (29.2%, $n = 40$) were located within Kirindon Division. However, within the elephant range, the majority of schools (43.0%, $n = 10$) were located within Lolgorian Division. Most of the schools (64.2%, $n = 88$) were dominated by pupils from the Maasai ethnic group whereas non-Maasai, notably Kipsigis, Kalenjin, Kisii, Kuria, and Luo constituted the rest of the ethnic groups in TM schools. The majority of schools in TM (86.1%, $n = 118$) offered either day facilities only whereas some 19 (13.9%) schools offered both day and boarding facilities of which 5 were found within elephant range. The number of teachers ranged from 4 to 21, with an average of 8.7 ± 3.3 teachers per year. However, there was no difference ($F_{(1,135)} = 2.8$, $p = .097$) in the mean number of teachers within (7.7 ± 2.4) and outside (8.9 ± 3.4) elephant range.

In contrast, the number of pupils enrolled in schools differed ($F_{(1,137)} = 4.84$, $p = .045$) and ranged from 118 to 968, with an average of 434.2 ± 182.3 pupils per year. The average number of pupils within the elephant range was lower (348.3 ± 157.4) than that of schools outside (451.5 ± 182.6) elephant range. This occurred against a background of higher population growth rate within the elephant ranges such as Lolgorian Division (Kenya National Bureau of Statistics, 2010). However, the mean of the PTR between schools within (45.7 ± 14.4) and outside (52.2 ± 16.8) elephant range did not differ significantly ($F_{(1,135)} = 2.9$, $p = .086$). Finally, the number of pupils registered for examination ranged from 12.2 to 107.8 with a mean of 35.2 ± 16.8 pupils per year, and this differed ($F_{(1,135)} = 5.8$, $p = .018$) within (27.7 ± 13.5) and outside (36.8 ± 17.1) elephant range (Table 1).

5.1.2 | Pupil profile

A total of 749 pupils from the 16 schools in TM sat for the KCPE examinations in 2014. The majority of the candidates (59.0%, $n = 443$) were from schools outside the elephant range. Most of the pupils (63.0%, $n = 470$) were from the Maasai ethnic group. Other tribes, notably the Somali, Kamba, Luhya, and Kuria constituted the minority ethnic groups (1.6%, $n = 12$) (Table 2).

5.2 | Academic performance of schools

The mean scores from all the 137 schools showed that schools in TM scored a mean of 252.6 ± 37.8, which was slightly above the national recommended average of 250 mean score. The scores ranged between 150.0 and 351.0. The mean scores revealed an overall upward trend

TABLE 1 Key characteristics of schools within and outside elephant range

School characteristics	Inside No. (%)	Outside No. (%)	Total (%)
Division			
Pirrar	0 (0.0)	25 (21.9)	25 (18.2)
Keyian	1 (4.3)	17 (14.9)	18 (13.1)
Kirindon	7 (30.4)	33 (28.9)	40 (29.2)
Kilgoris	5 (21.7)	29 (25.4)	34 (24.8)
Lolgorian	10 (43.5)	10 (8.8)	20 (14.6)
School type			
Boarding and day	5 (21.7)	14 (12.3)	19 (13.9)
Day only	18 (78.3)	100 (87.7)	118 (86.1)
Predominant tribe			
Maasai	21 (91.3)	67 (58.8)	88 (64.2)
Non-Maasai	2 (8.7)	47 (41.2)	49 (35.8)
School enrolment			
<300	10 (43.5)	25 (21.9)	35 (25.5)
301–600	10 (43.5)	65 (55.3)	73 (53.3)
>601	3 (13.0)	26 (22.8)	29 (21.2)
Exam entry			
<29	15 (65.2)	39 (34.2)	54 (39.4)
30–59	7 (30.4)	64 (56.1)	71 (51.8)
>60	1 (4.3)	11 (9.6)	12 (8.8)
Number of teachers			
<10	18 (78.3)	88 (77.2)	106 (77.4)
11–15	5 (21.7)	19 (16.7)	24 (17.5)
16–21	0 (0.0)	7 (6.1)	7 (6.1)

in academic performance between 2010 and 2011, followed by a downward trend between 2011 and 2013 and a gradual upward trend in 2014 (Figure 4). We assessed the school performance against three factors thus (i) the physical location of the schools relative to the administrative boundaries and elephant range; (ii) dominant ethnic groups in the school either as Maasai or non-Maasai, and (iii) type of school in terms of boarding and day facilities available to pupils. The school mean scores were normally distributed (Shapiro–Wilk test, $W = 0.99$, $p = .794$) and met the homogeneity of variance assumption as assessed by Levene's test for equality of variances for all the four factors assessed.

The results further showed that schools within the elephant range scored significantly ($F_{(1,135)} = 37.9$, $p < .001$) lower mean scores (213.0 ± 42.2) than schools outside the elephant range (260.0 ± 31.6). Trends in school mean scores within and outside the elephant range matched the overall trends observed in the district (Figure 4). Regarding the administrative location of the schools, in this case, division, we observed that schools in TM reported significant differences ($F_{(1,132)} = 3.4$, $p = .011$) in mean scores (Table 3).

In addition, trends in mean scores indicate that Lolgorian, Kirindon, Keyian, and Pirrar divisions registered above-average mean scores in 2010. However, in the succeeding years, Lolgorian and Kirindon registered a steady decline in mean scores between 2011 and 2013. Kilgoris Division scored below average throughout the 2010–2014 period (Figure 5).

TABLE 2 Key characteristics of pupils within and outside elephant range

Pupil characteristics	Inside No. (%)	Outside No. (%)	Total (%)
Ethnicity			
Maasai	260 (84.7)	210 (47.5)	470 (62.8)
Kalenjin	19 (6.2)	128 (29.0)	147 (19.6)
Kisii	16 (5.2)	53 (12.0)	69 (9.2)
Kikuyu	4 (1.2)	29 (6.6)	33 (4.4)
Luo	6 (2.0)	12 (2.7)	18 (2.4)
Others	2 (0.7)	10 (2.3)	12 (1.6)
Gender			
Male	185 (60.3)	238 (53.8)	423 (56.5)
Female	122 (39.7)	204 (46.2)	326 (43.5)
Age (years)			
12–14	157 (51.5)	190 (43.2)	347 (46.6)
15–17	131 (42.6)	221 (50.0)	352 (47.0)
18–21	19 (5.9)	31 (6.8)	50 (6.4)

Our results further suggest that non-Maasai dominated schools had significantly ($F_{(1,135)} = 14.5$, $p < .001$) higher mean scores (268.3 ± 32.9) than Maasai dominated schools (243.0 ± 37.7) and that schools offering both boarding and day facilities had significantly ($F_{(1,135)} = 4.6$, $p = .035$) higher mean scores (269.6 ± 29.8) than those offering day facilities only (249.0 ± 38.3).

5.2.1 | Factors predicting school performance

We conducted a linear regression analysis to assess whether school location within or outside elephant range, administrative division, type of school, predominant ethnic group, examination entry, and PTR significantly predicted the school mean score. The regression model significantly ($F_{(9,127)} = 9.9$, $p < .001$) predicted approximately 41.0% of the variance. For this sample, school mean score was predicted by location, division, type of school, predominant ethnic group, examination entry, and the PTR. Specifically, in TM a non-Maasai-dominated school located outside the elephant range with a higher PTR will most likely score better, while a day school in Kilgoris Division with a higher examination entry will score poor mean grade (Table 4).

5.3 | Academic performance of pupils

The assessment of pupil performance was based on the KCPE mean scores of pupils drawn from the selected 16 schools, of which eight were within and outside the elephant range, respectively. The results showed that pupil mean scores were normally distributed (Shapiro–Wilk test, $W = 1.00$, $p = .599$) and ranged from 76.0 to 404.0 with a mean of 240.5 ± 58.4. However, pupils outside the elephant range reported significantly higher ($F_{(1,743)} = 8.3$, $p = .004$) mean scores (247.0 ± 51.9) compared to pupils within the elephant range (235.0 ± 62.0). This is consistent with the overall performance of schools within and outside the elephant range established earlier. The results are also consistent with the views expressed by education officials and parents in TM thus:

> "*Although the government provides equal support for all schools and children here, pupils living [comfortably] in areas where they do not have to dodge elephants are generally safer, happier, calmer and more stable than children interacting more closely with elephants. Children who have no closer interactions with elephants will undoubtedly have*

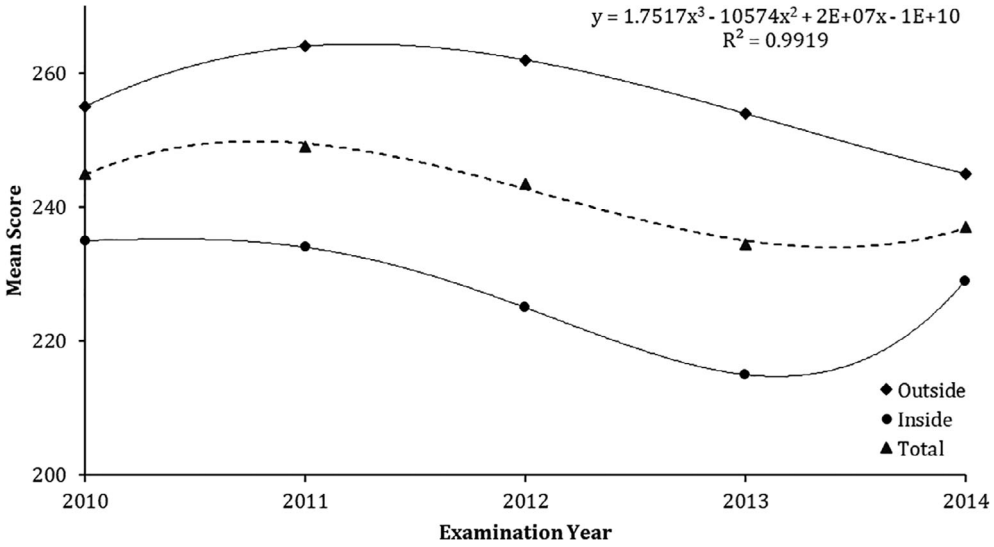

FIGURE 4 Trends in school mean scores within and outside elephant range

TABLE 3 Means and standard deviations of school mean scores by division

Division	Mean	*SE*	*n*
Pirrar	258.1	5.2	25
Kirindon	262.3	3.0	40
Keyian	265.4	5.7	18
Lolgorian	240.7	4.5	20
Kilgoris	237.4	6.6	34

> *ample time to read and excel in examinations* [Local education official]"

Furthermore, parents seem to accept this as a normal occurrence as expressed by some of them during community meetings thus:

> "*We agree that a child cannot do well in school if he is scared of elephants and in response, teachers understand these circumstances and are normally considerate. Consequently, the teacher cannot give him homework because, at what time will he do it, yet am also afraid of lighting my lantern in the dark thinking elephants will notice the light and attack us. You see?* [Community participant]"

For parents outside the elephant range, the difference in performance was attributed to other factors and not much about elephants. For example, one parent stated:

> "*Haaaa... education matters must be a collaboration between the parent and the teachers... period!!! A child cannot decide his future. The parent and the teachers must guide him; then he will just pass his examinations. But our neighbours from that side [read... pastoralists], they do not care, once the child leaves the house, their work is finished* [Community participant]"

The ages of candidates ranged from 12 to 21 years with a mean of 15.0 ± 1.5 years old. Candidates within the elephant range were significantly ($\chi^2 = 19.6$, $df = 9$, $p = .021$) older (15.1 ± 1.5) than those outside the elephant range (14.9 ± 1.5) at the time of writing examinations (Figure 6). Pupil mean scores varied by age (Figure 6). A Tukey post hoc analysis of each pair of age categories revealed that pupils aged between 12 and 14 years scored better (253.8 ± 53.9) than those aged 15 and 17 (230.7 ± 57.6), and 18 and 21 years old (215.9 ± 73.1). Although several factors could be linked to the late school enrolment, one reason cited by the local leaders was the general threat from wildlife, in turn, leading to a delay until the children can go to school on their own.

> "*school children live in an area where conflict with elephants is common, you cannot guarantee their safety walking through the bushes... we have had recent cases of elephants killing pupils and even teachers on their way to school here in Trans Mara. So, the children frequently don't start school until they are much older, because it is dangerous for them to walk to school at an early age* [Local elder]"

Furthermore, pupils' scores significantly differed ($F_{(1,734)} = 6.6$, $p = .010$) by gender with male pupils reporting higher mean scores (245.0 ± 60.4) than female

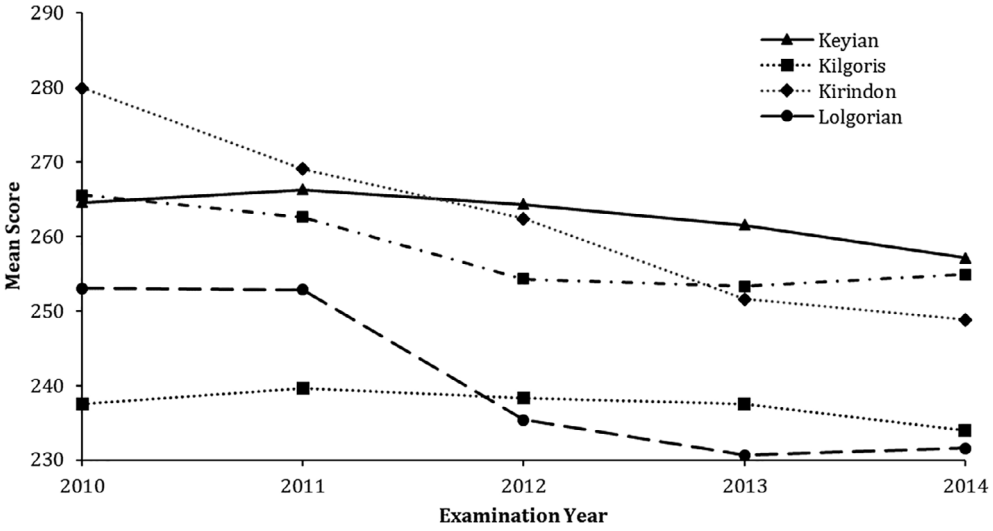

FIGURE 5 School mean scores in different divisions in TM. TM, Trans Mara

TABLE 4 Factors predicting academic performance of schools in TM

Variable	*B*	*SE*	*β*	*t*
(School mean score)	**239.37**	**14.97**	**.00**	**15.99*** **
Location				
Outside elephant range	**46.03**	**8.06**	**.46**	**5.71*** **
Division				
Kilgoris	**−18.21**	**9.18**	**−.21**	**−1.98** **
Kirindon	−8.41	9.44	−.10	−0.89
Lolgorian	−11.54	10.96	−.11	−1.05
Pirrar	−15.40	10.40	−.16	−1.48
Type of school				
Day only	**−33.94**	**8.24**	**−.31**	**−4.12*** **
Predominant ethnic group				
Non-Maasai	**14.42**	**6.64**	**.18**	**2.17** **
Examination entry	**−0.37**	**0.18**	**−.17**	**−2.05** **
Pupil–teacher ratio	**0.46**	**0.18**	**.20**	**2.59** **

Note: $F_{(9,127)} = 9.9$, $R^2 = 0.41$. ** and *** indicate statistical significance at the 5% and 1% levels, respectively.
Abbreviation: TM, Trans Mara.
Values in bold represent factors that significantly predicted school performance

pupils (234.0 ± 55.2). Distances from the pupils' homes to school ranged from 0.1 to 7.0 km with a median of 2.1 ± 1.2 km. Although most of the pupils (72.0%, $n = 535$) lived less than 2.0 km away from their schools, significantly ($\chi^2 = 141.0$, $df = 22$, $p < .001$) more pupils outside the elephant range (78.0%, $n = 344$) lived closer to their schools compared to pupils within the elephant range (62.0%, $n = 191$) (Figure 7).

However, the mean scores of pupils within and outside the elephant range did not vary ($F_{(1,741)} = 0.8$, $p = .493$) by distances from school.

Pupils in TM missed school for between 3 and 29 days during the year 2014. The mean absenteeism was 10.1 ± 5.1 days per year. Most of the pupils (44.0%, $n = 331$) missed between 6 and 10 days of schooling during the year. In particular, pupils within the elephant range missed significantly ($\chi^2 = 31.7$, $df = 4$, $p < .001$) more school days compared to pupils outside the elephant range (Figure 8).

Pupil mean scores varied depending on the number of school days missed (Table 5). A Tukey post hoc analysis showed that pupils who missed less than 5 days scored better (252.54 ± 64.00) than those who missed 16–20 days (214.51 ± 47.32) and more than 21 days (183.47 ± 38.19).

The PTR ranged from 31.1 to 60.1 with a mean of 48.3 ± 9.1 pupils per teacher. Schools from within the

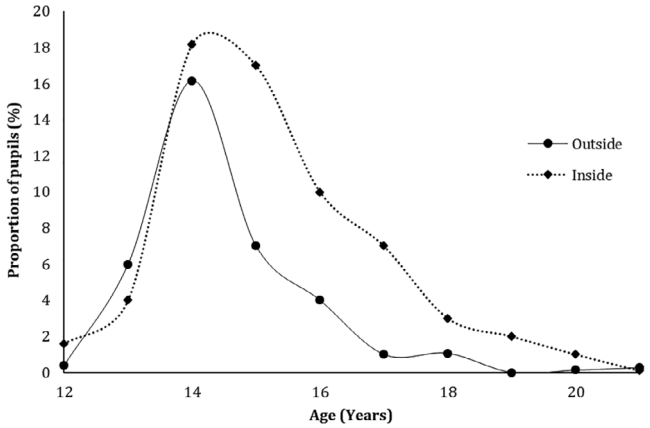

FIGURE 6 Age of pupils at the time of writing KCPE. KCPE, Kenya Certificate of Primary Education

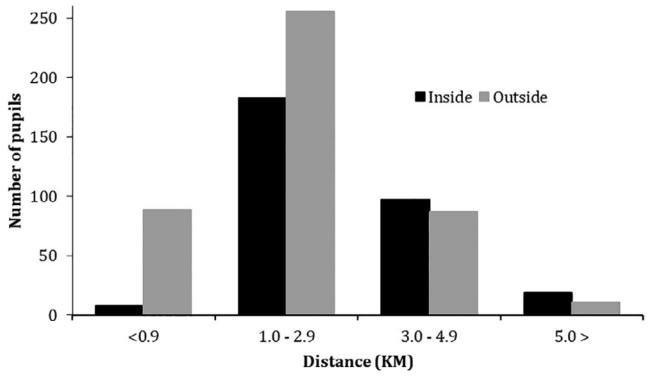

FIGURE 7 Distances between pupils' home and school

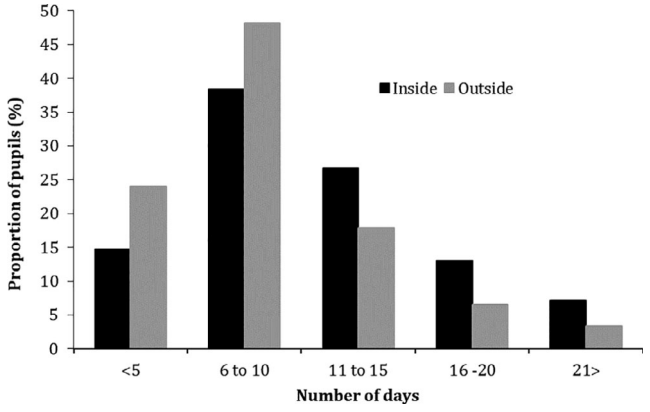

FIGURE 8 Number of school days missed during the year

elephant range had a significantly higher ($\chi^2 = 301.3$, $df = 5$, $p < .001$) mean of PTR (48.6 ± 6.3) compared to those from outside elephant range (47.9 ± 12.1).

Pupil mean scores varied by PTR (Table 6). A Tukey post hoc analysis showed that pupils from schools with a PTR of between 31 and 35 scored better (270.6 ± 33.8) than 36–40 (225.2 ± 49.7), 46–50 (233.2 ± 40.5), and 56–60 (218.7 ± 64.5).

TABLE 5 Means and standard deviations of mean scores by absenteeism

Number of days	Mean	*SE*	*n*
<5	252.5	5.2	151
6–10	247.6	3.0	331
11–15	214.5	5.7	68
16–20	237.6	4.5	161
>21	183.5	6.6	34

TABLE 6 Means and standard deviations of mean scores by pupil–teacher ratio

Pupil–teacher ratio (%)	Mean	*SE*	*n*
31–35	270.6	3.6	86
3640	225.2	4.2	137
4145	261.9	6.6	72
4650	233.2	4.6	76
5155	273.3	4.5	122
5660	218.7	4.1	252

5.3.1 | Factors affecting pupil academic performance

We conducted a multiple linear regression analysis to determine whether KCPE mean scores of pupils were best explained, singly or in combination, by location, gender, age, ethnicity, distance, absence and PTR. The regression model was significant ($F_{(8,736)} = 20.9$, $p < .001$) and predicted approximately 19% of the variance. For this sample, pupils' academic performance was best explained by location, gender, age, ethnicity, absenteeism, and PTR (Table 7). Specifically, in TM, female pupils attending schools outside the elephant range with a higher PTR were likely to score better grades, whereas older pupils missing more days of school will most likely score poorer grades.

6 | DISCUSSION

Studies have highlighted the possible impact of elephants on the education of children alongside other hidden impacts across sub-Saharan Africa (Hoare, 1999; Hunter et al., 1990; Mackenzie & Ahabyona, 2012; Nyamwaro et al., 2006; Nyumba et al., 2020; Sitati et al., 2012; Thirgood & Woodroffe, 2005). These studies in addition to the persistent public claims are a clear indication that the issue of elephants reducing access to school is gaining significance and needs to be analyzed in more detail, as

TABLE 7 Multiple linear regression with factors linked to pupil performance

Variable	*B*	*SE*	*β*	*t*
(Pupil mean score)	**310.32**	**22.51**	**.00**	**13.79*** **
Location				
Outside elephant range	**28.42**	**4.55**	**.24**	**6.24*** **
Gender of pupil				
Female	**10.00**	**3.97**	**.08**	**2.52** **
Age of pupil	**−6.24**	**1.36**	**−.16**	**−4.57*** **
Ethnicity				
Kalenjin	−4.81	6.51	−.03	−0.74
Others	**−22.57**	**5.48**	**−.19**	**−4.12*** **
Distance	−2.05	1.76	−.04	−1.16
Number of days absent	**−3.41**	**0.40**	**−.30**	**−8.48*** **
Pupil–teacher ratio	**1.23**	**0.22**	**.19**	**5.59*** **

Note: $F_{(8,736)} = 20.9$, $p < .001$, $R^2 = .19$. ** and *** indicate statistical significance at the 5% and 1% levels, respectively.
Values in bold represent factors that significantly affected pupil academic performance

part of the environmental factors impacting on academic performance of schools and pupils in rural communities (Andrewartha, 1961; Mbithi, 1982; Piaget, 1995). This is compounded by the fact that the elephant, as a flagship species is most commonly linked to some of the most intractable forms of conflict with humans, and therefore carry a historical and eminent burden of "unfavorable" interactions with people (Douglas & Veríssimo, 2013; Woodroffe et al., 2005). Our study has unpacked the different factors that might be responsible for the poor academic performance and how they act singly or in combination with elephant and elephant conservation and management related issues in TM. We endeavor to answer the question as to whether the elephants are the villain or just a scapegoat in the ongoing discourse.

6.1 | School and pupil characteristic in TM district

The literature has already identified factors relating to the pupils themselves, the school environment and government policies and objectives (Abagi & Odipo, 1997; Bommier & Lambert, 2000; Heyneman, 1977; Kasirye, 2009; Liddell et al., 1997; Simmons & Alexander, 1978). In TM, the spatial distribution and patterns of schools followed the historical planning where more schools were located within high agricultural zones and with higher human settlement, that is, 23 versus 114. The ethnic composition of the schools is consistent with their spatial distribution, for example, as observed by Sitati (2003) that the central parts of TM are occupied by the Maasai, and are inhabited by elephants, and have fewer and more widely disbursed schools.

Following the government's policy to strengthen FPE, expand equity, accessibility, quality, and relevance to all children of primary school age (Sifuna, 2005; UNESCO, 2016), the district has seen a growth in the number of schools offering both day and boarding facilities. For example, Sitati (2003) found that only three schools were offering both day and boarding facilities, of which, only one was within the elephant range in 2003, this changed rapidly in 2014 where 19 schools were offering both facilities and five were within elephant range (Nyumba, 2018). It is expected that these facilities can mitigate against the effects of poverty, long distances to travel to school, insecurity, household workloads and the effects of pastoralism including high levels of absenteeism and tardiness due to constant movements often without dependable transportation.

Meanwhile, Sifuna (1991) observes that boarding schools in the ASALs are yet to trigger the forecasted success due to two factors. First, the boarding facilities are considered low-cost, to which parents are required to make contributions. However, most parents are not able to meet their share of the cost. Second, some nomadic pupils might have opted out of boarding due to the predominantly vegetarian diet and "alien" facilities and curriculum (Souza, 2006). Our results indicate that schools in TM were also occupied by non-Maasai ethnic groups, notably Kipsigis, Kalenjin, Kisii, Kuria, and Luo. Consequently, some of the boarding schools in TM such as Olopikidong'oe and Emurtoto are filled by pupils from better-off districts around TM. This is consistent with the findings by Sifuna (1991) that settled communities who can afford the payment of fees to sustain the

boarding programs tend to "encroach" into the boarding schools and may render the prevailing school culture antipastoralists.

6.2 | Academic performance

The results of this study are consistent with the findings of Sitati (2003) in the same study site that schools within the elephant range and dominated by the Maasai reported lower mean scores. Although not a commonly studied phenomenon in sub-Saharan Africa, educational performance across ethnic groups is a common subject of enquiry in multicultural and ethnically sensitive settings such as the United States and the United Kingdom. In these contexts, researchers have identified cultural values and beliefs, particularly those related to the valuation of educational success, achievement-related socialization practices (e.g., parental discipline, parenting styles, family size) and the influence of social class as predictors of academic success (Blair et al., 1999). In our study area, the Maasai have been identified to subscribe to a strong cultural orientation that revolves around cattle and ceremonial ritual life, symbolism, and language idioms, which are also linked to cattle (Mbithi, 1982). Cases of female genital mutilation take place early in life and forced marriages, and underage teenage pregnancy are frequently reported. Although recent social–economic–cultural integrations have weakened these unique cultural orientations (Nyumba et al., 2021), the community still places a higher and immediate premium on their cattle compared to education or wildlife conservation and hence the lack of parental follow-up as observed by some parents.

It is, therefore, not surprising that schools dominated by the Maasai are performing poorly in national examinations. However, ethnicity alone can not be the predictor. According to Sitati (2003), pupil performance in TM was predicted by distance traveled, living within elephant range and absenteeism in addition to the ethnic origin of the candidate. The present study also established that fewer schools in the elephant range provided suitable facilities for pupils, whereas the schools were also sparsely spread out adding to the distances traveled by pupils to the school.

6.3 | So, is elephant the villain or just a scapegoat?

Our study is consistent with previous studies showing that pupils from schools within the elephant range perform poorly compared with their counterparts from outside the elephant range. A study around Kibale National Park, Uganda established that children from villages closer to the park tended to have lower grade averages than their peers from other villages, and this was linked to the perceived threats from elephants (Mackenzie & Ahabyona, 2012). Similarly, Sitati (2003) found that pupils within the elephant range in TM scored lower grades than those from outside the elephant range. Nevertheless, the present study established that age and gender of the pupil and PTR also predicted pupil performance in TM. Similarly, Mackenzie and Ahabyona (2012) established that distance traveled by pupils to school and gender of the pupil was among the most influential factors of scholastic achievement for children around Kibale National Park.

A study in the same site by Nyumba (2018) established that pupil absenteeism was more prevalent within the elephant range in TM and that the temporal pattern of absenteeism was consistent with crop planting, harvesting and raiding by elephants in June, July, and September. Keeping children out of school to guard crops or herd livestock is commonly reported especially adjacent to protected areas (e.g., Haule et al., 2002; Mackenzie & Ahabyona, 2012). Furthermore, other studies in TM have established that substantial amounts of time were lost whenever pupils waited for elephants to get out of their way to school and they would either get to school late or fail to attend school altogether (Sitati, 2003; Walpole et al., 2003). When analyzed in the presence of other factors, schools located outside the elephant range showed the strongest capacity to positively influence the academic scores of the school and its pupils at 46% and 24%, respectively. Meanwhile, absenteeism and schools offering day facilities only strongly reduced the pupil and school mean scores by 30% and 31%, respectively (Tables 4 and 7). Being located outside the elephant range means minimal or no interactions with elephants, while absenteeism is an indicator of interruption to school attendance as established earlier by Sitati (2003), Sitati et al. (2012), and Nyumba (2018) in TM.

Our study places elephants at the center of controversies surrounding academic performance within elephant ranges in Africa. However, our results, buttressed by results from previous studies across the continent do not categorically place elephants as villains or scapegoats in the HEC-Academic performance discourse. Instead, it places elephants on both sides of the villain-scapegoat continuum. Whereas these findings established that schools located within the elephant range significantly scored poor grades, other factors at play such as school infrastructure and ethnicity equally had significant contributions to poor grades. Sifuna (2005, 1991) highlight

the government's policy of investing in school infrastructure and the poor uptake of boarding schools systems in the pastoral areas due to cultural orientations which has nothing to do with elephants' presence or otherwise. In addition, Walpole and Leader-Williams (2001) and Nyumba et al. (2021) highlight a benefit-sharing policy between MMNR and the community from elephant conservation which is invested mainly in educational infrastructure, scholarships and other provisions through a locally elected committee. These are supposed to foster a favorable view of elephants, yet we see the reverse is the case. We therefore can conclude that under these circumstances, elephants can only be considered a scape goat to the poor academic performance in the study area.

Even if it remains unclear to what extent HEC is correlated with school performance, pupils remain threatened by wildlife leading to risks to their lives, especially within elephant ranges. Some of the contributing factors to poor pupils' performance include age and absenteeism. These have been directly linked to the presence of elephants and engaging in HEC mitigation activities. Reporting to school late, closing schools early, failing to report to school at all have all been identified in the study area. Meanwhile, pupils starting school late due to fear of encountering elephants at an early age has been reported in this landscape. The consequences of absenteeism, lateness and late enrolment in school is poor academic outcomes and hence lost opportunities for future employment and better livelihoods. For these communities, elephants are a villain responsible for their educational losses.

7 | CONCLUSION AND RECOMMENDATIONS

Education is a core well-being domain and is one of the key determinants of attitudes toward conservation. Consequently, any impacts on education linked to conservation do not only affect the overall human well-being but might also affect the overall support for conservation. Elephants represent some of the most intractable human–wildlife conflict (HWC) issues. In most cases, these have manifested in the form of direct and measurable outcomes such as livestock deaths and injuries, damage to property and loss of crops for which conservationists have managed to identify and implement suitable solutions. Indirect and secondary impacts, such as interference with education, are understudied and likely undervalued by conservation organizations in their efforts to work with people to reduce HWC. Here we show how HEC can be an impediment to educational success in elephant ranges and may affect wildlife conservation and the pursuit of human well-being. Consequently, it is important to find sustainable ways to address these costs. Here, we offer some recommendations to address the impacts of elephants on the academic achievement of schools and pupils in TM. We acknowledge the fact that we cannot eliminate elephants from the landscape, nor can we remove the schools and human settlements from the elephant range. Therefore our recommendations will target measures that can address interruption to school attendance including lateness and absenteeism.

School going children and especially boys, living within the elephant range, should be helped to acquire bicycles to enable them to overcome the challenge of getting to school late. This will allow them to use the safest routes to school without worrying about distances. The education and conservation actors in TM must be encouraged to borrow lessons elsewhere in Kenya and Africa where the help with transport to school through bicycles has not only improved school attendance but also improved enrolment and school performance (e.g., Mitani, 2007; World Bicycle Relief, 2016). As noted in TM, the cultural barriers that hinder girls from using bicycles are still abound. Consequently, there is a need for education and awareness creation to increase the buy-in by the community. This should enhance the self-esteem and confidence of girls in taking up cycling to school as well.

In the longer term, there is a need to expand the provision of boarding facilities especially for schools within the elephant range. This will reduce the risks of encountering elephants since pupils will only be walking to and from their homes at the beginning and end of the school term. Furthermore, the parents can easily arrange to collect the children at the end of the term without having to lose much productive time. In addition, schools within elephant range could be secured through electrified ring-fencing to keep elephants off the school compound such as has been done in Olopikidong'oe and Emurtoto primary schools.

The government and education partners should consider establishing additional primary schools closer to pupils within elephant range to reduce the distances between pupils' homes and school. Overall, all these initiatives must be linked to the conservation of elephants as a suit of direct incentives resulting from coexisting with elephants in the TM landscape.

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CONFLICT OF INTEREST

The authors have declared that no competing interests exist, financial, or otherwise.

AUTHORS CONTRIBUTIONS

The authors confirm contribution to the paper as follows. Nyumba Tobias led the study conception and design, data collection, analysis and interpretation of results, and draft manuscript preparation. Nigel Leader-Williams participated in the study conception and design, supervised data analysis and interpretation of results, and draft manuscript preparation. All authors reviewed the results and approved the final version of the manuscript.

DATA AVAILABILITY STATEMENT

The authors confirm that the relevant data supporting the findings of this study are available within the article [and/or] its Supporting information files.

ETHICS STATEMENT

This study was approved by the Ethics Review Group of the University of Cambridge, and the protocols used in the study were approved by the National Council for Science and Technology and Innovation of the republic of Kenya (Permit No. NACOSTI/P/14/0362/2798) and the Kenya wildlife Service (Permit No. KWS/BRM/5001). Several school pupils, teachers and community members were involved in this study between 2014 and 2015 in the Mara Ecosystem, Kenya and informed consent was sought according to the University of Cambridge Research Ethics guidelines and strategies aimed at minimizing harm to the subject.

ORCID

Tobias Ochieng Nyumba https://orcid.org/0000-0002-7821-5197

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SUPPORTING INFORMATION

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