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Anthropogenic bush fires and environmental degradation in Makindu Sub-County, Makueni County Kenya

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Abstract

Anthropogenic fires are common in rural Africa as the indigenous people use fire to modify the environment for their survival. Although human caused fire burning occurs as a significant traditional natural resource management practice and manifest a variety of ecological advantages, human initiated fires are viewed by conservation authorities as destructible and a cause for environmental degradation. The study gains local perception from the local respondents of Makindu Sub County, Kenya near Chyulu Hills National Park on the cause of bush fires and their impact on environmental degradation. The study was carried between October to January 2022 on various focused questionnaires, interview schedules, group discussions and observations were conducted among gender balanced respondents. The study findings recorded ten reasons why they use fires justifying its use as a land management tool and most conspicuously acting as a catalyst of environmental degradation in the study area. The study used descriptive research design to determine the causes of human induced bush fires and their recommends the use of adaptive collaborative management (ACM) where religious institutions, non-profit making organizations. Government agencies like the NEMA, KWS and the local residents promote opportunities for shares learning are viewed as critical towards a better and a sustainable environmental conservation in Makindu Sub County, Kenya.

Keywords: Anthropogenic bush fires, Environmental Degradation, resource management, sustainable, land management, ecological



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Public Interest Statement

Bushfires are a major course of environmental degradation across the world. At Makindu sub-county, bushfires are a menace to the wellbeing of the ecosystem. This study sought to investigate the role of the church in engaging the community on the fight against bushfires. In this way, the study contributes to the overall impact of the social responsibility of the church in ensuring the well being of its people and caring for the environment.

Introduction

Fire is a key environmental catalyst that influences the condition of tropical ecosystems by directly modifying the structure and composition of natural vegetation (Sheuyange, 2019). Fire also plays an important role in the environmental conditions thus affecting the rural communities around the world (Cotton, 2018). Historically human beings used fire as one of the easily available vegetation management tool that enables them to quickly altar the natural environment (Bultz, 2019). In Australia, natural habitat manipulation through the use of fires by aborigines is dated more than 25000 years ago (cotton, 2021) and gives evidence of even greater use of fire in antiquity in the tropical savannah of the north. (Vigilante, 2019) the Australian aborigines are known to have coexisted with “flammable landscapes for millennia” (Brown man and murphy, 2021.p5) and manage them carefully to ensure a diversity of plant and animal foods (Yibank 2020)

Comparatively , indigenous African communities like wise show a deep history of using fires in the day season for many reasons , including to stimulate sub counting game and livestock grazing create new areas for cultivation and even settlement , kill disease causing vectors like ticks, and scare away dangerous predatory animals hyenas , lions and poisonous reptiles like snakes (Belts , 2019) seasonal bush fires practices by the indigenous communities can present damaging late season fires , increase plant biodiversity, and improve the productive capacity of the ASAL grazing areas(Angasa & Sheuyange,2018)

Although , bush burning is documented as a crucial traditional land management practice, anthropogenic induced fires in Africa are viewed by conservation authorities as destructive to environmental conservation and a major cause for environmental degradation (kill slain, 2019) . During the colonial period, indigenous burning regimes were curtailed as a result of the introduction of fire suppression policies (Wardell, 2020). The local native authorities argued that traditional fire burning practices were destructive to wildlife and led to environmental degradation. (Erickson, 2017). In addition, they lamented that overgrazing of livestock and reduced pasture availability diminished the indigenous forest cover, reducing shrubs vegetation cover and catalyzed soil erosion (Wardell, 2018). Indigenous land management practices were either devalued / ignored or even neglected. African colonial land management practices imposed strict regulations on the use of fire by the indigenous groups of people preferably on bide the homestead (Erickson, 2017)

After independence, colonial land policies and practices, including the approaches to fire management were inherited and enforced as the new post-colonial emerging leaders were socialized rigid colonial government systems (Erickson, 2017). Post-colonial land policies were consequently implemented without due considerations of local livelihoods adaptation needs and the environmental role that fire might contribute towards a sustainable environmental conservation. Fire suppression policies thereby resulted in the encroachment of bush in the pastoral grazing lands (Angasa, 2020)

The consequences of enforcing strict fire control policies in rural African have resulted to large scale illegal bush burning accompanied by the occasional occurrence of catastrophic human self-fires (Sheuyange, 2018) . Illegally set fires account for 70% of annual fires in Africa (Bultz, 2021), supporting a form of everyday resistance in agrarian polities that is directly liked the local subsistence economics

(Scott, 2018). In Madagascar, farmers and cattle herders burn about a half of the country's grasslands and about 1000-3000km² of moist forests annually (Kull, 2019). Policy debates on anthropogenic fires emphasize the environmentally detrimental aspects of fires, presenting a resource conflict in relation to human livelihoods (Erickson, 2017), and a hypothesized misinterpretation of the landscapes where they live (Leach & Mearns, 2020).

In contrast, political ecological research on human resource relationships challenge dominant and often authoritative narratives linking indigenous practices with land degradation, and question the role of extra local authorities on sustainable resources management (Robins, 2018). As traditional environmental knowledge becomes increasingly valued in human resource research (Folke, 2020), more opportunities emerge for the effective integration between conservation authorities and local communities on the sustainable dynamics of fire management (Smith, 2017).

After many years of policy enforcement fire suppression and authoritative control, fire management in Kenya's rural areas still remains a big environmental conservation challenge. Chyulu Hills ecosystem and the surrounding areas of Makindu Sub County present an interesting case study of the challenges faced by counties to effectively manage anthropogenic fires, reduced natural resource based conflicts, and sustain human livelihoods. Chyulu Hills National Park protects one of the Kenya's most significant water catchment areas, which is the source of Mzima springs (KWS, 2022). Across Chyulu Hills National Park and Makindu Sub County the local residents continue to use fires as an efficient and cheap means of pasture, woodland and crop field management in total disliked to environmental conservation regulations (Okello & Tome, 2018). In and around Chyulu Hills National Park ecosystem conflicts are intense between the enforcement of an official fire suppression policy by environmental conservation authorities and Makindu residents whose situated traditional knowledge dictates use of fire for economic livelihood activities.

The paper sought to have a better understanding and validation of indigenous people's perspectives on the role and effects of bush fires on natural resources in the Chyulu hills ecosystem and Makindu Sub County, Kenya. The residents of Makindu Sub County illegally use fires to convert montane woodland to farming areas outside the park area. The paper focused on how the residents of Makindu Sub County use fire as a management practice and secondly explored how local participants believe their traditional knowledge contributes to fire management with community KWS guards. The paper employed an applied research design that supports adaptive co- environmental management (Kofinas, 2019) by promoting shared learning opportunities between different stakeholders on why and what purpose anthropogenic fires recurrently occur in the study region (Armitage, 2018).

Research Methodology

The study used descriptive research design. Descriptive survey involves a detailed account of the context, the activities, participants observations. The goal of the study was to explain the role of the Catholic Church in environmental conservation in Makindu Sub-County, Kenya. The research design enabled the researcher to collect information from respondents on the participants opinions in relation to the participatory role of Catholic Church in environmental conservation in their area. The design enabled the researcher to gather both primary and secondary data. Primary data was obtained from field research using questionnaires, oral interviews, and participant observation. Secondary data was generated from un/published research materials, journals and electronic books. The descriptive design generated both qualitative and quantitative. This method was thus preferred because it allowed for an in-depth study of the case.

Description of the study area

The study was carried in Makindu Sub-County, Kenya. The reasons for choosing this area included one; the area is known for a resource based human wildlife conflict and notorious for all forms of

environmental degradation as a result of declining indigenous forests is located in south-west of Makueni County and bisected by the Mombasa highway almost in the middle. Makindu Sub-County occupies an area 852.1 km² with a population of 84,946 and a population density of hundred people per square Km, and the number of households are 21,756, with an average household size of 3.8 as per population census 2019 (KNBS, 2019).

Geographically, Makindu Sub-County is located in the most arid area of the County and it is extremely the driest part of Makueni County as it lies on the lower altitude. It borders Kibwezi and Mtito-Andei Sub-County, Kajiado and Kitui County and Chyulu Hills National Park. Administratively, Makindu Sub-County has four locations and fifteen Sub-locations based on the population census of 2019 (KNBS, 2019). In the past the Makindu Sub-County served as a home to a large number of Agro-pastoralists but continued spells of drought, coupled with stringent supply of grazing lands, has forced the Agro-pastoral farmers to struggle to sustain their herds and supplement with crop growing due to dwindling grazing area and little rainfall.

After the gazettelement of Chyulu Hills ecosystem as a National Park in 1983 majority of the displaced Agro-pastoralists are engaged destructive lifestyles causing massive environmental destruction. In order to survive, the internally displaced persons resorted to wanton environmental destructive lifestyles including: tree poaching, Charcoal burning and anthropogenic bush fires, wood carving, cutting down and use of indigenous trees for construction purposes, firewood, sandal wood, debarking, grass harvesting, overgrazing, etc. (Muriuki,2019, pp.391-406). These poor land management practices have led to over use of natural resources and therefore, the area is selected because of the visible destruction of indigenous forests characterized by severe cycles of drought has led to acute food insecurity and water scarcity, a dual existential environmental challenge commonly being experienced in Makindu Sub-County, Makueni County Kenya.

Target Population

Makindu Sub-County is a 'home' of numerous main line Christian denominations, including Catholic Church. The study focused on Catholic Church which is well established, has a long history in the community and is evenly distributed in all the fifteen sub locations of Makindu Sub-County. The targeted Catholic faithful's in Makindu Sub-County comprise 24,097 (28%). The study focused on Catholic Church leadership: Priests, Lay leaders, and Church members. Other Stakeholders considered in this study included Farmers, Government officials and the Business Community.

Sampling Technique and Sample Size

Sample Size

The sample size of one hundred fifty respondents was selected from the target population using simple random sampling and purposive sampling procedures i.e. Church leaders (20), Farmers (40); Government officials (20) and the Business Community (70).

Sampling Technique

Two sampling techniques were used; simple random sampling and purposive sampling method. First, the researcher randomly selected one Catholic Church across the fifteen sub-locations of Makindu Sub-County. The sample size was determined in accordance to Fisher et al., 1998 as applied by Braun and Clarke (2021).

$$n = \frac{z^2 pq}{d^2} = \frac{(1.96)^2 (0.31)(0.69)}{(0.05)^2} = 100$$

where: n – the desired sample size is greater than 10,000, z – the standard normal deviation, set at 1.96, which corresponds to 95% confidence level p- The proportion in the target population estimated to

have a particular characteristics (31% in this study are Catholics)

$$q=1.0-p=0.07$$

d = the degree of accuracy desired, here set at 0.05 corresponding to the 1.96 to assign the example size to the strata, the proportionate stratification equation was used.

$N_b = (\frac{N}{b}) * n$; where n_b = sample size of catholic Christians for stratum h ; nb = population size of Catholic for stratum h ; N = total population of Christians and n = total size of Catholic Christians.

In total, one hundred fifty respondents were drawn. The first category comprised of government officials. Purposive sampling was used to select respondents for this category. This involved two officers; one Sub-County Agricultural officer and one NEMA officer. These officers interviewed provided detailed information on the causes of environmental degradation. The second category was drawn using purposive sampling from the selected Catholic Churches within Makindu Sub-County.

These included; Catholic Church leadership: ten (10) parish priests were picked from each of the selected Catholic Church’s making four respondents. Next were the Church priests; ten (10) priests from each selected Catholic Church were taken, making eight (20) respondents. The two categories are the ones directly concerned with the implementation of various stewardship projects hence provided a detailed information on the role of Catholic Church in regard to environmental conservation. The other Catholic Church group consisted of Lay leaders and Catholic Church members. The researcher randomly selected two Catholic Church Development officers from each of the selected Catholic Churches, making eight respondents who provided data on the stewardship projects implemented by Catholic Church.

Through oral interviews, questionnaires and observation the farmers provided data on human activities related to environmental degradation, i.e. the poor land management practices, overgrazing, Charcoal burning and bush fires, clearing of indigenous forests etc. and their response to Climate shocks hence escalating poverty level in the study area.

The Government officials provided an updated data on the extent of environmental degradation in the study area and the policy intervention measures to the residents on how to diversify their farming practices and cushion the resident farmers from adverse effects of drought which substantially leads to food insecurity and water scarcity, the two observable negative effects of environmental degradation in the study area.

The Business community provided data on anthropogenic causes of environmental degradation by identifying the sources of energy most commonly used and their contribution to waste disposal management, challenges and intervention measures. Simple random sampling was emphasized because it eliminated biasness and accorded the business community members an equal chance to participate in the final sample while purposive sampling helped the research to focus on particular characteristics of a population of interest, which best enabled to answer the research questions (Denscombe, 2019:40). Overall, one hundred respondents were drawn to participate in the study. The sample was tabulated as indicated in the table.

Study Area	Respondents Selected	Frequency
Church Leaders	- Clergy	10
	- Lay leaders	10
	- Development officers	10
Community Members	- Farmers	40
Government Officials	- Sub-County Environmental officers	10
	- Sub-County Agricultural Extension officers	10
Business Community	- Shopkeepers/ Hoteliers	60

Data analysis and interpretation of the findings

The study generated both quantitative and qualitative data for processing and analysis. Qualitative analysis was used to analyze the structured, open-ended questionnaires that were used for the study. The researcher applied content analysis methodology. This technique involved gathering of the common themes, grouping them according to their commonality and analyzing them in those groups. Finally, the researcher undertook a series of steps to detect data quality errors. The process involved detection of outliers, missing values, logical inconsistencies and coding errors, the researcher addressed first by detecting the source of the error and secondly, using statistical methods to clean data set. Descriptive statistical analysis was applied for the analysis of quantitative data. The analyzed data was presented using simple figure tables, pie charts and bar graphs. After the analysis and interpretation of data, a report of the findings was compiled and submitted.

Use of Fire in Makindu Sub County near Chyulu Hills National Park

Participants in focused group discussions identified 10 different reasons why fires occur on areas near the borderline of Chyulu Hills National Park and Makindu Sub County (Table 1). The most important reasons for purposely setting human fires was to stimulate new and more nutritious pasture for livestock and honey harvesting other frequently reported reasons for burning included killing of pests and disease causing vectors, clearing bush to improve visibility and open grazing lands, and clearing new lands for cultivation by the residents of Makindu Sub County.

Most of the respondents reported that burning bushes is related extraction activities like charcoal burning, hunting and the collection of miraa (*Catha adulis*). One of the respondents alluded that they used fire as a form of protest both inside and outside Chyulu Hills National Park. The residents of Kaunguni Sub location set fires inside and outside Chyulu Hills National Park as an indication of revenge against the Kenya wildlife service (KWS). After Chyulu Hills were officially declared a national park, the locals living in the hills had not anticipated leaving their volcanic fertile ancestral areas and live in the semi-arid areas of Makindu Sub County where means of living were unpredictable. Those who delayed to move out were ruthlessly evicted by the authorities and their houses set on fire. This inhumane relocation has caused a perennial human conflict between the residents of Makindu Sub County and the KWS staff where the local residents treat the KWS as their enemy. Consequently, this has young generations hence some of the locals light fires to register their bitterness and as a form of rebellion against the KWS's (Interview, 10.11.2022).

Charcoal burning is one of the major indigenous climate change adaptation mechanisms for the residents of Makindu Sub County (Muriuki, 2019) and that which is also widely related to bush fires in Kaunguni Sub location near Chyulu Hills National Park. Bush fires from charcoal burning are therefore both intentional and accidental. We rely on charcoal burning for our incomes in Kaunguni sub location, Kalakalya village, although the authorities are very much against it.

We use fire to burn the wood and make charcoal and sometimes where an inexperienced charcoal producer does not cover the charcoal kiln (*ndubia*) with enough soil, a fire might escape and end up burning the many surrounding bush or spill over to neighboring homesteads. Hence, some of the bushfires (interview, 11.11.2022).

Bush burning mostly in areas near Chyulu Hills National Park occurs between months of May to October the driest months.

Causes of Bush Fires in Makindu Sub County near Chyulu Hills National Park

	Causes Of Bush Fires	Percentage of Respondents
1	Stimulate growth of livestock pasture	20
2	Human set- fires / cooking	10
3	Open bush for livestock grazing	10
4	Clear bush for farming	20
5	Clear dense bush for Miraa (<i>Catha adulis</i>)	10
6	As a protest against the Kenya Wild life service	20
7	Charcoal burning	20
8	Domestic use in homesteads – cooking	10
9	Felling big trees for wood carving /firewood	15
10	Burn crops residue after harvesting	15
	TOTAL	150

Conclusion

The residents of Makindu Sub County viewed fires as an integral part of their production systems. The participants reported the occurrence of accidental fires, most fires are intentionally set for purposes that contribute to diverse livelihood strategies (Ellis, 2019).

The research findings concurred with traditional fire burning practices in other tropical and semi-arid areas in Africa, i.e Bultz 2019 , in Tanzania, Erickson 2017, in Zambia, Kull 2019 in Madagascar; Laris 2020 , in Mali, South America, Rodrigues 2019 in Venezuela and Australia vigilante 2019 which show how bush fires support resource extraction, agriculture and pastoralism. Human activities change fire regimes as defined by their seasonal occurrence, frequency, spatial pattern, and intensity (Laris, 2018) and human – environmental consequences of these changes vary in response. From the respondents of Makindu Sub County in and outside Chyulu Hills National Park are for ‘good’ intentions like when they improve the forage production grasslands , reduce pests, and create space for farming activities but they can also be bad when they degrade the environmental resources (The nature of fire; bad fire , good fire , complex fire in Kull 2018). Fire regimes and their environmental influence requires a better understanding from the people who use and manage those fires.

All anthropogenic fires in Kenya are illegal as they are an environmental hazard in reference to environmental conservation and extraction. In addition, bush fires in Makindu Sub County are primarily a passive expression of rebellion by the locals living previously close the marginal of subsistence (Scott, 2017). Accordingly to Muriuki (2019) the wide spread use of bush fires highlights a history of voluntary and forced migrations, squatter settlements insecure tenure and population rise in and area which remarkably registers a decline in agriculture production lightening food insecurity and an increasingly variable climate change. The criminal activities of producing charcoal, hunting, cultivating bhang (cannabis sativa), extracting miraa (*calthat edulis*) and anthropogenic fires associated with the people living in Makindu Sub County and its environs are climate change adaptation strategies mostly in the ASAL regions, leading to phenomenal environmental degradation.

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