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The Contribution of Research in Combating Wildlife Poaching in Tanzania: Review of Existing Literature

Jafari R. Kideghesho

Abstract

Conservation challenges such as human population growth, land use changes, human-wildlife conflicts, poaching, encroachment, wildlife diseases and pollution, among others, have grown in recent decades. Their solutions and policy responses require scientific approaches based on informed decisions. This chapter seeks to inform the contribution of research in addressing wildlife poaching in Tanzania, one of the serious management challenges facing the wildlife sector in the country. It reviews a number of publications to establish contribution of numerous scientific studies on wildlife poaching conducted in Tanzania. The review identifies different ways in which research can contribute in combating the problem—including establishing status and trends of poaching, understanding the drivers and effects of poaching, inspiring interventions at different levels and recommending the appropriate policy actions and strategies.

Keywords: wildlife, poaching, research, publications, Tanzania

1. Introduction

In the recent decades, wildlife poaching, driven by the demand for bushmeat and trophies, has been increasingly featured as one of the major global crimes [1–3]. The crime, ranking the third after human trafficking and drugs [4, 5], has some far-reaching repercussions ecologically, economically and politically. The large and charismatic wildlife species have been the main targets of poaching, leading to a dramatic decline of their numbers. For instance, in 1930 the number of elephants in Africa ranged from 5 to 10 million [6]. The number plummeted to 1.3 million in 1979, and in 1989 only 600,000 remained [7, 8]. The number dropped further to about 350,000 in 2016 [9, 10]. The population of black rhino, which was widely distributed in Africa, declined from almost 100,000 in the 1960s to less than 3% in the 1990s [11, 12]. These species are ecologically important as keystone and umbrella species due to their ecological role in ecosystems [13–15]. Extinction of keystone species and, subsequently, ecological cascade effects in ecosystems are one of the ecological repercussions of wildlife poaching [16–19]. The ecological cascade effect involves a series of secondary extinctions triggered by the primary extinction of a keystone species in an ecosystem.

The detrimental impacts of poaching on household and national economies are apparent. This is due to a role played by wildlife species, especially large mammals,

as principal resources in tourism. In Africa, availability and diversity of wildlife species are the main factors which influence tourists' willingness and decision to visit a particular destination and pay for available services and products. Large and charismatic species such as elephants, rhinos, buffaloes, lions and leopards offer unique experience and opportunity for hunting and game viewing. Poaching of these species deprives the households, communities and governments substantial benefits generated through tourism. The annual analysis of the global economic impact of Travel and Tourism in 2017 indicated that, in Tanzania, where almost 80% of tourism is wildlife-based, tourism contributed 17% of the GDP and 25% of the foreign currency. It created 1,092,500 jobs in 2017 and was projected to rise by 6.6% in 2018. Revenues reached USD 2.43 billion in 2018, up from USD 2.19 billion in 2017 [20].

In order for conservation, as a land use, to excel and win popular support from people and the government, it must be able to compete effectively with alternative land uses by generating adequate benefits to households, communities and the government [3, 21]. It is unlikely for this to happen when significant numbers of the charismatic species capable of attracting revenues through tourism are exterminated by poachers. Failure to do so waters down the commitment to conservation and rationale to forgo economic activities which are ecologically destructive [3, 21–26]. For instance, in Tanzania, in the face of human population growth, there has been a growing pressure from local communities and politicians urging the government to open protected lands for agriculture and livestock grazing. Land use conflicts between conservation authorities and local communities have also increased. In addressing this long-term concern, on 15 January 2019, H.E. the President of the United Republic of Tanzania directed the conservation authorities to identify the protected areas which were devoid of wildlife and allocate them to landless peasants and pastoralists. Expounding his directive, the President stated bluntly:

“I am not happy to see cattle keepers rejected everywhere. If there is a wildlife reserve which is not being utilized, we shall change the law, take part of it and distribute to pastoralists as well as farmers [27].”

The President's Directive was implemented on 23 September 2019, when the government deregistered 12 game controlled areas and 14 forest reserves covering 707,659 and 46,715 acres, respectively, in order to redistribute to farmers and pastoralists (The Citizen, 24 September 2019).

Wildlife poaching is also linked to global insecurity and erosion of government credibility. The revenues generated from poaching are believed to finance civil wars and terrorist activities in Africa, thus affecting conservation programmes and making some destinations risky places for tourists [28–33]. Poaching lowers credibility and reputation of the governments in international forums. The countries with high gravity of poaching have been implicated with poor governance, corruption and lack of accountability [34, 35].

This review identifies different ways in which research can contribute in combating the problem—including establishing status and trends of poaching, understanding the drivers and effects of poaching, inspiring interventions at different levels and recommending the appropriate policy actions and strategies.

2. Wildlife poaching in Tanzania

Tanzania's wildlife sector is faced with numerous challenges, wildlife poaching ranking at the top, among others. Poaching is pursued to cater for subsistence and

commercial needs. Household poverty and a need to meet the dietary requirements are the main drivers for subsistence poaching [35–38]. Commercial poaching is mainly motivated by high market demand and, consequently, high economic returns accruing to criminals [4, 5]. Both subsistence and commercial poaching are linked to a dramatic decline of population and local extinction of wildlife species in different parts of Tanzania [35, 36].

Tanzania had registered two major poaching episodes in her history. The first episode occurred between the 1970s and 1980s following global economic melt-down which weakened the law enforcement capacity [3, 35]. The populations of two keystone species, elephant and rhino, were reduced to less than 30 and 10%, respectively [39, 40]. In 1991, the elephant population was less than 58,000 individuals compared to 203,000 in 1977, while rhino population dropped from 3795 in 1981 to 275 in 1992 [40].

The second major poaching episode emerged between 2009 and 2016. Though its span was shorter, it had colossal impact on wildlife species, particularly elephant. In a period of 3 years, the country's population plummeted to 109,000 in 2009 from 143,000 in 2006 [34, 41]. Further declines were noted in 2013 and 2015, when the numbers recorded were 50,500 [41] and 43,500 [34], respectively. The major drivers of poaching were the increased demand for ivory in Asian countries and widespread corruption in different sectors within and outside the country.

3. The role of research in combating poaching

Basically, scientific studies seek to find answers to numerous questions and guide decision-making process. They provide an opportunity for knowledge and experience sharing on best practices, challenges and strategies to address the problems. Furthermore, they bring changes on understanding and inspire the necessary reforms along with forming the basis for future studies about the subject. Scientific studies on poaching in Tanzania have sought to understand the magnitude, drivers, trends and effects of poaching, behaviors and characteristics of poachers, seasons, poaching hotspots, strategies employed in poaching and genetic makeup of species, among others.

3.1 Understanding the drivers and effects of poaching

Numerous studies in Tanzania have established the magnitude, drivers or factors influencing poaching and the resultant effects. These studies acknowledge the gravity of poaching as a major challenge facing conservation with far-reaching economic, security, ecological and social repercussions [3, 35–37, 42]. The drivers of poaching identified include poverty, inadequate conservation budget, cultural reasons, immorality and corruption, high opportunity cost of conservation and political instability associated with refugee influx from neighboring countries (**Table 1**). The effects established, among others, include financial losses, loss of biodiversity, insecurity and loss of national credibility (**Table 1; Figure 1**).

Understanding the drivers of poaching is crucial if practical solutions of the challenge are to be sought. For instance, addressing poverty and provision of alternative livelihood strategies may be an appropriate intervention against food and income poverty among the communities living around the protected areas [10, 35, 36, 42–44]. Similarly, adequate budget allocation to wildlife sector can improve law enforcement and reduce poaching [35, 46], while implementing good governance policies and curbing corruption can equally lower the levels of poaching [35]. Furthermore, knowing the magnitude and effects of poaching rings a

Drivers of poaching		Source
1.	Household poverty – limited livelihoods options	[10, 35, 36, 42–44]
2.	Poor economic policies	[3, 35]
3.	High economic returns from wildlife products	[3, 21, 35, 45]
4.	Limited budget – inadequate resources for anti-poaching patrols	[35, 46]
5.	Political interference, insufficient support from other institutions and low employees morale	[35]
6.	Cultural reasons	[47]
7.	Corruption and poor governance	[10, 34, 35, 42]
8.	Population growth	[35, 44, 45, 48, 49]
9.	Increased demand for wildlife products within and outside the country	[3, 10, 35]
10.	Failure of wildlife conservation to compete effectively with alternative economic activities	[21, 35]
11.	Political instability/refugees influx	[37, 42, 50]
Effects of poaching		Source
1)	Impact on tourism and economic losses	[3, 35, 51, 52]
2)	Inadequate budget for conservation	[3, 35]
3)	Credibility of the country eroded	[3, 35]
4)	Increased political conflicts; refugees and terrorism	[3, 35]
5)	Loss of habitats; wildlife populations decline and local extinction	[3, 35, 37, 53–57]
6)	Reduced incentive for conservation and a need to adopt land uses which are incompatible with conservation	[3, 35]
7)	Violent behavior against the wildlife rangers and staff	[35]

Table 1.
Drivers/causes of poaching as identified in different studies.

warning bell for conservation authorities to act promptly by adopting appropriate interventions to address the challenge.

3.2 Identifying groups of poachers to be targeted and effective strategies against them

Knowledge on characteristics of poachers (e.g. in terms of age, gender, wealth, residence, ethnicity, poaching strategies and behaviors) helps to identify a specific group of poachers which should be targeted for anti-poaching operations and the most appropriate strategy to deal with such group. For instance, if bushmeat trade is more common among the male-headed households living in proximity to the protected area, efforts to address the challenge should target these households [58]. Studies seeking to uncover strategies employed by poachers to surmount anti-poaching efforts and avoid arrest by rangers can provide an entry point for devising the best ways to counteract poaching strategies and improving planning for anti-poaching programmes [59]. Understanding the drivers and factors affecting poaching can help in changing the behaviors of criminals. For example, if the drivers are associated with poverty or lack of alternative sources of income, provision of alternative economic options can reduce pressures on wildlife. If poaching is linked to particular ethnic or affiliations, mitigation strategies should target these specific

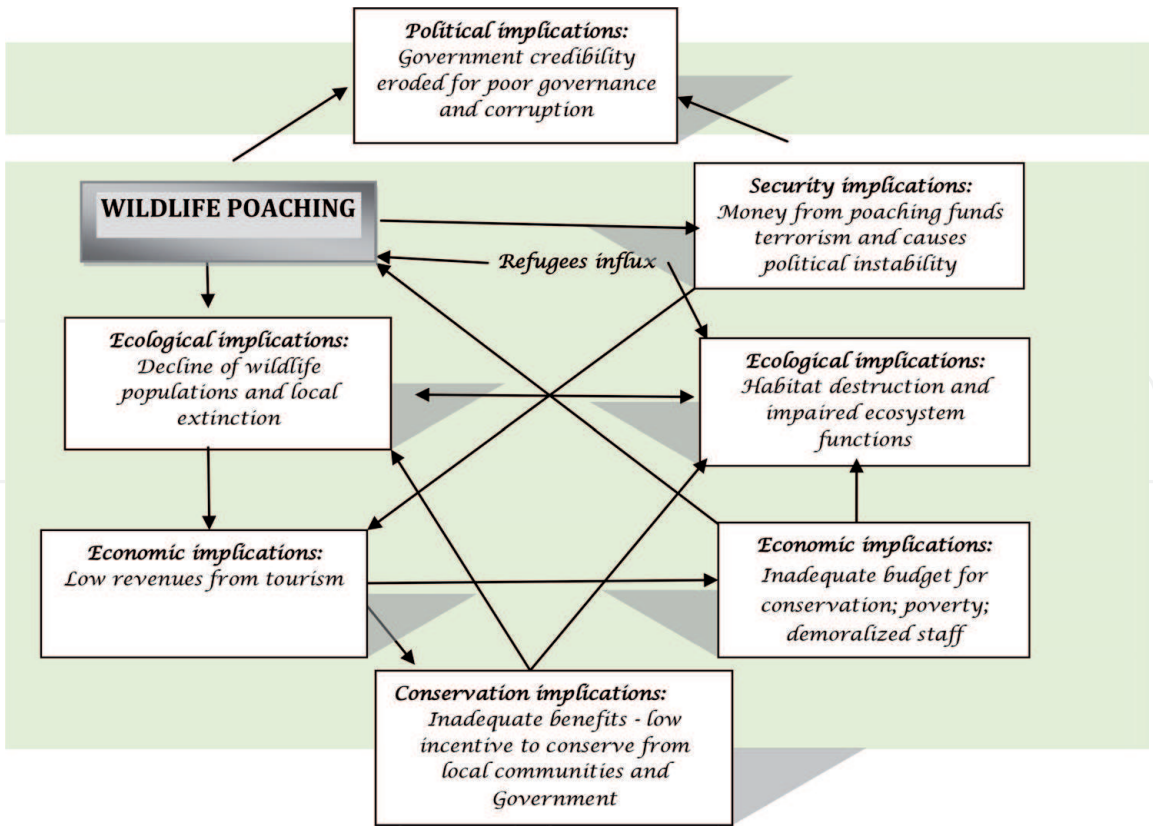


Figure 1.
The schematic presentation of the political, security, ecological and economic implications of wildlife poaching [3, 35].

groups. For instance, in Western Serengeti, where bushmeat poaching is endemic, it is estimated that approximately 40% of the crime is committed by people of Ikoma tribe [44, 60]. By using this fact, the conservation authorities can take advantage of traditional practices and systems of this particular tribe to address the challenge of poaching [61, 62].

3.3 Establishing the priority geographical sites for intervention

Studies seeking to understand the areas of high risks of poaching (poaching hotspots) and seasons are useful in informing the sites where the conservation managers should focus for intervention in terms of allocating human and financial resources to achieve maximum anti-poaching results. Examples of studies of this nature were conducted in Selous [46, 63] and Western Serengeti [44]. Wasser et al. [64, 65] used DNA to track the origin of large seizures of elephant ivory since the 1989 trade ban. The results revealed that most of the ivory originated from a relatively small area in the Selous and Niassa protected areas along the Tanzania and Mozambique border. This evidence was important for the planning of law enforcement operations to curtail further elephant losses and disrupt the organized transnational crime [64].

3.4 Recommending policy actions and strategies

The objective of wildlife research is to provide solutions for problems and challenges facing the sector. Research findings are the bases for informing policy actions and recommending appropriate strategies to address the existing and potential conservation challenges. A number of research articles reviewed in this chapter have recommended some policy actions for combating poaching (Table 2).

	Policy action/strategy	Source
1.	Strengthen law enforcement and patrols (increase number of rangers and equipment, increase penalties) and intelligence-led operations within and outside the protected areas.	[42, 57, 66–68]
2.	Increased budget for conservation	[35]
3.	Appropriate and timely compensation for wildlife staff	[35]
4.	Community involvement, incentive schemes	[22, 42, 67, 69]
5.	Application of technologies (forensic, poaching detection technologies, SMART etc.)	[49, 70, 71]
6.	Enhanced sustainable livelihood opportunities and delivery of alternative sources to reduce dependency on vulnerable habitats and wildlife (Distractions)	[44, 49, 68, 72–74]
7.	Employment opportunities to local communities	[67]
8.	Promote political stability within and outside the country	[35, 37, 50]
9.	Intensify war against corruption	[35]
10.	Address the challenge of political interests overriding professionalism	[35]
11.	Reduce demand for wildlife products	[35, 75]
12.	Improve conservation education programmes	[44, 49, 67]
13.	Address the problem of household poverty and unemployment	[21, 22, 35, 72, 73]
12.	Encourage presence of researchers in areas with minimal protective status and low government surveillance	[76]
11.	Addressing root causes of poaching through strategies that go beyond coercive measures	[77]

Table 2.
Policy actions and strategies recommended for addressing poaching problem from various research articles.

Besides coming up with recommendations, wildlife research can also play an important role in evaluating the efficiency and effectiveness of the existing conservation policies and strategies [78–82]. Research may also inform the best ways of implementing the specific policy actions for combating poaching.

3.5 Building justification for local and international intervention

In order to combat poaching effectively, it is imperative that the problem is critically analyzed to establish its magnitude, trends and effects. This calls for adequate data and information, which are obtained through a planned and executed research targeting a number of indicators for poaching (number of poachers arrested, type and number of weapons confiscated, species and number of animals killed, number of carcasses, number of staff injured or killed and poaching hotspots).

The research findings about the magnitude, status, trends and impacts of wildlife poaching in the country have been crucial in shaping the policy decisions towards the appropriate course of action. They have inspired considerable support and interventions in combating the challenge from the general public, conservationists, media, influential personalities and international community. The interventions prompted by these findings are discussed briefly hereunder.

3.5.1 Local intervention

Tanzania has made several interventions in stepping up efforts to address a challenge of poaching. One of such interventions is collaboration with other countries through

ratification and implementation of a number of regional and international conventions, protocols and agreements. Examples of these protocols include the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) of 1979, Protocol Concerning Protected Areas and Wild Fauna and Flora in the Eastern African Region (1985), Lusaka Agreement on Co-operative Enforcement Operations Directed at Illegal Trade in Wild Fauna and Flora (1994); and SADC Protocol on Wildlife Conservation and Law Enforcement (1999). Besides, on different occasions, Tanzania was compelled to launch nationwide anti-poaching operations to reverse the poaching trends and safeguard the populations of its wildlife species (**Table 3**).

Other interventions adopted recently have included formulation of National Elephant Action Plan, a National Ivory Action Plan and National Strategy for Combating Poaching and Illegal Wildlife Trade [83]. The Conservation and Management Plans have also been developed to guide the conservation of species which are facing a high risk of poaching and other threats. Examples of species with such Plans are elephant and rhino [84, 85] (**Figure 2**).

Following poaching crisis and subsequently launching of *Operation Uhai* in 1990, Tanzania adopted community-based conservation as a new conservation approach to complement the centralized (also known as ‘fences and fines’) approach. This resulted from a perceived failure of the latter to conserve wildlife [82]. It was also clear that, though it was proven to be effective, ‘Operation Uhai’ was an expensive undertaking which could hardly be sustained as a long-term strategy. Community-based conservation was premised on the assumption that long-term conservation success depends on the involvement of local communities

	Operation	Period	Results
1)	<i>Operation Uhai</i> (<i>‘Operation life’</i>): The six-month <i>Operation Uhai</i> to curb poaching and to rapt ivory trade.	1989–90	Over 2,000 people were arrested and 10,000 firearms were confiscated.
2)	<i>Operation “SpiderNet”</i> : Coordinated efforts of law enforcement and intelligence agencies, including National and Transnational Serious Crimes Investigation Unit (NTSCIU) and Tanzania National Parks Authority (TANAPA), to combat ivory poaching and arms smuggling in Katavi.	2014–15	Hundreds of firearms were confiscated; dozens of arrests were made with special emphasis on villages within the Katumba Refugee Camp which was implicated with giving shelter to Hutu rebels with ties to the Rwandan genocide
3)	<i>Operation Kipepeo (Butterfly)</i> : in Selous Ecosystem to curb elephant poaching	2009	Some criminals were arrested and firearms confiscated
4)	<i>Operation “Tokomeza Ujangili” (Eradicate Poaching)</i> : The goal of operation was to curb poaching in protected areas, identify and arrest suspected poachers and organized groups, and seize property of poaching suspects.	2013	952 suspects were arrested and 104 pieces of ivory were seized. However, the operation was canceled after alleged human rights abuses conducted by Tanzanian authorities, which included rape, torture, murder, and illegal seizures of property (including livestock).
5)	<i>Tanzania’s National and Transnational Serious Crimes Investigation Unit (NTSCIU): Operations Against Major Wildlife Traffickers</i>	2016–18	Major criminal syndicates, high-profile poachers and wildlife traffickers were arrested
6)	<i>Operation Costa</i> : (in collaboration with other East African nations of Burundi, Ethiopia, Kenya, Rwanda, Tanzania, and Uganda) to stem illegal wildlife trade with a focus on ivory.	2009	Over 100 people were arrested and roughly 1,500 kg of elephant ivory were seized along with hundreds of other wildlife products

Table 3.
Some of the major operations conducted in Tanzania to curb wildlife poaching.

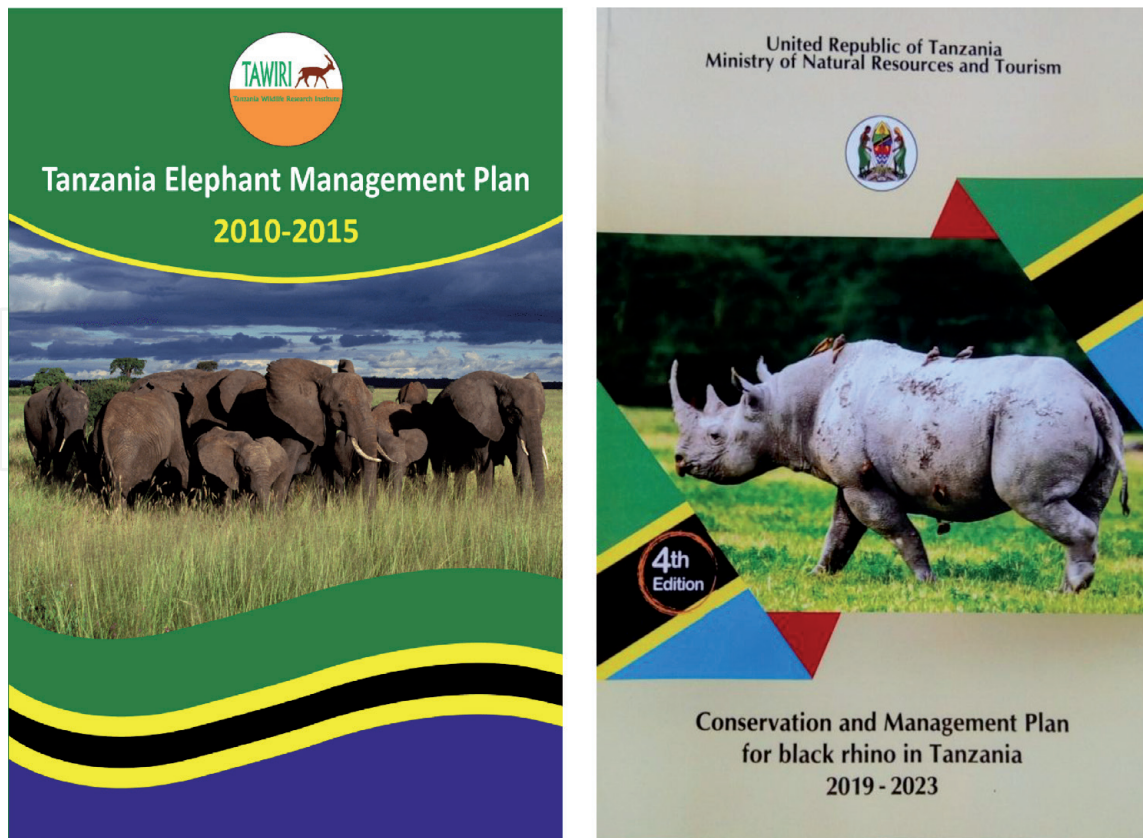


Figure 2.
Tanzania elephant and rhino management plans.

in management and guaranteeing them tangible benefits [22, 25, 79, 80, 82]. Essentially, the idea behind the approach is to motivate local communities to align their behaviors with conservation goals by refraining from activities which are illegal and destructive to wildlife including poaching.

However, Community Based Conservation approach has not been a panacea to a poaching challenge. Multiple strategies are being pursued along with further transformation of the natural resources sector. The complexity of wildlife crime has increased following technological advancement and access and use of more sophisticated firearms among the poachers [3, 35]. The government has, thus, adopted a paramilitary model in managing its natural resources in view of increasing efficiency and effectiveness in combating the challenge.

3.5.2 International interventions

Intervention in combating poaching by the international community has often involved financial and technical support along with imposing sanctions to pressurize the individual countries to comply with international commitments in fighting wildlife crime. The following are examples of interventions from the international community:

- a. In March 2013, the CITES Standing Committee singled out Tanzania along with the seven other countries—Kenya, Uganda, Malaysia, Vietnam, the Philippines, China and Thailand as the ‘Gang of eight’ due to worst record in illegal ivory trade [3, 86]. This followed a widespread elephant poaching that occurred in the 2010s. The Committee directed each of the offending countries to submit a detailed National Elephant Action Plan to curb the illegal ivory trade or face a ban on all legitimate wildlife trade.

- b. In 2014 the World Heritage Committee inscribed the Selous Game Reserve on the List of World Heritage in Danger [87]. The Committee called on the international community, including ivory transit and destination countries, to support Tanzania in the fight against this criminal activity. Tanzania was further required to submit an Emergency Response Action Plan for Selous Game Reserve to the Committee.
- c. During the 2014 London Conference on illegal wildlife trade, the London Declaration was adopted in which 46 countries including Tanzania and 11 international organizations resolved to adopt a number of measures to reverse the trend of wildlife crime. These measures included ending the market for illegal wildlife products, putting in place effective legal frameworks and deterrents, strengthening enforcement and guaranteeing sustainable livelihood options, nurturing poverty reduction strategies and building on and strengthening the wider global efforts to combat the crime [88]. The declaration took on board the scientific facts on the magnitude of the crime and the potential effects which it could bring to national security and sustainable development.
- d. In 2016, UNDP launched a large-scale project which sought to support the Government of Tanzania in implementing the National Strategy to Combat Poaching and Illegal Wildlife Trade by strengthening legislation and capacity to tackle poaching and wildlife trafficking at the national level [89]. The Project also seeks to enhance the collaboration to fight illegal wildlife trade between Tanzania and neighboring countries, which is in alignment with the objectives of the overall Global Wildlife Programme, launched in 2015 by the Global Environment Facility (GEF).

3.5.3 Influential personalities

Research findings, particularly on population numbers and trends, have also played a significant part in inspiring actions from important personalities. For example, in July 2013, the US President, Barack Obama, issued an Executive Order 13648 outlining measures to combat wildlife trafficking. The Order pledged financial and technical support to governments to address the challenge [90]. The royal family in the UK has also been in the forefront in supporting efforts to address poaching and illegal wildlife trade through funding and conducting numerous campaigns. For example, in February 2014, Prince William, the Duke of Cambridge, and his father, Prince Charles, the Duke of Wales, released a video clip urging global efforts to end poaching and illegal wildlife trade:

“We have come together, as father and son, to lend our voices to the growing global effort to combat the illegal wildlife trade - A trade that has reached such unprecedented levels of killing and related violence that it now poses a grave threat not only to the survival of some of the world’s most treasured species, but also to economic and political stability in many areas around the world. [91]”

Many other personalities expressed concerns over wildlife crime and urged actions from different stakeholders. These included UN Secretary General, Ban Ki Moon, Heads of States and other people.

4. Conclusions

Wildlife poaching remains one of the top threats to wildlife and humankind despite efforts devoted to conservation work. Poaching has serious ecological,

political, social, security and economic ramifications. It is responsible for a dramatic decline of wildlife populations and species extinction, habitat loss, household poverty and economic loss to government. Furthermore, poaching erodes credibility of governments when high poaching levels is attributed to poor governance, corruption and lack of accountability. In recent years, the crime has emerged as one of the main security issues due to its role in funding civil wars and terrorist activities.

Research has the potential to contribute effectively to wildlife conservation through combating poaching. It provides a better understanding of the relationships between the drivers of poaching and individual poacher motivation and, therefore, provides an entry point towards developing the effective policy actions and strategies. The studies which establish the magnitude, trends and effects are important in inspiring interventions at different levels, while understanding the poaching hotspots and vulnerable species targeted by poachers can help in allocating time and resources for anti-poaching operations. Knowledge on types, behaviors and characteristics of poachers is important in devising the policy responses which can suit each type.

Despite the relevance and potential of different scientific studies in guiding decision-making and providing practical solutions against poaching, the evidence on how much do wildlife managers and authorities make use of the findings generated in addressing the challenge is scant. Further studies are, therefore, imperative to address this knowledge gap. This will ensure that time and financial resources used in research are not wasted and that the findings are used effectively to solve conservation problems rather than being left to gather dust in the shelves.


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References

- [1] TRAFFIC. Illegal Hunting and Trade of Wildlife in Savanna Africa May Cause Conservation Crisis. ScienceDaily; 2012
- [2] Ripple WJ, Newsome TM, Wolf C, Dirzo R, et al. Collapse of the world's largest herbivores. *Science Advances*. 2015;**1**(4):e1400103
- [3] Kideghesho JR. Elephant poaching crisis in Tanzania: A need to reverse the trend and the way forward. *Tropical Conservation Science*. 2016;**9**(1):369-388
- [4] Convention on International Trade for Endangered Species of Flora and Fauna (CITES). Wildlife crime ranks among trafficking in drugs, arms and humans. 2013. Available from: http://cites.org/eng/news/sg/2013/20130926_wildlife_crime.php [Accessed: July 15, 2015]
- [5] United Nations Office on Drugs and Crime (UNODC). Wildlife crime worth USD 8-10 billion annually, ranking it alongside human trafficking, arms and drug dealing in terms of profits. UNODC chief. 2015. Available from: <https://www.unodc.org/unodc/en/frontpage/2014/May/wildlife-crime-worth-8-10-billion-annually.html> [Accessed: July 10, 2015]
- [6] Worldwide Fund for Nature (WWF). African Elephants. 2019. Available from: http://wwf.panda.org/knowledge_hub/endangered_species/elephants/african_elephants/ [Accessed: September 20, 2019]
- [7] Barbier E, Burgess J, Swanson T, Pearce D. Elephants, Economics and Ivory. London: Earthscan Publications; 1990
- [8] Bulte EH, van Kooten GC. Economics of antipoaching enforcement and the ivory trade ban. *American Journal of Agricultural Economics*. 1999;**81**(2):453-466
- [9] Steyn P. African Elephant Numbers Plummet 30 Percent, Landmark Survey Finds. National Geographic. 2016. Available from: <https://www.nationalgeographic.com/news/2016/08/wildlife-african-elephants-population-decrease-great-elephant-census/>
- [10] Hauenstein S, Kshatriya M, Blanc J, Dormann CF, Beale CM. African elephant poaching rates correlate with local poverty, national corruption and global ivory price. *Nature Communications*. 2019;**10**:2242
- [11] Dublin H, Wilson A. The Fight for Survival: Four Decades of Conserving Africa's Rhinos. Conservation Advisory Services, Le Muids, Switzerland: Desktop Publishing; 1998
- [12] Leader-Williams N. Regulation and protection: Successes and failures in rhinoceros conservation. In: Oldfield S, editor. *The Trade in Wildlife: Regulation for Conservation*. London: Earthscan; 2003
- [13] Roberge JM, Angelstam P. Usefulness of the umbrella species concept as a conservation tool. *Conservation Biology*. 2004;**18**:76-85
- [14] Mouquet N, Gravel D, Massol F, Calcagno V. Extending the concept of keystone species to communities and ecosystems. *Ecology Letters*. 2013;**16**:1-8
- [15] Cromsigt JPGM, te Beest M. Restoration of a megaherbivore: Landscape level impacts of white rhinoceros in Kruger National Park, South Africa. *Journal of Ecology*. 2014;**102**(3):566-575
- [16] Ripple WJ, Abernethy K, Betts MG, Chapron G et al. 2016j. Bushmeat hunting and extinction risk to the world's mammals. *Royal Society Open Science*. 2016;**3**(10): 160498

- [17] Poulsen JR, Rosen C, Meier A, Mills E, Nuñez CL, Koerner SE, et al. Ecological consequences of forest elephant declines for afrotropical forests. *Conservation Biology*. 2018;**32**:559-567
- [18] Diplock N, Johnston K, Mellon A, Mitchell L, Moore M, Schneider D, et al. Large mammal declines and the incipient loss of mammal-bird mutualisms in an African savanna ecosystem. *PLoS One*. 2018, 2018;**13**(8):e0202536. DOI: 10.1371/journal.pone.0202536
- [19] Daskin JH, Pringle RM. Warfare and wildlife declines in Africa's protected areas. *Nature*. 2018;**553**(7688):328-332
- [20] Tanzania Invest.com. Available from: <https://www.tanzaniainvest.com/tourism/tanzania-tourism-revenues-and-arrivals-up-in-2018> and follow us on www.twitter.com/tanzaniainvest [Accessed: September 24, 2019]
- [21] Knapp EJ. Why poaching pays? A summary of risks and benefits illegal hunters face in Western Serengeti, Tanzania. *Tropical Conservation Science*. 2012;**5**(4):434-445
- [22] Emerton L, Mfunda I. Making wildlife economically viable for communities living around the Western Serengeti, Tanzania. In: *Evaluating Eden Series Discussion Paper, No. 1*. London: International Institute for Environment and Development; 1999
- [23] Holmern T, Røskft E, Mbaruka J, Mkama SY, Muya J. Uneconomical game cropping in a community-based conservation project outside the Serengeti National Park, Tanzania. *Oryx*. 2002;**36**(4):364-372
- [24] Kideghesho JR, Røskft E, Kaltenborn BP. Factors influencing conservation attitudes of local people in Western Serengeti corridor, Tanzania. *Biodiversity and Conservation*. 2007;**16**(7):2213-2230
- [25] Kideghesho JR, Tarimo L. Recent research on CWM in Tanzania—Successes, benefits, and challenges. A Paper Presented at the Tanzania Natural Resources Forum Roundtable Meeting on Wildlife for Communities in Tanzania: Taking Stock of Governance of Wildlife by Communities; 2-3 November 2011; Giraffe Hotel, Dar es Salaam; 2011
- [26] Wambura G. Prospects of the Authorized Associations Consortium (AAC). A Paper Presented at the Tanzania Natural Resources Forum Roundtable Meeting on Wildlife for Communities in Tanzania: Taking Stock of Governance of Wildlife by Communities; 2-3 November 2011; Giraffe Hotel, Dar es Salaam; 2011. Available from: https://www.ucl.ac.uk/pima/docs/reference/16_cwm_roundtable [Accessed: August 12, 2019]
- [27] The Guardian. Magufuli: Give people idle wildlife reserves, forests. *The Guardian* 16; 2019
- [28] Kalron N. Africa's White Gold of Jihad: Al-Shabaab and Conflict Ivory. *Elephant League*. 2012. Available from: <http://elephantleague.org/project/africas-white-gold-of-jihad-al-shabaab-and-conflict-ivory/> [Accessed: July 09, 2015]
- [29] Marais A, Fennessy S, Fennessy J. Giraffe conservation status—Country profile: Democratic Republic of Congo. *Giraffa*. 2012, 2012;**6**(2):13-16
- [30] Tumanjong E. Foreign Poachers Target Cameroon Elephants: Expert. *The World Post*. 2012. Available from: <http://www.huffingtonpost.com/huffwires/20121204/af-cameroon-elephant-poaching/> [Accessed: July 12, 2015]
- [31] Somaville K. Ivory, Insurgency and Crime in Central Africa: The Sudans Connection. 2014. Available from: <http://africajournalismtheworld.com/tag/janjaweed-ivory/> [Accessed: July 10, 2018]

- [32] Nellemann C, Henriksen R, Raxter P, Ash N, Mrema E, editors. The Environmental Crime Crisis—Threats to Sustainable Development from Illegal Exploitation and Trade in Wildlife and Forest Resources. A UNEP Rapid Response Assessment. United Nations Environment Programme and GRID-Arendal, Nairobi and Arendal. 2014. Available from: <http://www.unep.org/unea/docs/RRACrimecrisis.pdf>
- [33] Vira V, Ewing T. Ivory's Curse—the Militarization and Professionalization of Poaching in Africa. Washington D. C: Born Free USA; 2014
- [34] Environmental Investigation Agency (EIA). Vanishing point: criminality, corruption and the devastation of Tanzania's elephants. Environmental Investigation Agency, Washington DC. 2014. Available from: <http://eiainternational.org/wp-content/uploads/EIA-Vanishing-Point-lo-res1.pdf> [Accessed: July 10, 2018]
- [35] Kideghesho JR. Reversing the trend of wildlife crime in Tanzania: Challenges and opportunities. Biodiversity and Conservation. 2016;25:427-449
- [36] Loibooki M, Hofer H, Campbell KLI, East M. Bushmeat hunting by communities adjacent to Serengeti National Park: The importance of livestock ownership and alternative sources of protein and income. Environmental Conservation. 2002;29:391-398
- [37] Jambiya G, Milledge S, Mtango N. Night Time Spinach: Conservation and Livelihood Implications of Wild Meat Use in Refugee Situations in North-Western Tanzania. TRAFFIC East/Southern Africa. 2007
- [38] Martin A, Caro T, Borgerhoff MM. Bushmeat consumption in western Tanzania: A comparative analysis from the same ecosystem. Tropical Conservation Science. 2012;5(3):352-364
- [39] IUCN. Updated African Elephant Database Reveals Declining Elephant Populations. Available from: www.elephantdatabase.org [Accessed: July 12, 2019]
- [40] Sas-Rolf. M't. Does CITES Work? Four Case Studies. IEA Environment Briefing No. The Institute of Economic Affairs, London; 2000
- [41] Convention on International Trade for Endangered Species of Flora and Fauna (CITES). CITES Cop15, Doc. 68 annexe 6a; 2010
- [42] Lotter W, Clark K. Community involvement and joint operations aid effective anti-poaching in Tanzania. Parks. 2014;20(1):19-28
- [43] Hariohay KM, Fyumagwa RD, Kideghesho JR, Røskft E. Awareness and attitudes of local people toward wildlife conservation in the Rungwa game Reserve in Central Tanzania. Human Dimensions of Wildlife. 2018;23(6):503-514
- [44] Samwel DN. Local people knowledge on bushmeat hunting in the Serengeti ecosystem: A case study of Topi (*Damaliscus lunatus*) [MSc dissertation]. Trondheim: Norwegian University of Science and Technology; 2017
- [45] Campbell KLI, Hofer H. People and wildlife: spatial dynamics and zones of interaction. In: ARE S, Arcese P, editors. Serengeti II: Dynamics, Management and Conservation of an Ecosystem. Chicago: Chicago University Press; 1995. pp. 534-570
- [46] Kyando MT, Ikanda D, Roskft E. Hotspot elephant-poaching areas in the eastern Selous game reserve, Tanzania. African Journal of Ecology. 2017;55(3):365-371

- [47] Kaltenborn BP, Nyahongo JW, Kideghesho JR. The role of hunting in the Serengeti. In: Proceedings of the 2nd Annual Scientific Conference of the Tanzania Wildlife Research Institute (TAWIRI); 1-3 December 2002; Arusha, Tanzania; 2003. pp. 32-40
- [48] Metzger KL, Sinclair ARE, Hilborn R, Grant J, Hopcraft C, Mduma SAR. Evaluating the protection of wildlife in parks: The case of African buffalo in Serengeti. *Biodiversity and Conservation*. 2010;**19**:3431-3444
- [49] Bitanyi S, Nesje M, Kusiluka LJM, Chenyambuga SW, Kaltenborn BP. Awareness and perceptions of local people about wildlife hunting in western Serengeti communities. *Tropical Conservation Science*. 2012;**5**(2):208-222
- [50] Kideghesho JR, Msuya TS. Managing the wildlife protected areas in the face of global economic recession, HIV/AIDS pandemic, political instability and climate change: Experience of Tanzania. In: Sladonja B, editor. *Protected Areas Management*. London: IntechOpen Science/Open minds; 2012. pp. 65-91. ISBN: 980-953-307-448-6
- [51] Naidoo R, Fisher B, Manica A, Balmford A. Estimating economic losses to tourism in Africa from the illegal killing of elephants. *Nature Communications*. 2016;**7**:13379
- [52] World Tourism Organization (UNWTO). *Towards Measuring the Economic Value of Wildlife Watching Tourism in Africa - Briefing Paper UNWTO*. 2014
- [53] Rusch GS, Stokke S, Røskaft E, Mwakalebe G, Wiik W, Arnemo JM, et al. Human-wildlife interactions in western Serengeti, Tanzania. Effects of land management on migratory routes and mammal population densities. Norwegian Institute for Nature Research Report; 2005
- [54] Setsaas TH, Holmern T, Mwakalebe G, Stokke S, Røskaft E. How does human exploitation affect impala populations in protected and partially protected areas?—A case study from the Serengeti ecosystem, Tanzania. *Biological Conservation*. 2007;**136**:563-570
- [55] Marealle WN, Fossøy F, Holmern T, Stokke BG, Røskaft E. Does illegal hunting skew Serengeti wildlife sex ratios? *Wildlife Biology*. 2010;**16**:419-429
- [56] Strauss MKL, Kilewo M, Rentsch D, Packer C. Food supply and poaching limit giraffe abundance in the Serengeti. *Population Ecology*. 2015;**57**:505-516
- [57] Walelign SZ, Nielsen MR, Jacobsen JB. Price elasticity of bushmeat demand in the greater serengeti ecosystem: Insights for managing the bushmeat trade. *Frontiers in Ecology and Evolution*. 2019. DOI: 10.3389/fevo.2019.00162
- [58] Manyama FF, Nielsen MR, Roskaft E, Nyahongo JW. The importance of bushmeat in household income as a function of distance from protected areas in the Western Serengeti Ecosystem, Tanzania. 2019. DOI: 10.5539/enrr.v9n3p49
- [59] Rija AA, Kideghesho JR. Poacher's strategies to surmount anti-poaching efforts in Serengeti, Tanzania. In: Martin EH, Hadfield LA, Melubo K, Jensen RR, Durrant JO, Hardin PJ, et al. editors. *Protected Areas in Northern Tanzania*. In Press
- [60] Mfunda IM, Røskaft E. Bushmeat hunting in Serengeti, Tanzania: An important economic activity to local people. *International Journal of Biodiversity and Conservation*. 2010;**2**:263-272
- [61] Kideghesho JR. Co-existence between the traditional societies

and wildlife in western Serengeti, Tanzania: Its relevancy in the contemporary wildlife conservation efforts. *Conservation and Biodiversity*. 2008;**17**(8):861-1881

[62] Kideghesho JR. The potentials of traditional African cultural practices in mitigating overexploitation of wildlife species and habitat loss: Experience of Tanzania. *International Journal of Biodiversity Science and Management*. 2009;**5**(2):83-94

[63] Zafra-Calvo N, Lobo JM, Prada C, Nielsen MR, Burgess ND. Predictors of elephant poaching in a wildlife crime hotspot: The Ruvuma landscape of southern Tanzania and northern Mozambique. *Journal for Nature Conservation*. 2018;**41**:79-87

[64] Wasser SK, Clark WJ, Drori O, Kisamo ES, Mailand C, Mutayoba B. Combating the illegal trade in African elephant ivory with DNA forensics. *Conservation Biology*. 2008;**22**(4):1071

[65] Wasser SK, Brown L, Mailand C, Mondol S, Clark W, Laurie C. Genetic assignment of large seizures of elephant ivory reveals Africa's major poaching hotspots. *Science*. 2015;**349**(6243). DOI: 10.1126/science.aaa2457

[66] Duffy R, St Freya J. Poverty, poaching and trafficking: What are the links? Evidence on demand. *Climate, Environment, Infrastructure and Livelihoods*. London; 2013

[67] Hariohay KM, Fyumagwa RD, Kideghesho JR, Ranke PS, Røskoft E. Drivers of conservation crimes in the Rungwa-Kizigo-Muhesi game reserves, Central Tanzania. *Global Ecology and Conservation*. 2019. DOI: 10.1016/j.gecco.2019.e00522

[68] Nielsen MR, Jacobsen JB, Thorsen BJ. Factors determining the choice of hunting and trading bushmeat

in the Kilombero Valley, Tanzania: Choice of hunting and trading bushmeat. *Conservation Biology*. 2014;**28**:382-391

[69] Archabald K, Naughton-Treves L. Tourism revenue sharing around National Parks in Western Uganda: Early efforts to identify and reward local communities. *Environmental Conservation*. 2001;**28**:135-149

[70] Mgimba M. Prevention of wildlife trafficking and poaching in Tanzania by using forensic science technological approach. *Journal of Forensic Science and Criminal Investigation*. 2017;**2**(1):JFSCI.MS.ID.555577

[71] Banzi JF. A sensor based anti-poaching system in Tanzania national parks. *International Journal of Scientific and Research Publications*. 2014;**4**(4):1-7

[72] Knapp EJ, Peace N, Bechtel L. Poachers and poverty: Assessing objective and subjective measures of poverty among illegal hunters outside Ruaha National Park, Tanzania. *Conservation and Society*. 2017;**15**:24-32

[73] Wilfred P, MacColl AD. Income sources and their relation to wildlife poaching in Ugalla ecosystem, Western Tanzania. *African Journal of Environmental Science and Technology*. 2010;**4**(12):886-896

[74] Rentsch D, Damon A. Prices, poaching, and protein alternatives: An analysis of bushmeat consumption around Serengeti National Park, Tanzania. *Ecological Economics*. 2013;**91**:1-9

[75] Holden MH. Increase anti-poaching law-enforcement or reduce demand for wildlife products? A framework to guide strategic conservation investments. *Conservation Letters*. 2018;**2018**:e12618

- [76] Piel AK, Lenoel A, Johnson C, Stewart FA. Detering poaching in western Tanzania: The presence of wildlife researchers. *Global Ecology and Conservation*. 2015;3:188-199
- [77] Mabele MB. Beyond forceful measures: Tanzania's 'war on poaching' needs diversified strategies more than militarised tactics. *Review of African Political Economy*. 2017;44(153):487-498
- [78] Adams WA, Hulme D. If community conservation is the answer in Africa, what is the question? *Oryx*. 2001;35(3):193-200
- [79] Kicheleri RP, Treue T, Kajembe GC, Mombo FM, Nielsen MR. Power struggles in the management of wildlife resources: The case of Burunge wildlife management area, Tanzania. In: Kideghesho JR, Rija AA, editors. *Wildlife Management: Failures, Successes and Prospects*. London: IntechOpen; 2019. pp. 81-102
- [80] Mariki SB. Successes, threats, and factors influencing the performance of a community-based wildlife management approach: The case of Wami Mbiki WMA, Tanzania. In: Kideghesho JR, Rija AA, editors. *Wildlife Management: Failures, Successes and Prospects*. London: IntechOpen; 2019. pp. 103-123
- [81] Nelson F, Agrawal A. Patronage or participation? Community-based natural resource management reform in sub-Saharan Africa. *Development and Change*. 2008;39(4):557-585
- [82] Songorwa AN. Community-based wildlife management (CWM) in Tanzania: Are the communities interested? *World Development*. 1999;27(12):2061-2079
- [83] United Republic of Tanzania. National Strategy for Combating Poaching and Illegal Wildlife Trade. Dodoma, Tanzania; 2014
- [84] Tanzania Wildlife Research Institute. Tanzania Elephant Management Plan 2010-2015. Arusha, Tanzania; 2010
- [85] United Republic of Tanzania. Conservation and Management Plan for Black Rhino in Tanzania 2019-2023. Dodoma, Tanzania; 2019
- [86] Otieno J. CITES Threatens Sanctions on 'Gang of Eight' Over Poaching, Illegal Ivory Trade. Available from: <http://www.theeastafrican.co.ke/news/East-Africa-joins-the-infamous-Gang-of-Eight-over-poaching/> [Accessed: August 09, 2015]
- [87] IUCN. Illegal Trade Puts More World Heritage Sites in Danger. 2014. Available from: <https://www.iucn.org/content/illegal-trade-puts-more-world-heritage-sites-danger>
- [88] UK Department for Environment, Food and Rural Affairs. 2015. London Conference on the Illegal Wildlife Trade 12-13 February 2014 Declaration. Department for Environment, Food and Rural Affairs, Department for International Development, Foreign and Commonwealth Office and Home Office. 2014. Available from: https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/281289/london-wildlife-conference-declaration-140213.pdf [Accessed: July 12, 2015]
- [89] UNDP. 2018. Combating Poaching and Wildlife Trade. Available from: <http://www.tz.undp.org/content/tanzania/en/home/projects/combating-poaching.html>
- [90] Leader J. Obama's Executive Order To Combat Wildlife Trafficking Lauded By Conservation Groups. 2013.

Available from: https://www.huffpost.com/entry/obama-executive-order-wildlife-trafficking_n_3536536
[Accessed: August 16, 2019]

[91] <https://www.eonline.com/news/508752/prince-william-and-prince-charles-make-plea-to-stop-illegal-wildlife-trade-watch-now>). 2014
[Accessed: July 12, 2015]