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Comparing the Opportunity Cost of Living Inside and Outside Game Management Areas under Zambia's Wildlife Conservation Policy: A Choice Experiment

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SUMMARY

Managing wildlife resources requires balancing the needs of people living near wildlife-protected areas (PAs) with the grazing and habitat needs of wildlife. However, rising encroachment by households seeking new land for agriculture and increasing wildlife populations from wildlife-protected areas result in human-wildlife conflicts. Furthermore, protecting wildlife resources needs decreasing and restricting their illegal harvest, especially by people living near wildlife-protected areas, thereby imposing an opportunity cost on these households, who often depend on poaching for their livelihood. In this paper, we use a discrete choice experiment (DCE) based on a split sample of respondents living inside and outside the Game Management Area (GMA) near Kafue National Park in Zambia. The aim is to estimate the opportunity cost of conservation imposed on communities living near the national park under a hypothetical protection scenario in which households would receive various incentives in exchange for stopping poaching. Proposed incentives included donations of agro-input packs, donations of milking cows, and the presence of a community micro-credit facility. In addition, two measures aimed at discouraging poaching were an increase in the frequency of patrols by wildlife game scouts per week and an increase in the minimum number of years in jail for poaching offenders. In a test of external validity, we find that households living inside the GMA report a lower mean willingness to accept (WTA) compensation for the provision of wildlife conservation services compared to those outside the GMA. The study also reveals differences in other welfare-related preferences between respondents within and outside the GMA. Our methodology provides useful insights for policy prescription in addressing the problem of poaching and poverty alleviation in developing countries.

Keywords: Opportunity cost, Wildlife policy, Choice Experiment, Zambia

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INTRODUCTION

Rural communities worldwide face a dilemma on how to balance the preservation of surrounding natural ecosystems with the immediate resource needs they face (King, 2009). While surrounding ecosystems offer essential ecosystem services, protecting them by creating protected areas (PAs) can limit local communities' access to necessary resources, creating a complex dilemma between conservation and livelihood (Pullin et al., 2013). Though the need to conserve biodiversity and ecosystems is widely acknowledged (Mojo et al., 2020), careful consideration must be given to how PAs affect local livelihoods. In particular, the right conservation measures that must be put in place may directly affect how the local population can use the natural resources. This issue is becoming a challenge, especially in Africa, where many people have relied on wildlife hunting as a crucial part of their livelihoods. As such, some questions remain unanswered on how the establishment of such PAs affect the residents who live nearby and rely on the resources found in the now-protected space (Pullin et al., 2013; Mojo et al., 2020).

Although people living near wildlife PAs may benefit from long-term conservation returns, studies also show that PAs sometimes deny people access to resources they depend on for livelihoods, in addition to suffering losses from nuisance wildlife damage (Naidoo et al., 2019). Whether these households take actions that are consistent with conservation or detrimental to conservation depends in part on the costs and benefits associated with each action (Nana, 2014; Nyirenda et al., 2015). Under community-based wildlife conservation models, the establishment of PAs often come with suggested alternative livelihood opportunities aimed at attenuating the impact of the PAs on affected communities and helping in compliance.

Studies conclude that local communities living near wildlife PAs receive a number of benefits from conservation-related efforts, which include construction of health facilities, schools, and provision of improved water and sanitation services (Ntuli, Muchapondwa and Okumu, 2020). However, relatively few people within these areas are reported to have received adequate compensation from tourism or other conservation-related interventions they undertake. Yet, these communities also experience a number of costs when engaged in conservation, the most significant being increased crop damage and livestock predation, as well as threats to human life from wildlife (Wicander, 2014; Nyirenda, 2015; Simasiku et al., 2008; Bajracharya et al., 2005).

In particular, policymakers don't seem to differentiate between the impact of the opportunity costs incurred by communities living in the immediate neighborhoods of PAs, called Game Management Areas (GMAs), and those located outside the GMAs. GMAs, as natural habitats, are characterized by a variety of terrain ranging from rivers, valleys, swamps, and floodplains to savannah woodlands and grasslands that are adjacent to National Parks (Simasiku et al., 2008). They are created to allow the free movement of wildlife between the national parks and the GMAs and are constantly replenished by the population in the national parks and, in some cases, vice versa.

The failure by policymakers to provide adequate compensation for the provision of conservation services partly stems from the inability to estimate the

opportunity cost imposed on people living inside and outside the GMAs, in order to develop appropriate equivalent interventions. This invariably leads to poor compliance due to inadequate compensation that does not match the cost of conservation, leading to establishment of PAs becoming ineffective. Therefore, it is imperative to evaluate the opportunity costs of conservation faced by households living inside and outside GMAs in order to develop evidence-based wildlife conservation policy interventions (Mutti et al., 2023).

Wildlife conservation is one of Zambia's economic activities affecting the livelihoods of approximately 1.3 million people (nearly 8% of the national population) living near wildlife PAs (GRZ, 2019). In addition, the tourism sector in Zambia, classified by the World Bank as "nature-based," contributes significantly to the country's economy. In 2019, it contributed US$1.1 billion (7.3%) to GDP, in addition to creating over 465,000 direct jobs (GRZ, 2019). The above statistics underscore the importance of ecotourism and wildlife conservation to the economic and social development of Zambia if fully exploited.

To differentiate our study from previous work, we applied a discrete choice experiment (DCE) methodology to determine the difference in compensation required by households poaching with snares and/or bows and arrows rather than firearms, based on whether they live inside or outside the GMA. This is due to growing evidence pointing to poaching using such tools as having an inestimable growing impact on large mammals (Damania et al., 2005).

Our study findings show that households living inside the GMA report a much lower mean WTA for the provision of wildlife conservation services compared to those outside the GMA. This is due to the low value of game meat in the GMA compared to outside the GMA, as well as the limited application of proposed alternative livelihoods inside the GMA. The study also reveals differences in other welfare-related preferences between respondents within and outside the GMA.

MATERIALS AND METHODS

STUDY AREA

The study was conducted in the Mumbwa GMA situated adjacent to the Kafue National Park in the Central Province of Zambia (Fig. 1). Kafue National Park is the third largest park in Africa and Zambia's oldest and largest wildlife protected area. Mumbwa GMA makes for an appropriate context for this study in that the size and composition of the local communities in the GMA are not only large but also representative of the populations of other GMAs in the country. In terms of demographics, Mumbwa GMA has an approximate population of over 43,700, with an estimated annual growth rate of 0.4% (ZAWA, 2017). Over 56% of the population are male, while adults (16 years and above) make up about 49% (GRZ, 2019). Locally elected Community Resource Boards (CRBs) are grassroots institutions providing policy guidance and extension support regarding wildlife conservation to the local communities (Simasiku et al., 2008). In addition to promoting wildlife conservation among local communities, CRBs provide platforms for development partners wishing to improve the welfare of local communities. They also ensure equitable distribution and use of resources provided as compensation for the

provision of conservation services in each community, often offered in the form of community-based developmental projects.

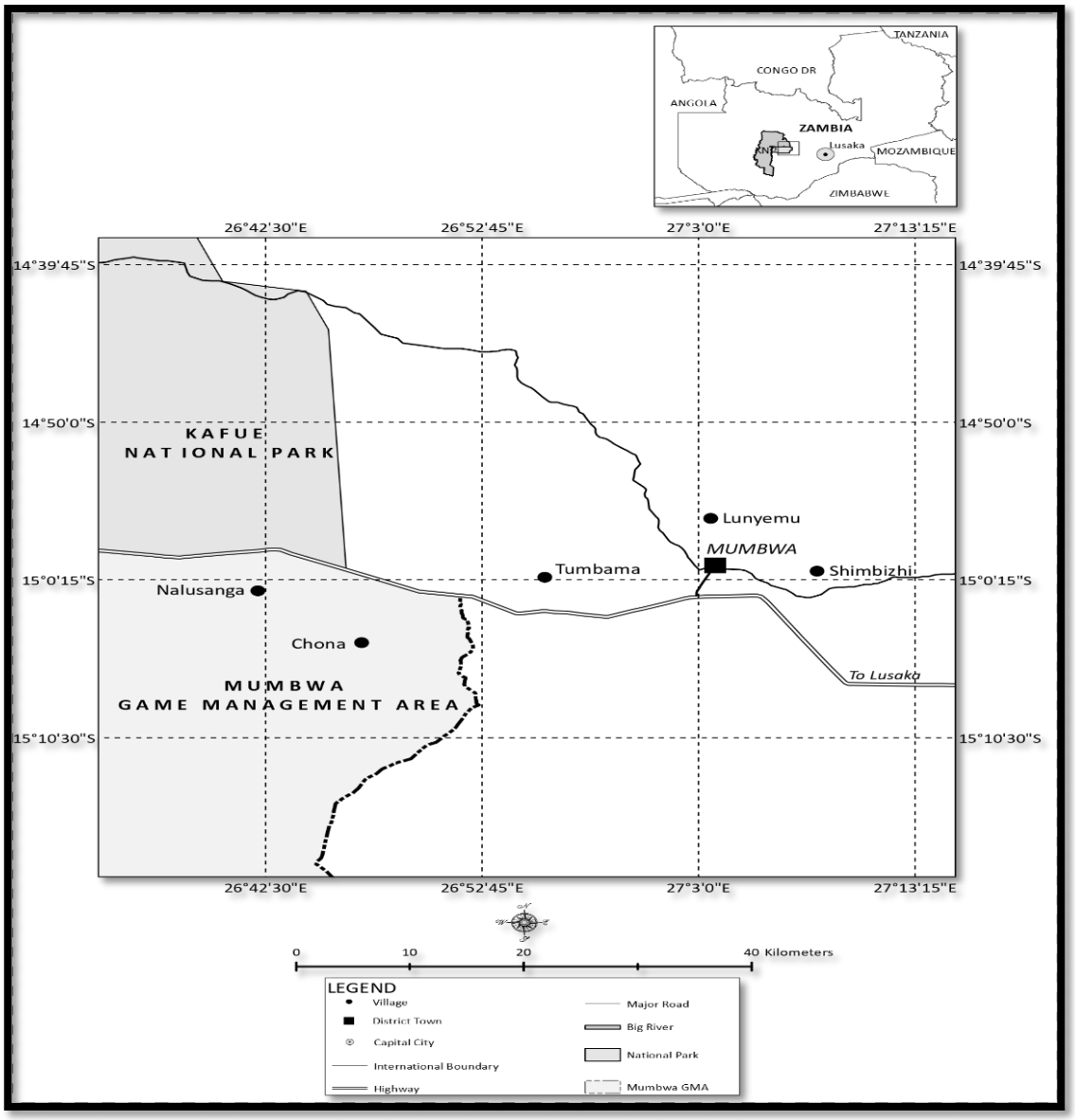

Figure 1. Map of Mumbwa Game Management Area.

According to ZAWA (2017), Mumbwa GMA has a great diversity of wildlife including 19 species of large herbivores, 13 species of carnivores, seven species of omnivores and four species of primates.

DESIGNING THE CHOICE EXPERIMENT

Selection of policy attributes

Attributes are proposed interventions presented to respondents as alternative forms of livelihoods (to be supplied by donors comprising local and international organizations

with an interest in conservation) to substitute poaching. To ensure that selected attributes are demand-driven, relevant, and realistic to respondents, the study design was informed by four iterative focus group discussions (FGDs). These were conducted with community members under the Mumbwa GMA, with each subsequent FGD providing more information that helped us refine the study questionnaire. Each FGD comprised seven to nine people randomly selected, including a village head, to help us understand what they knew about community-based wildlife conservation policy, its performance, and current challenges. The last FGD was attended by six former convicted poachers from whom we sought to understand the extent of the poaching problem, its causes, and law enforcement-related issues, based on their own and other people's experiences. Using results from the FGDs and insights from existing literature, we established a first list of attributes.

The FGD findings were presented and discussed with the following groups and institutions: selected local village wildlife game scouts in Mumbwa GMA, Zambian wildlife conservation experts, Zambia Wildlife Authority staff, park managers, and local key informants with an understanding of the study area. We reviewed the literature (e.g., Nthuli et al., 2020; van Velden et al., 2020; Travers et al., 2019; Berhanu and Teshome, 2018; Costedoat et al., 2016; Nielsen et al., 2014; Piñar et al., 2014; Nielsen et al., 2013; Kaczan et al., 2013; Moro et al., 2012; Johannesen, 2004;Milner-Gulland and Bennett, 2003). From the review of literature and engagement with some local community members, we developed a final list of attributes and levels presented in Table 1.

Table 1: Attributes, attribute levels, descriptions and their impact on household.

Attributes	**Description**	**Levels (* = status quo)**
Agro-input packs	Agro-input packs comprise 20 kg maize seeds, 200 kg of basal dressing and 200 kg of top-dressing chemical fertilisers delivered at the beginning of each growing seasons for the next two years (equivalent of 220 USD per year).	0*, 1, 2, 4
Cows for milk	Once-off donation of cows at in-calf stage mainly for milking and later on beef (equivalent of 160 USD each).	0*, 2, 4, 6
Community Micro-credit facility	Access to a community micro-credit facility from which to obtain small loans of up to K1000 (US$50) for business start-ups. The loans will be secured through “group lending” as a form of Collateral.	YES, NO*
Hunting trips	Households allowed a number of hunting trips per month (cost attribute).	4*, 2, 1, 0
Frequency of game patrols per week	Increased frequency of game park patrols per week through recruitment of more wildlife game scouts.	3*, 4, 5, 7
Minimum years in Jail for poaching offences	Increased minimum jail term for convicted poaching offenders.	3*,5,10, 15

Hypothetical scenarios

As part of an introduction to the survey, respondents were informed that a group of donors is planning to provide some income-generating opportunities to assist community members under Mumbwa GMA in improving their livelihoods. The donors will also support government efforts to enhance the enforcement of wildlife regulations by implementing measures to discourage people from poaching. Respondents were also informed that the survey aimed to elicit information that would be used for developing the proposed donor-supported alternative livelihood interventions. This would be an upgrade to the current community-based wildlife conservation program, which failed to meet their expectations. The alternative forms of livelihoods would be financed through donor support.

Card 1	Current Situation	Alternative A	Alternative B
Number of agro-inputs Packs 	**0**	**4**	**1**
Numbers of Cows for milk 	**0**	**8**	**0**
Number of hunting trips per month 	**4 times in a month**	**Once in a month**	**4 times in a month**
Access to community micro-credit facility 	**0**	**NO**	**YES**
Frequency of game patrols per week 	**3 days a week**	**5 days a week**	**7 days a week**
Minimum jail sentence for poaching offences 	**3 years**	**10 years**	**15 years**
Please choose one only	( )	( )	( )

Figure 2: An example of choice set used in the study.

Proposed alternative policy interventions include donations of agro-input packs for two farming seasons, a one-time donation of milking cows, and access to a community micro-credit facility. Deterrent measures in support of government efforts and regulation enforcement include an increase in the frequency of game patrols per week through the hiring of more wildlife scouts and a rise in the minimum number of years in jail for poaching offenses. The attribute "number of hunting trips allowed per

month" is used as a cost attribute to trade off against alternative livelihood interventions. The proposed payment vehicle is assumed to be a jointly managed (donor-local community elected committee) hypothetical donor-supported wildlife conservation trust fund. A choice set of the above attributes selected for this study is illustrated in Figure 2.

EXPERIMENTAL DESIGN, SAMPLING AND SURVEY

After conducting the FGDs towards the end of 2019, we conducted a pre-survey with 50 respondents, split into 25 living in the GMA and the other 25 living outside the GMA, using an orthogonal design with seven attributes. We used these preliminary results to develop a D-efficient design with 12 choice tasks using Ngene v.1.1.2 (Rose and Bliemer, 2009). The D-error of the final experimental design is 0.048. The survey instrument was implemented in early 2020. We used a split sample from 219 randomly selected households (69 living inside and 150 living outside the Mumbwa GMA, based on a 1:3 ratio given the larger population found outside the GMA, to arrive at a representative sample with similar characteristics to the smaller population inside the GMA). Data were collected from five villages: Shimbizhi, Tumbama, and Lunyemu (located outside the GMA) and Nalusanga and Choona (located inside the GMA), all located near the Kafue National Park (Fig. 1). Based on information from the FGDs, we considered poaching as an activity carried out by males above 16 years old. Consequently, we interviewed household heads for male-headed households. For female-headed households, a male adult family member older than 16 years was interviewed.

EMPIRICAL MODEL

We analysed the data using a conditional logit model. In accordance with the random utility theory (McFadden, 1974), we assumed that the utility of individual *n* from choosing alternative *j* in choice situation *t* can be represented as: $U_{njt} = \beta'.X_{njt} + \varepsilon_{njt}$, where X_{njt} is a vector of observed attributes related to alternative *j* of the choice situation *t*; β' is a vector of preference parameters explaining choices while ε_{njt} is the unobserved error term. We tested the hypothesis that there could be interactions between the number of hunting trips, jail sentence, and patrol frequency attributes. This is because an increase in the jail sentence or the frequency of patrols is likely to increase the cost of hunting trips, since the risk of being caught increases, and the cost when caught increases (see Mutti *et al.*, 2023 for a thorough discussion of the introduction of interactions in our analysis).

We modelled, utility of households in equation (1) below[1] :

$$U(a,c,cr,h,j,p) = ASC + \beta_{ag} \times agropack + \beta_{cow} \times cows + \beta_{credit} \times credit + \beta_{hunt} \times hunt + \beta_{patrol} \times patrol + \beta_{jail} \times jail + \beta_{jh} \times jail \times hunt + \beta_{ph} \times patrol \times hunt + \beta_{pj} \times patrol \times jail \quad (1)$$

[1] We also tested a model with three ways interactions, but the results suggested that the effect of this interaction was not significant. We decided to opt for a model with only two-ways interactions.

Based on the second model, we estimated willingness to accept (WTA) compensation through agro-packs, donation of cows and access to credit for reducing the number of hunting trips. To demonstrate the approach, we used in estimating WTA, we present the calculation for the case of agro-packs. Taking the marginal utility of agro-packs as β_a , the marginal utility of hunting trips is shown in equation (2) below:

$$\frac{\partial U}{\partial h} = \beta_h + \beta_{jh} \times jail + \beta_{ph} \times patrol \quad (2)$$

For a given number of years in jail and patrols per week, we can calculate the WTA for agro-packs to reduce hunting trips by one unit as the marginal rate of substitution between agro-packs and hunting trips in equation (3) below:

$$WTA_{agr} = \frac{\beta_h + \beta_{jh} \times jail + \beta_{ph} \times patrol}{\beta_a} \quad (3)$$

To evaluate the possible policy consequences, we calculated WTA at the current levels of jail sentences and patrols per weeks at three years jail term and three patrols per week, respectively. We then evaluated the marginal effect of changing the minimum jail sentence or the patrol frequency on WTA. For example, the marginal effect of increasing the jail sentence by one year on WTA for agro-packs is calculated as:

$$\frac{\partial WTA_{agr}}{\partial jail} = \frac{\beta_{jh}}{\beta_a}$$

The same reasoning was applied to the computation of WTA for milking cows and access to credit. To estimate the variability of our results, the standard errors of these values were computed using the Delta method. We estimated coefficients and willingness to accept (WTA) for agro-packs, cows, and access to credit for reducing the number of hunting trips by respondents living in the GMA and those living outside the GMA. The same reasoning was used to calculate other WTAs and marginal effects.

RESULTS

SOCIO-DEMOGRAPHIC CHARACTERISTICS OF SAMPLES (INSIDE AND OUTSIDE THE GMA)

Table 2 presents the socio-demographic characteristics of respondents from the split sample. Results show that there are generally no significant differences in socio-demographic statistics between the split samples. There is no significant difference in the average age of respondents between those inside the GMA (42.77) and those outside the GMA (43.57). Similarly, there is no significant difference between the mean household family size of 6.99 for respondents inside the GMA and 6.90 for those outside the GMA. The majority of respondents in the two groups are married, with 83% (inside the GMA) and 89% (outside the GMA). The majority of respondents in both groups had attained up to secondary education, represented by 81% (inside the GMA) and 79% (outside the GMA).

Table 2: Socio-demographic characteristics.

Variable	Inside GMA	Outside GMA	t-test p-values[a]
	Group Average	Group Average	H_o
Age	42.77	43.57	0.7389
Family size	6.99	6.90	0.9697
Married	83%	89%	-
Educated up to Secondary education	81%	79%	-
Unemployed	61%	51%	-
Own at least one animal (cattle)	45%	33%	-
Eengaged in subsistence agriculture (maize)	97%	88%	-
Owns at least one hectare of land	96%	95%	-
Reported poaching as main source of income	90%	87%	-
Reported poaching as main source of protein	87%	87%	-
Reported poaching as the only form of livelihood	90%	80%	-
Satisfied with type of compensation for conservation services	9%	12%	-
Satisfied with amount of compensation for conservation services	3%	5%	-
Satisfied with distribution process of compensation	6%	8%	-

a = pvalues are computed for continuous variables only
H_o = Significant difference in Social demographics

Only 45% of respondents in the GMA and 33% outside the GMA report owning cattle (at least one animal). With regard to the type of compensation and the distribution process of compensation provided in exchange for the provision of conservation services, a significantly low number (9% inside and 12% outside the GMA) of respondents report satisfaction with the type and (3% inside and 5% outside the GMA) with the distribution process of compensation under the current policy. Similarly, few respondents (6% inside the GMA and 8% outside the GMA) report satisfaction with the amount of compensation provided.

RESULTS OF THE DISCRETE CHOICE EXPERIMENT

We estimated two conditional logit models one with inside the GMA, one with outside the GMA datasets. The results of the two models with inside and outside the GMA data sets are jointly presented in Table 3.

Table 3: Conditional logit model estimates for Inside and Outside the GMA models.

Variable	Inside GMA			Outside GMA		
	Coefficient	Sig.[a]	Standard error	Coefficient	Sig.[a]	Standard error
Agro-packs	0.720	***	0.095	0.798	***	0.000
Donated Cows	0.447	***	0.049	0.403	***	0.000
Access to Credit	0.996	*	0.247	1.260	***	0.000
Patrolling	-0.179		0.189	-0.263	*	0.010
Jail sentence	-0.256	*	0.112	0.311	**	0.001
Hunting	0.131		0.313	0.752	**	0.002
Jail hunt	-5.555		0.490	-0.040	**	0.001
Patrol hunt	-0.045		0.210	-0.107	**	0.007
Patrol jail	0.028		0.109	0.055	**	0.009
ASC	-1.059		0.042	-1.676	**	0.007
Observations	828.0			1800.0		
Log-likelihood	-517.16			-1125.55		
McFadden's pseudo R^2	0.4205			0.4258		
AIC	1054.33			2271.09		
BIC	1101.52			2326.05		
Estimated parameters	10			10		

[a] ***, **, * indicates significance at 1%, 5%, 10% levels

The results for the inside the GMA model show that all variables were significant with expected signs except for the variables patrol, hunt, jail*hunt, patrol*hunt, and patrol*jail, which are not significant. Furthermore, the interaction variable patrol*jail does not have the expected negative sign, as their joint impact would reduce the motivation to poach, but it did not have any signs and is also not significant (Table 3). Compared to the output for the inside the GMA model, the outside the GMA model in Table 3 shows that all the main variables are significant with expected signs. However, the interaction term patrol*jail, which did not have the expected sign and was not significant in the inside the GMA model, still does not have the expected sign but is now significant in the outside the GMA model. However, we cannot compare the values between the two models because they have different scale coefficients. Therefore, we will next analyze the WTA values, which are comparable across models since the scale factor disappears.

TRADE-OFFS

Based on the outputs of Table 3, we calculated the trade-offs accepted between reducing hunting (number of hunting trips per month) and receiving compensations (agro-packs, cows, credit). In other words, the objective is to determine the necessary compensation for households to reduce the number of hunting trips per month. First, we calculated the willingness to accept compensation for a riskless scenario (WTA_0), that we defined as a scenario where there were no patrols or jail terms for poaching. WTA_0 can be interpreted as the gross value of hunting trips, which would bring meat,

etc., and have no costs other than time of the poacher. These WTA values are reported in Table 4.

Table 4: WTA for compensations under a hypothetical riskless environment.

Variable	Estimate	SE	2.5%	97.5%	Prob
Agropack, Inside	0.182	0.421	-0.644	1.007	0.333
Agropack, Outside	0.943	0.313	0.330	1.556	0.001
Cows, Inside	0.293	0.702	-1.084	1.670	0.339
Cows, Outside	1.867	0.696	0.503	3.232	0.003
Credit, Inside	0.131	0.297	-0.452	0.714	0.329
Credit, Ourside	0.597	0.206	0.194	0.000	0.001

Riskless environment is defined as jail sentence = 0 and no of patrols =0

Results in Table 4 suggest that the WTA for respondents inside the GMA is not significantly different from zero as such, we won't compute the WTA into real money value. However, for the respondents outside the GMA, the results show that they are willing to forego one monthly hunting trip in exchange for 0.943 agro-packs per year. Since we know the total price of the agro-packs (220 USD per year), the monetary equivalent would be 1660 USD/per household/2 years (0.943 x 220 x 4[2]). This would reduce hunting from the current maximum of four to zero trips per month, meaning one hunting trip would cost 17 USD for respondents outside the GMA. This value corresponds to the value of meat, net of the cost of labor time and other perceived costs. The same calculations were made with the cows and credit compensations. All yearly compensations required to stop hunting in a riskless environment are presented in Table 5.

Table 5: Yearly amount of compensation required to stop the hunting in a riskless environment.

Instrument	**Agro-packs**		**Cows**		**Credit**	
Method	Inside	Outside	Inside	Outside	Inside	Outside
Units to stop hunting under current hunting level[a]	0.724	4.150	1.76	11.202	0.131	0.597
Unit cost in USD for 2 a year program[b]	440.00	440.00	160.00	160.00	100.00	100.00
Equivalent USD compensation for 2-year program[b]	318.6	1660	281.28	1792.32	13.10	59.70

a Current hunting trips per months =4
b Two-years program. Agro-pack and credit given at the beginning of each year. Cows are given only once at the beginning of the program

Secondly, we computed the marginal effects of jail sentences and patrols on the WTA for respondents inside and those outside the GMA, based on the effect of one additional year in jail and one additional day of patrol on the WTA. Given our hypotheses, these can be calculated at any level of jail and patrol. The results are

[2] 4 represent the highest attribute level

presented in Table 6. The findings from Table 6 suggest significant differences in the impact of jail terms and patrols on the WTA for reducing hunting between respondents inside the GMA and those outside the GMA. One additional year in jail reduced the WTA of one hunting trip by 0.0007 Agro-packs, i.e., 0.0007 * 440 = 0.308 USD for the respondents inside the GMA and 0.050 * 440 = 22 USD for the respondents outside the GMA. On the other hand, one additional patrol per week reduced the WTA of one hunting trip by 0.063 Agro-packs, i.e., 0.063 * 440 = 27.72 USD for those inside the GMA and 0.135 * 440 = 59.4 USD for those outside the GMA.

Table 6: Marginal effect of jail sentence and number of patrols on WTAs: A comparison between respondents inside and outside the GMA.

Effect of	Policy instrument	Elicitation Method	Estimates	SE[a]	2.5%	97.5%	Prob
Jail	Agropack	Inside	-0.0007	0.032	-0.064	0.063	0.491
	Agropack	Outside	-0.050	0.015	-0.079	-0.020	0.000***
	Cows	Inside	-0.001	0.052	-0.103	0.1001	0.491
	Cows	Outside	-0.098	0.032	-0.161	-0.036	0.001**
	Credit	Inside	-0.0006	0.023	-0.046	0.045	0.490
	Credit	Outside	-0.031	0.009	-0.049	-0.014	0.000***
Patrol	Agropack	Inside	-0.063	0.075	-0.210	0.085	0.202
	Agropack	Outside	-0.135	0.052	-0.237	-0.032	0.005**
	Cows	Inside	-0.101	0.128	-0.352	0.149	0.202
	Cows	Outside	-0.266	0.114	-0.491	-0.042	0.010*
	Credit	Inside	-0.045	0.056	-0.155	0.064	0.208
	Credit	Outside	-0.085	0.035	-0.154	-0.166	0.008**

[a] SE were obtained using the delta method with the robust variance-covariance matrix of the conditional logit models

Our findings in Table 6 show that additional jail terms would have an impact on the behaviors of respondents living outside the GMA (or at least on their WTA). Therefore, for the government, there is a possible discussion regarding respondents outside the GMA on whether the regulator should be harsher (increase jail terms) or be lenient (give payments to the farmers). However, for the respondents living inside the GMA, additional jail terms would not really influence the WTA. Similarly, additional patrol days would impact the behaviors of respondents living outside the GMA. As a regulator, a direction towards being harsher through increased patrols would be feasible. But for respondents living inside the GMA, increased patrols would have no impact on the WTA. Again, this shows that policies based on the location of respondents with respect to wildlife PAs have different effects from the same policy instruments.

EFFECTS OF LIVING INSIDE AND OUTSIDE THE GAME MANAGEMENT AREAS

The proximity of households to wildlife protected areas has the potential to influence the behaviors of respondents regarding conservation policy requirements. Although

results from our choice experiments show that access to a community micro-credit facility, donation of agro-input packs, and milking cows could potentially reduce the desire to poach for both respondents living inside and outside the GMA (Table 3), our findings in Table 4 show that the WTA required to reduce poaching in the current policy environment (3 patrol days per week and a minimum 3-year jail sentence) is influenced by whether respondents live inside or outside the GMA. It would require (0.181 agro-packs, 0.292 cows, and 0.131 credit) for respondents living inside the GMA to stop poaching, compared to those outside the GMA who would require (0.943 agro-packs, 1.867 cows, and 0.597 credit) units of compensation. Further, results in Table 5 show that for respondents to stop hunting completely, those living inside the GMA report lower units of each of the three proposed incentives (0.724 agro-packs, 1.76 cows, and 0.131 credit). In comparison, respondents living outside the GMA would require (4.150 agro-packs, 11.202 cows, and 0.597 credit) to stop poaching completely, which is higher for all three incentives. Probable explanations could be that the GMA, being a primary market for products from poaching, reflects a lower value of benefits compared to the value reflected outside the GMA, which is a secondary market. Additionally, given limited land for cultivating crops and the problem of nuisance wildlife damage to crops and predation of domestic animals, respondents in the GMA do not see much value in the proposed donation of agro-packs and cows.

IMPACT OF LOCATION OF RESPONDENT (INSIDE OR OUTSIDE THE GMA) ON PREFERENCE FOR AGRO-PACKS

Respondents would give up one trip per month if they were given 0.720 agro-packs for those inside the GMA (Table 3) and 0.798 agro-packs for those outside the GMA (Table 3), under current jail and patrol conditions. These parameters are comparable since both marginal effects are significant. Therefore, this result shows that the location of respondents, whether inside or outside the GMA, has an impact on the preference for agro-packs as a substitute for poaching.

IMPACT OF LOCATION OF RESPONDENT (INSIDE OR OUTSIDE THE GMA) ON PREFERENCE FOR ACCESS TO MICRO-CREDIT

The study results show that access to community microcredit has great potential to reduce the number of hunting trips a household can undertake per month for both respondents living inside and outside the GMA under the current jail sentence and patrol frequency. The results indicate that it would be cheaper to compensate respondents living inside the GMA (0.996 in Table 3) compared to those outside the GMA (1.260 in Table 3) with the availability of community microcredit facilities. A possible explanation is that respondents outside the GMA have more investment opportunities from funds supplied under the credit facilities compared to those inside the GMA.

IMPACT OF LOCATION OF RESPONDENT (INSIDE OR OUTSIDE THE GMA) ON PREFERENCE FOR DONATION OF COWS

The utility from one hunting trip per month is equivalent to the economic benefits received from 0.445 (Table 3) or 0.403 (Table 3) dairy cows, according to

respondents inside and outside the GMA, under current jail and patrol conditions. These results differ from those in the case of agro-packs and credit in that, for the donation of cows, the levels of compensation are lower for respondents outside the GMA compared to those reported by respondents inside the GMA. The conclusion is that the location of the respondent (inside or outside the GMA) has an impact on the preference for cows.

IMPACT OF LEVELS OF ADDITIONAL JAIL TERMS AND PATROLS ON LOCATION OF RESPONDENT (INSIDE OR OUTSIDE THE GMA).

Table 6 shows that one additional jail term would reduce compensation levels by (agro-pack=0.050, cows=0.098, credit=0.031) for respondents living outside the GMA, as its impact is insignificant for those inside the GMA. Therefore, this means that additional jail terms have no effect on respondents inside the GMA; as such, the way forward would be to rely on compensation. On the other hand, one additional patrol per week would reduce the levels of compensation due to households by (agro-packs=0.05, cows=0.01, credit=0.04) for respondents inside the GMA and (agro-packs=0.135, cows=0.266, credit=0.085) for respondents outside the GMA (Table 6). As with jail terms, the impact of patrol efforts is not significant for respondents inside the GMA, implying that only compensation would influence compliance. The conclusion is that the location of the respondent (inside or outside the GMA) still appears to have an impact on the application of additional jail and patrol efforts.

DISCUSSION

Our model results consistently indicate that donating agro-packs and cows, along with providing access to a community microcredit facility, significantly enhances household utility for respondents. Conversely, increasing the length of jail sentences clearly reduces household utility from illegal hunting. Similarly, raising the frequency of patrols, which heightens the likelihood of arrest, also diminishes household utility from illegal hunting. These findings are applicable to both respondents within and outside the GMA. Additionally, our model demonstrates that household utility declines for hunting trips as the risks associated with increased patrol frequency or harsher penalties for poaching offenses rise.

The comparison of the inside and outside the GMA model outputs shows that WTAs and marginal effects of jail sentences and the number of patrols are different, suggesting different impacts of jail and patrol on the two groups. Results from this study are consistent with other studies reporting that increasing patrolling frequency did not appear to act as a very strong deterrent effect compared to that of jail terms (Moro et al., 2012; Nielson et al., 2014). In this study we noted that, the impact of having additional patrol days per week is insignificant. There are several potential explanations for this discrepancy. First, an increased patrolling frequency may not be perceived as an indicator of risk. If an increased probability of being caught only means more frequent payment of bribes to game scouts, then an increase in the frequency of patrols is likely to have a minor effect. Moro et al. (2012) also observed that more well-off hunters are likely to have the financial means to cope with the risk of being arrested. Similarly, Jachmann (2008) reports that patrol efficiency can vary considerably, and in some protected areas, the number of patrols may be a poor

indicator of the probability of being caught. On the other hand, an additional year in jail has an impact on reducing the desire to poach. This finding is supported by FGDs where it was revealed that sentences for poaching offenses were considered relatively shorter compared to those for other criminal offenses; hence, increasing the jail term has a higher impact. Lindsey et al. (2012; 2011) also report that one of the key drivers of illegal hunting in developing countries is their weak penal system. They note that most punishments for poaching offenders provide inadequate deterrents and often do not reflect the value of destroyed resources. Our results suggest that an increase in the minimum jail sentence by an additional year, all else equal, would reduce the required compensation for agro-packs, cows, and credit for respondents living outside the GMA.

Results show that the impact of both additional jail terms and patrol frequency have significant effects in reducing the desire to poach for respondents inside and outside the GMA. Our results suggest that an increase in the frequency of patrolling by an additional day, all else equal, would reduce the required compensation for agro-packs, cows, and credit for respondents outside the GMA, all at the expense of additional costs of hiring more game scouts and patrolling equipment.

CONCLUSION

Empirical findings have shown that local communities living around PAs face a dilemma of balancing wildlife conservation efforts with their livelihoods. The communities living inside and outside the Mumbwa GMA are no different, as they often have to make trade-offs between these choices while facing the issue of compliance with conservation authorities or the consequences of not complying. Efforts by park authorities to promote conservation in the GMA don't seem to be effective in uplifting the communities' standard of living, leaving them vulnerable to finding alternative means of survival, including poaching.

Since communities inside and outside the GMA face different challenges and opportunities, it is important to evaluate the opportunity cost of stopping them from poaching in order to develop a sustainable and cost-effective compensation strategy. This paper used a split sample under DCE to analyze the WTA of communities living inside versus those living outside the GMA to evaluate the differences in their opportunity costs. This would then form a basis for determining levels of compensation to promote conservation. The study findings have shown that there are marked differences between respondents living in the GMA and those outside the GMA with regards to both the levels of compensation (WTA) required (cows, agro-packs, credit) to induce conservation and the effort of enforcement required (frequency of patrols and length of jail terms) to discourage poaching. In general, respondents inside the GMA report lower levels of compensation and enforcement effort required for them to stop poaching. The findings suggest that our proposed methodology has the potential to generate cost-effective long-term empowerment opportunities for households and create an adequate substitution effect that could shift households' attention from poaching to any of the proposed desirable livelihood activities for both respondents living inside and outside the GMA. Further, our selected alternative policy interventions (agro-packs, cows, and credit) incorporate the important element of normative value of incentives, which is critical to

acceptance by the local communities. Our sample size and the significant coefficients we obtained from it enabled us to make valid inferences based on well-predicted choices.

CONTRIBUTIONS OF THE STUDY AND FUTURE RESEARCH DIRECTION

The study's methodological contribution lies in the fact that it develops and employs a conceptual/analytical framework that has not been employed (to the best of our knowledge) in Zambia to analyze the opportunity cost of stopping poaching. Future areas of study should include investigating compensation options that could provide for wildlife-caused damages, in addition to determining the impact of institutional arrangements on the implementation of our proposed policy interventions. The observed impact of interacting terms on poachers' decisions to stop poaching also reveals another perspective that requires further inquiry.

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