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ANALYSIS

Improving the benefits of wildlife harvesting in Northern Cameroon: a co-management perspective

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Abstract

We examined ways of improving the incentive structure of a safari company, the state, and the local communities within a wildlife co-management framework in Northern Cameroon. To this end, we built an integer linear programming model with state-allocated quotas and a profit maximisation objective function for a typical hunting concession. The model was evaluated under three scenarios representing varying taxation schemes and apportionment of trophy fees and company's profits. Further, we set forth three principles that should underlie a good incentive structure, namely (i) a close link to the resource base, (ii) economic sustainability, and (iii) a transfer of land property rights from the state to the communities neighbouring the hunting areas. Our results indicate that the safari company would improve its profits if the concession term is extended to 15 years and a single business tax is substituted to the current myriad of levies. The local communities should be apportioned 25% of the trophy fees and a negotiated percentage of the company's profit, in return for resource custodianship. Finally, the state could expect an increased efficiency of its conservation policy through an improved regulatory framework and a more equitable distribution of wildlife revenues.

Keywords: Safari industry; Poaching; Wildlife co-management; Incentive structure; Economic sustainability

1. Introduction

The persistent decline of African wildlife derives from at least two clusters of anthropogenic factors. First and foremost are economic hardship and demographic pressure. In effect, protected areas are increasingly encroached upon by a growing, ever pauperised population, through farming, grazing, logging, and mining (Lewis et al., 1990; Durbin and Ralambo, 1994; Nepal and Weber, 1995). Also, the conservation orthodoxy curtailed the access of local communities to their traditional resources in return of

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little compensation (Neumann, 1992; Nepal and Weber, 1995; Naughton-Treves, 1999).

Second is an ambiguous property right system that facilitates the encroachment of conservation areas. Indeed, while expropriation imposed de jure state property (i.e., res publica), it actually led to de facto open access (i.e., res nullius) due to insufficient enforcement (Feeny et al., 1990; Bromley, 1992). The theory predicts that a lack of clearly defined and/or enforced property rights will result in market failures (Hanley, 1998). Such failures are reflected in the encroachment of conservation areas and the entailed social costs of privatisation that may culminate in wildlife extinction, if the situation remains unchecked. Thus about two decades ago, a new conservation paradigm emerged that advocates the devolution of wildlife use rights in the park surroundings (Child, 2000; Child and Chitsike, 2000). Depending on whether the dispersal areas are privately owned or held in common, one distinguishes between private conservacies (in South Africa) and community-based management (e.g., CAMPFIRE–Communal Area Management Programme for Indigenous Resources–in Zimbabwe). An alternative setting emerges where the park and the peripheral areas (e.g., hunting zones) are state-owned, as in Northern Cameroon. The state may thus allocate usufruct right to the local communities while retaining ownership right on behalf of the citizenry at large. In this case, as with strictly communal lands, the term "community-based management" is a misnomer as, most often than not, the joint governance of wildlife resource by the state and local communities is more likely to prevail. This setup is referred to as collaborative management or briefly co-management.

Wildlife co-management has its own failures, however, as a raft of recent reports have shown (Gibson and Marks, 1995; Wainwright and Werhmeyer, 1998; Fabricius et al., 1999; Songorwa, 1999; Roe et al., 2000). Some of its weaknesses include failed delivery and/or insufficient incentives, lack of power devolution, and in some cases persistent loss of biodiversity. But these flaws derive more from implementation difficulties than the concept itself. Indeed, in addition to being congruent with the socio-cultural constructs of most traditional communities, co-management can be justified by the lack of scientific, marketing, and organisational skills that plagues local communities. Thus, Mayaka (2002) proposes that co-management should be a triadic convention between the three segments of the society, namely the state, the private enterprise (in casu a safari company), and the civil society (local community and facilitating NGOs). The proposed arrangement spells out the sharing of wildlife management duties and benefits among the three groups of stakeholders. It also conforms with the Ecosystem Approach, as laid down by the UN Convention on Biological Diversity.[1]

Wildlife use includes game viewing, sale of live animals, and hunting for trophy and/or meat. The latter activity is the backbone of a major tourist industry known as safari hunting, on which more would be said shortly. Of all the above use forms, trophy harvesting is the most advantageous on both ecological and economic accounts. Firstly, safari hunting requires little infrastructure (tracks and buildings), draws smaller crowds, and produces less litter than game viewing. Also, it concerns only a small fraction of the animal population viz., old males with mature, aesthetic trophies (Child, 1990; Hurt and Ravn, 2000). Secondly, safari hunting generates much more revenues from a small number of sport hunters compared to the mass tourism of game viewing (Child, 1990; Lewis and Alpert, 1997). The exception in this regard being a few countries, for example, Kenya and South Africa, which boast famous parks and remarkable tourist facilities. Further, these revenues accrue to safari operators, the state, and local communities but also airlines, charter companies, taxidermy companies, hotels, restaurants, firearms and ammunitions dealers, camp equipment manufacturers, amongst others.

Despite its economic importance, wildlife industry has received little attention compared to ecological and institutional issues (but see Hearne et al., 1996; Hearne and McKenzie, 2000). The current work investigates ways of improving the benefits of safari hunting for all three parties to a wildlife collaborative management in Northern Cameroon. The study site harbours three national parks and 26 hunting zones, whose management involves local communities, state agencies, and safari companies in varying roles.

[1] See: http://www.biodiv.org/doc/meetings/cop/cop-04/information/cop-04-inf-09-en.pdf.

After state expropriation of land, local communities were demoted from their traditional role of resource stewardship to providing the safari industry with manpower (drivers, cooks, waiters, skinners, etc.). Several approaches have been suggested for mitigating the negative effects of protected areas on adjacent communities. These include, among others, sharing conservation benefits and creating jobs (Fiallo and Jacobson, 1995; Nepal and Weber, 1995; Bruner et al., 2001).

The state contracts out hunting concessions to safari companies for a period of 5 years, renewable. The lease is conditional on investment clauses (dirt tracks and permanent buildings) in addition to annual levies. Further, tenants are recommended to provide local residents with social amenities (mostly employment), to the extent possible. The state also collects several levies from tourist hunters (entrance visa, hunting license, firearm taxes, trophy fees, etc.).

The company sells safaris to expatriate clients mostly from Europe and, to a lesser extent, North America. What is actually sold is the outdoor experience of great landscapes with aesthetic species, the tracking and killing of animals in their natural setting, and the prestige of taking home a trophy (Child, 1990; Hurt and Ravn, 2000). Practically, each safari hunter will purchase a 'bag of game'. In safari jargon, this term refers to a strategic assortment of animal species drawn in limited number from three categories of body size, namely big, plains, and small. The marketing of safaris is done through booking agents at specialised fairs but also by the word of mouth. Therefore, the pricing mechanism is customised and somewhat cryptic. At any rate, a professional hunter welcomes, lodges, and guides the client(s) usually on a one-to-one basis (1×1 option). Often, however, a pair of clients may request a joint safari under the guidance of either the professional hunter or his assistant (2×1 option).

Locally, the safari industry is confronted to several hurdles. Among these are (i) poor organisation, (ii) limited infrastructure, and (iii) insecurity over investment (short-term concession, corruption, inappropriate business legislation, highway robbery).

Further, the safari companies generate annually about US$2 million in gross revenues (Mayaka, 2002), of which less than 3% trickles down to local communities. This unfair distribution has failed to attract local support for conservation efforts. Thus, rampant poaching and spreading agropastoralism continue to whittle away wildlife and its habitat.

Accordingly, in this study we scrutinised the co-management framework from the perspective of benefits sharing, in an attempt to promote a sustainable use of wildlife through an improved incentive structure for all stakeholders involved. As a springboard for this ultimate goal, we analysed the benefits of wildlife harvesting and their distribution among a safari company, the state, and the local communities. To achieve this subsidiary aim, an integer linear programming model was built with state-allocated quotas and a profit maximisation objective function for a typical hunting concession. This approach was adopted as a benchmark in palliating the sparse and inconsistent information provided by safari companies and, above all, the current lack of standardised species assortments (i.e., 'bags of game') on offer. The model was evaluated under three contending scenarios by considering, among other criteria, the payback time and the income distribution between the stakeholders. Each scenario represented a different incentive structure based on variable shares of land royalty, trophy fees, and the profit made by the safari company. We set forth three principles that should underlie a good incentive structure, namely (i) a close link to the resource base, (ii) economic sustainability, and (iii) a transfer of land property rights from the state to local communities neighbouring hunting zones. The emerging results indicate that it is possible to increase the benefits of all three stakeholders by changing the regulatory framework. More specifically, we suggest an extension of the concession term to 15 years and the substitution of a single business tax to the myriad of levies currently borne by safari companies. Further, we argue that a better incentive structure apportions 25% of the trophy fees and a negotiated percentage of the company's profit to the local community. We recognise that the institutionalisation of co-management is a costly, lengthy process requiring inter alia arduous negotiations, physical and legal delimitation of the resource, capacities building and/or strengthening among local communities, and enforcement mechanisms. The received theory holds that the transaction costs related to conflicts resolution and property rights arrangements are better met for high-valued resources (Pearse, 1988; Adams and Hulme, 2001), such as in our case. Moreover, we posit that in

the long run, the transaction costs entailed by the proposed co-management will be smaller than those currently borne by the social actors.

2. Methodology

This section describes the data and the linear programming model that were used in simulating the management of a representative hunting zone for one year. This order of presentation has the merit to introduce the adopted notation along with safari specific terminology, prior to model formulation. It is worth mentioning that the use of an optimisation model was motivated by the lack of a standardised species assortments (i.e., 'bags of game') on offer. This situation derives partly from a lax regulation that does not require a formal training of safari operators in lodge and wildlife management. Also, hunting areas are allocated under a non-transparent procedure that enables the entry of part-timers and amateurs in the business.

2.1. Data

The simulation exercise used harvest and economic data described below.

2.1.1. Harvest data

For each species s ($1 \le s \le 16$) of the harvested assemblage, Table 1 provides the following.

(i) The annual quotas (q_s) set by the state in the period 1996–2000 and their minimum ($\tilde{q}_s$).
(ii) The group affiliation including I (big game other than lion), II (plains game), III (small game). Although lion is a big game species, it was assigned in a group of its own (namely O), for mathematical convenience.
(iii) The proportion of used quotas–i.e., the percentage killed effectively–(θ_s), as recorded through several years over 26 hunting zones in Northern Cameroon.
(iv) The number of safari-days supported by each species (d_s); big game species were assumed to require 4 hunting days each, except for eland (8 days) and elephant (6 days), as against 2 days for plains game whereas small game is merely a "filler" used in extending the length of hunt.
(v) The unit trophy fee in US$ (t_s).
(vi) The average body mass in kg (m_s), assumed to yield 45% of meat after dressing.

The crux of safari marketing lies in the strategic mixing of the allocated quotas into assortments of

Table 1
Harvest data for a representative hunting concession include for each species: group affiliation (see details under Section 2.1.1); percentage use of past quotas; number of supported hunting days; unit trophy fees; body mass (adapted from Kiss, 1990; Kingdon, 1997); state allocated quotas

Species	Group	% quotas used	Safari-days	Trophy fee (US$)	Body mass (kg)	Quotas[a]				
						1996	1997	1998	1999	2000
Lion *Panthera leo*	O	30.4	4	1540	180	2	**1**	1	2	2
Elephant *Loxodonta africana*	I	45.0	6	1540	3000	**1**	2	2	2	3
Eland *Taurotragus derbianus*	I	50.0	8	1540	500	**3**	3	4	3	4
Buffalo *Syncerus caffer*	I	41.4	4	770	450	**4**	4	4	4	4
Hippopotamus *Hippopotamus amphibus*	I	18.6	4	770	1100	3	3	3	**2**	2
Roan antelope *Hippotragus equinus*	I	25.3	4	770	270	8	7	7	**6**	6
Hartebeest *Alcelaphus buselaphus*	II	34.1	2	310	170	**6**	7	7	6	6
Waterbuck *Kobus ellisyprimnus*	II	83.3	2	385	200	**4**	4	4	4	4
Kob *Kobus kob kob*	II	53.1	2	154	100	6	6	6	**5**	5
Bushbuck *Tragelaphus scriptus*	II	44.4	2	154	55	5	5	5	**4**	4
Reedbuck *Redunca redunca*	II	36.9	2	154	54	**4**	4	4	4	4
Warthog *Phacochoerus africanus*	II	23.3	2	154	75	5	5	5	**4**	4
Oribi *Ourebia ourebia*	III	17.8	0	77	18	12	12	12	**10**	10
Grimm's duiker *Sylvicapra grimmia*	III	19.8	0	77	16	8	**8**	8	10	10
Red-flanked duiker *Cephalophus rufilatus*	III	15.2	0	77	12	6	**6**	6	8	8
Baboon *Papio anubis*	III	8.8	0	77	36	10	10	10	12	**8**

[a] Shown in bold are the minimum quotas used in the LP-model.

species referred to as "bags of game" (see further Child, 1990). Throughout this paper, the terms bag of game (or briefly bag), hunt type, safari type are used interchangeably. It is customary to define a bag by a key species and the total number of hunting days (or hunt length). The size and composition of bags, known as 'bag limits' in the safari jargon, are constrained by regulatory provisions as follows.

(i) Big game safaris: two big game species (in addition to lion, if offered) and four plains game species.
(ii) Plains game safaris: two plains game species and four small game species.

Let there be a total of B possible bags of which $(B-p)$ correspond to big game safaris; further let a_{sb} be an indicator variable which equals 1 if species s appears in bag b $(1 \le b \le B)$ and 0 otherwise. The bag limits stated above translate mathematically in the following inequalities $\sum_{s\in \mathrm{I}} a_{sb} \le 2$ $(b = 1, 2, \ldots, B-p)$; $\sum_{s\in \mathrm{II}} a_{sb} \le 4$ $(b = 1, 2, \ldots, B)$; $\sum_{s\in \mathrm{III}} a_{sb} \le 4$ $(b = B-p+1, \ldots, B)$.

In this study, five bags were defined, namely lion (18 days), eland (20 days), elephant (14 days), roan antelope (10 days), and plains game (8 days). Table 2 details the composition of these bags.

2.1.2. Economic data

This category of data will be considered for each of the three stakeholders, namely the safari company or its promoter henceforth referred to as the investor, the state, and the local community.

To begin with, the investor shoulders the initial capital (US$200,000), overhead costs (US$122,100), and variable daily safari costs. These costs appear respectively under sections A, B, and C of Table 3. Except for the state levies (starred in Table 3), all other expenditures were based on guesswork or adapted from Kiss (1990) after adjusting for inflation or using guess estimates which approximate the standards found in Tanzania. Two reasons motivated this approach. Firstly, safari companies are reluctant to disclose their accounting books. Secondly, their prima facie investment is low compared to the international standards of the safari business to which this study

Table 2
Description of the safari types used in simulation, including bag composition, hunt length, daily charged fees (based on two price scales) and daily costs of operation

Species	Group	Bags				
		18-day Lion	20-day eland	14-day elephant	10-day roan	8-day plains game
Lion	O	1	0	0	0	0
Elephant	I	0	0	1	0	0
Eland	I	0	1	0	0	0
Buffalo	I	1	0	1	0	0
Hippopotamus	I	0	1	0	0	0
Roan antelope	I	1	0	0	1	0
Hartebeest	II	1	1	0	1	1
Waterbuck	II	1	0	0	1	1
Kob	II	0	1	1	0	0
Bushbuck	II	1	0	0	1	1
Reedbuck	II	0	1	1	0	1
Warthog	II	0	1	0	0	0
Oribi	III	0	0	0	0	1
Grimm's duiker	III	0	0	0	0	1
Red-flanked duiker	III	0	0	0	0	1
Baboon	III	0	0	0	0	1
Daily price, p_b (US$ day^{-1})		2600	2300	2000	1900	1700
Daily cost, c_b (US$ day^{-1})[a]		590	530	515	500	455

[a] See Table 2 for a breakdown of daily operating cost.

Table 3
Estimated costs and expenditures for running a hypothetical safari company in Northern Cameroon

A. Capital outlay	**US$**
	200,000
1. Fixed assets	*45,000*
Track opening (assuming a minimum of 30 km) 12 bulldozer-days @ US$ [700 (rent)+150(fuel)+80 (personnel)]/bulldozer-day+2 days rent of bulldozer carrier @ US$300/day+6 grader-days @ US$ [400 (rent)+100 (fuel)+40 (personnel)]/grader-day	15,000
Buildings	30,000
3 bungalows for senior staff @ US$2000 each	
4 luxury bungalows for clients @ US$4000 each	
1 social building (with restaurant, bar, living room, kitchen) @ US$7000	
1 technical building (taxidermy) @ US$1000	
2. Moveable assets	*121,700*
Vehicles	57,500
2 hunting cars @ US$[12,300 (purchase, second hand)+6000 (conversion)]/car	
1 shuttle car @ US$12,300 (second hand)	
2 motorcycles @ 3800 a piece	
5 bicycles @ 200 apiece	
Furniture	10,000
Deep freeze (2pc @ 800 each) and refrigerator (2pc @ 1200 each)	4000
Water pump	1500
Electricity generator and wiring	3500
Crockery and cutlery	700
Kitchenware	1000
Linen, table clothing, and blinds	3500
Weapons (minimum assortment)	35,500
2 big guns @ US$6200 each	
2 medium guns @ US$4600 each	
2 short guns @ US$1200 each	
1 22-long riffle @ US$2300	
2 light guns @ US$4600 each	
Radio	1300
Binocular 2 pairs @ US$1200 each	2400
Tools/implement	2300
3. Miscellaneous (20% of all the above)	*33,300*
B. Recurrent expenditures (overhead)	
1. Staff (annual gross salary, actually based on 10 months)	*82,100*
1 professional hunter @ US$5000 month^{-1}	50,000
1 assistant professional hunter @ US$1500 month^{-1}	15,000
12 game wardens @ US$50 month^{-1} each	6000
3 drivers/mechanics @ US$60 month^{-1} each	1800
2 cooks @ US$90 month^{-1} each	1800
3 waiters @ US$50 month^{-1} each	1500
2. Other operating costs	*40,000*
road maintenance	4500
lease fees (assume 50,000 ha @US$0.12 ha^{-1} year^{-1})[a]	6000[b]
professional hunter's license[a]	2600
2 big game permits (hunter and assistant) @ 550 each[a]	1100
commercial license (sale of drinks, food, etc.)[a]	500
4 round trips to USA and Europe (fairs and vacation) @ US$2000 each	8000
spare parts and maintenance	4500
insurance and social security	6500
medical supplies	500
advertisement and bookkeeping	3000
cleaning materials	300
salt chemicals	500
miscellaneous (≈5% of all the above)	2000
C. Daily safari costs (variable)	
commercial agents (15% of safari sold)	in US$ safari-day^{-1} client^{-1}
petrol, diesel, lubricant, gas	US$100 safari-day^{-1} client^{-1}
food and drinks	US$200 safari-day^{-1} client^{-1}
temporary labour	US$15 safari-day^{-1} client^{-1}
ammunitions	US$5 safari-day^{-1} client^{-1}

[a] These fees are levied by the state.
[b] The area fees are shared equally between the state and the local community (rural council and villages).

refers. The results are about 10% below the investment costs observed in Tanzania, which provides some confidence towards the number used.

A bag of game sells at a daily price (p_b)–that increases with the inclusion of 'prestigious' (i.e., big game) species–and entails a daily cost (c_b). The values of p_b and c_b are shown at the bottom of Table 2. The actual price scale is customised and rather cryptic; however, the proposed daily rates conform

with the international standard (see Hurt and Ravn, 2000, pp. 298–300).

Next, the state derives its income from trophy fees (Table 1), levies on safari companies (Table 3), income and business taxes at unspecified but assumed rates of 20% and 35%, respectively. To these should be added a number of fees paid by each tourist hunter. These include entrance visa (US$47), license fees (US$660 and 340 for big and plains game safaris, respectively), firearm taxes (US$62, assuming two guns), and trophy transfer (US$250).

Lastly, the benefits of the local communities include half of the area fees (according to regulatory provisions), the salaries paid by the safari company, and meat value. Legally, the harvested meat is the client's property. In practice, however, it is distributed to the camp staff or to the neighbouring villagers. The average value of meat is computed as the product of meat unit price (US$0.5 kg^{-1}) and the mass of the dressed carcass ($0.45m_s$ kg). This computation will further be elaborated upon shortly.

2.2. The model

2.2.1. Model formulation and assumptions

The objective function of the current model is to maximise the net revenue, NR, using the minimum quotas $\tilde{q}_s$ ($1 \le s \le 16$) set in the period 1996–2000. This net revenue is then projected to infinity (using a time exogenous model). From its present value the initial investment costs, I, are deducted in order to (i) evaluate the net present value, NPV, at specified interest rate, r, and time horizon, T_0; (ii) identify the payback time, $T \le T_0$; and (iii) scrutinise the distribution of benefits among the stakeholders.

Turning now to the optimisation of the net revenue, we setup three side conditions. Firstly, let there be x_b sold units for bag b, the number of individuals n_s sold for species s, that is, $n_s = \sum_{b=1}^{B} a_{sb} x_b$, is at most equal to the minimum quota, that is, $\tilde{q}_s$. Secondly, the overall number of safari-days in a year may neither exceed the total number of days supported by the aggregate quotas (i.e., $\sum_s d_s \tilde{\boldsymbol{q}}_s$) nor 480 days, or which either is smallest. The maximum of 480 days assumes that during the 6-month hunting season (December–May), the professional hunter and his assistant will carry out 20 safari-days a month, escorting each two clients (the so-called 2×1 option in the safari jargon). Thirdly, the safari company may be obligated to pay in advance a proportion α ($0 < \alpha \le 1$) of the total trophy value expected from the allocated quotas. This advance payment could serve as a guaranteed minimum income to the local community, whether or not safaris are conducted. To formalise the last constraint, notice that the total trophy value of the aggregate quotas is $\sum_s t_s \tilde{\boldsymbol{q}}_s$ as against $\sum_s t_s n_s$ for the sold bags. These quantities are nothing but linear combinations of binomial variables with probability of success θ_s. Their respective expected values are $\sum_s t_s \tilde{\boldsymbol{q}}_s \theta_s$ and $\sum_s t_s n_s \theta_s$, the latter term being equal to $\sum_s \sum_b t_s a_{sb} x_b \theta_s$.

Next, denoting staff salaries and recurrent costs by SOC, the net revenue (i.e., cash flow) is computed as $NR = \sum_{b=1}^{B} (p_b - c_b) x_b^* - SOC$, where x_b^* is the optimal linear programming solution. Projecting the net revenue to infinity, calculating the present value and subtracting the initial investment provides the net present value $NPV_{r,\infty} = -I + NR \sum_{t=1}^{\infty} (1+r)^{-t}$, wherein I is the initial investment and r is the interest rate of an investment in commercial hunting.

The optimisation problem can be stated formally as follows:

$$\max \sum_{b=1}^{B} (p_b - c_b) x_b$$

s.t.

1. $\sum_{b=1}^{B} a_{sb} x_b \le \tilde{\boldsymbol{q}}_s$, for all s;
2. $\sum_{b=1}^{B} d_b x_b \le \min\left(\sum_s d_s \tilde{\boldsymbol{q}}_s, 480\right)$;
3. $\sum_s \sum_{b=1}^{B} t_s a_{sb} x_b \theta_s \ge \alpha \cdot \sum_s t_s \tilde{\boldsymbol{q}}_s \theta_s$, for some α $(0 < \alpha \le 1)$.

From the investor's viewpoint, the payback time, say T, is the solution (if it exists) to the equation $NPV_{r,T} = 0$.

At this point, a number of points bear mention. Firstly, the optimisation problem is defined with respect to the safari company because it links the resource to the market. Secondly, the minimax approach (i.e., the use of minimum quotas to maximise profits) errs on the safe side with respect to a possible risk of resource mining. Thirdly, a time exogenous model is easily tractable as well as the logical choice for the adopted minimax approach. It also avoids setting an arbitrary time horizon for the harvesting of long-lived species.

Lastly, the expected values of meat are computed as their trophy counterparts above, except that t_s is replaced throughout by $05*0.45*m_s$. This quantity is simply the product of meat unit price (US$0.5 kg^{-1}) and the mass of the dressed carcass (in kg).

The simulation model assumes the following:

(i) the current contractual conditions prevail but otherwise the operating setup is improved with respect to organisation, infrastructure, security of investment (better legislation and less corruption) and individuals (reduced criminality);
(ii) the quotas are allocated according to a sustainable procedure;
(iii) the initial investment is raised by a private individual (other than the professional hunter) or a corporate body (excluding the state and the local community);
(iv) the real rate of interest remains constant at 10% over the time horizon which is also the write-off period;
(v) only big and plains game safaris are sold;
(vi) once a bag has been sold, its composition may not be modified on the field.

2.2.2. Model implementation and evaluation

The optimisation problem was solved by means of integer linear programming, using the simplex algorithm and the branch and bound method (see, e.g., Winston, 1994). The actual implementation used the software XPRESS-MP (Dash Associates, 1999). A sensitivity analysis was performed by shifting to alternative scales of daily prices and costs, namely (1400, 1800 1400, 1400, 1200) and (430, 490, 430, 430, 400), respectively. Finally, the model was evaluated by computing the discounted benefits accruing to the stakeholders, at a given time horizon ($T_0 \geq T$) and under three different scenarios. The scenarios represent different incentive structures through varying taxation schemes and apportionment of trophy fees and company's profits. Throughout, the income of the professional hunter and that of his assistant are taxed at a rate of 20%. By contrast, the net present value $NPV_{0.10,T_0}$ (or part of it depending on the scenario) is subjected to a 35% business tax rate. We now describe the scenarios, their underlying political economy, and potential obstacles to their implementation.

(i) Scenario 1: keep the current incentive structure. This scenario reflects the actual setting as described earlier, except for an increased concession term to T_0 ($\geq$5 years) and an alignment of the local safari industry with the international business standards (e.g., initial investment, service quality, and marketing strategies).

An extension of the concession period is a long standing request by safari outfitters, although in virtually all cases, tacit renewal has meant a tenure of several decades. Therefore, incertitude over tenure cannot alone account for low investment and poor quality service. Other constraints include lack of professionalism, opaque lease procedures, shortage of infrastructures (communications, transport, and health), insecurity over investment (corruption) and people (criminality). Surely the state could formally extend the lease period conditional on competitive business standards. However, to be effective an overhaul of the safari industry also requires a concomitant alleviation of the constraints listed above.

(ii) Scenario 2: same as in scenario 1, but the local community is paid a proportion α ($0<\alpha\leq 1$) of the expected total trophy fees, as a guaranteed minimum income.

In the past, some concessionaires have not conducted safaris for several years running. Such an option deprives the state and local communities of their entitlements, in particular through a disrupted stream of statutory (or customary) revenues and benefits. Thus, as part of a poverty reduction policy, a safari company that opts not to harvest wildlife should nevertheless pay a minimum percentage of all trophy fees to the local communities. This mandatory payment may cause a disincentive effect among concessionaires who already bear several recurrent fees and taxes. On the other hand, local communities may lack the bargaining power to reclaim their dues from fraudulent companies. The state could continue to collect this payment on behalf of the communities, until proper enforcement mechanisms are worked out as part of the co-management institutionalisation.

(iii) Scenario 3: same as in scenario 2, but the state cancels all its levies on the safari company (except for business tax) and allocates the land property right to the local community. This land property right is converted into capital shares of the company thus entitling the local community to a tax-free portion β

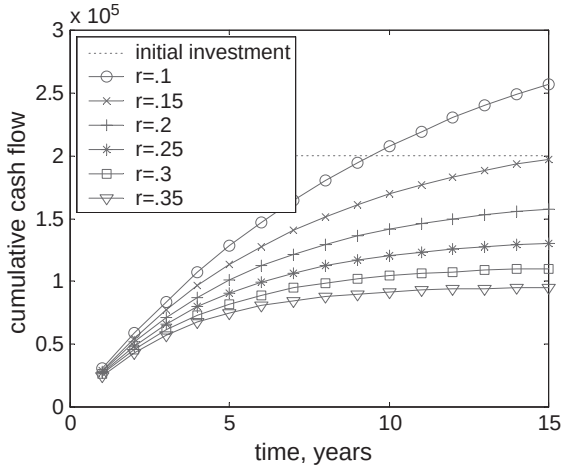

Fig. 1. Plots of the cumulative cash flow (US$) against time (years) under scenarios 1 and 2, using different values of interest rates.

($0<\beta\leq 1$) of the company's profit. This study assumes $\beta=0.08$.

The rampant poaching reflects the increasing difficulty of African states to meet the costs of law enforcement. A great share of theses costs are transferred to the tenant of hunting areas who, in compensation, could be relieved of all levies except for the business taxes. This simplified procedure will reduce the transaction costs of collecting (or paying) numerous levies due at several periods of the fiscal year. The current conservation paradigm is to secure the support of the local population through an attractive incentive, monetary and otherwise. The transfer of land entitlements would seem a reasonable quid pro quo, particularly where customary rights can be clearly identified and assigned. The concern over the bargaining capacities of local communities alluded to under scenario 2 comes into an ever sharper focus under this more elaborated scheme.

3. Results

No optimal solution was possible if more than 25% of the total expected trophy value was required in advance. Setting thus $\alpha=0.25$, the returned solution revealed that only big game safaris could be sold including lion (one), eland (two), elephant (one), and roan antelope (two). This outcome amounts to 92 safari-days. The LP solution did not changed when the alternative scales of daily price and cost were adopted.

The percentage of sold quotas would be as follows: 100.0 (lion, elephant, and hippopotamus), 75.0 (waterbuck, bushbuck, and reedbuck), 66.7 (eland), 60.0 (kob), 50.0 (roan antelope and warthog), and 0.0 (for all small game).

The plots of the cumulative cash flows against time are shown in Fig. 1 (scenarios 1 and 2) and in Fig. 2 (scenario 3), for different values of interest rates. Under scenarios 1 and 2, the initial investment would be recovered in 10 and 16 years, at 10% and 15% rates of interest, respectively. At higher rates, the investor can hardly expect to break even any time in future. However, assuming a concession term of 15 years, the maximum initial investment should be set at US$198,000 ($r$=0.15), and US$158,000 (r=0.20).

By contrast, scenario 3 allows the invested capital to be recovered after 15 years at 20% interest rate. Further, with lower rates of interest, the payback time is shorter than under scenarios 1 and 2, giving 7 and 9 years, respectively, at 10% and 15% interest rates.

Setting the time horizon at 15 years and the opportunity cost of capital at 10%, the net present value would increase by 127% from US$56,900 (scenarios 1 and 2) to US$129,100 (scenario 3). Finally, the internal rate of return is 20% under scenario 3 compared to 14% in the other two cases.

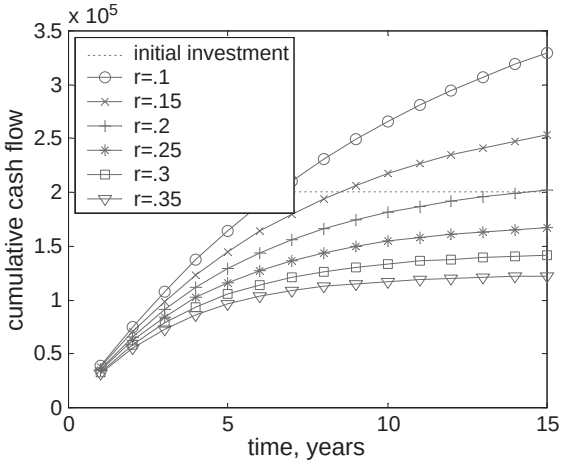

Fig. 2. Plots of the cumulative cash flow (US$) against time (years) under scenario 3, using different values of interest rates.

Table 4 reports the stakeholders' income size and structure under the compared scenarios. In term of aggregate amount, the state always ranks first and the investor last. However, the income distribution is less skewed under scenario 3 (US$77,210–217,410) than in scenario 1 (US$36,960–268,670) and scenario 2 (US$36,960–250,500). But the income structure of each stakeholder changes quite differently with the compared scenarios.

To begin with, the rate of return to the investor increases from 18.5% (scenarios 1 and 2) to 38.6% (scenario 3). Next, wages total US$140,560 and make up the bulk of the community's income under all scenarios. By comparison, the community shares of trophy fees and business profit amount to US$28,500 (scenario 3), which is larger than US$22,820 obtained from land royalty alone. But either amount is less than US$40,990 that would result from combining the community shares of land royalty and trophy fees (scenario 2). Lastly, most of the state income is comprised of US$98,800 of income tax collected under all scenarios.

Another noteworthy point is that while the amount of business tax may be double under scenario 3 (US$41,580), it only represents about half of the total levies borne by the safari company under either scenario 1 or 2 (US$74,660). As a result, the sum of all net benefits for all three stakeholders is slightly lower in scenario 3 compared to scenarios 1 and 2.

Table 4
Distribution of harvest income among the investor, the local community, and the state using a time horizon of 15 years and a 10% discount rate

Stakeholder	Income item	Income, US$		
		Scenario 1	Scenario 2	Scenario 3[a]
Investor	net return to investment	**36,960**	**36,960**	**77,210**
Local community		**170,240**	**188,410**	**175,920**
	total amount of wages[b]	140,560	140,560	140,560
	share of land royalty	22,820	22,820	0
	expected value of meat	6860	6860	6860
	share of trophy fees	0	18,170	18,170
	share of company's profit	0	00	10,330
State		**268,670**	**250,500**	**217,410**
	fees paid by safari company	54,760	54,760	0
	fees paid by tourist hunters	46,500	46,500	46,500
	expected trophy fees	48,630	30,460	30,460
	income tax	98,880	98,880	98,880
	business tax	19,900	19,900	41,580

The aggregate income of each stakeholder (in bold) is broken down into its contributing components.

[a] Assuming that the local community is apportioned 8% of the company's net profit.

[b] This amount does not include the labour related to the capital outlay.

4. Discussion

4.1. Resource allocation

The LP solution revealed that only the selling of big game safaris can be financed by a safari company. These hunt types made up 87% of the 209 licenses issued in 1999, as against 5% and 8% for plains and small game safaris, respectively (MINEF, 2000). Based on the defined bags, none of the quotas would be sold for small, prolific species compared to 100% for some large, slowly reproducing species (e.g., elephant and hippopotamus). Besides Bongo *Tragelaphus euryceros* in (Southern Cameroon) rainforest, eland and roan antelope are the two flag species of the safari industry in (Northern) Cameroon (Hurt and Ravn, 2000). However, the mathematical model revealed that the percentage quota sales for the latter two species were only 66.7% and 50%, respectively. Although mathematically optimal such an outcome would seem less satisfactory financially, especially so for the roan antelope. Indeed, due to a persistent decline of its population in Southern Africa (Harrington et al., 1999), the roan antelope is currently hunted almost exclusively in Northern Cameroon where it occurs at densities as high as 5 individuals per km^2 (Mayaka, unpublished data).

This paradoxical result points to the constrained supply of safaris which in turn derives from at least three factors. Firstly, the number of trophy species is smaller compared, for example, to Tanzania where it is almost fourfold larger. Secondly, the current bag limits make an extensive use of medium-size species in packaging big and plains game safaris. Thirdly, due to widespread poaching in the study area (Depierre and Olé, 1976; Brugière, 1995), quotas are set low. In

effect, the number of animals found killed illegally represents as mush as 70% of the total official quotas (Per Aarhaug, personal communication). This form of allocation dissipates the resource as it concerns meat rather than the high-valued trophy. For instance in Tanzania (in Maswa Makau, to be specific) wildlife poaching accounts for 80% of the total off-take (Hurt and Ravn, 2000), but contributes only 47% of wildlife revenues at national level (Leader-Williams, 2000). These market failures need to be addressed through a reallocation of property rights, as will be discussed shortly. More importantly, it is necessary to keep poaching in check so as to sustain larger wildlife stocks and hence higher quotas.

The marketing of eland and roan antelope safaris could be improved by allowing these hunt types to make use of small game. Alternatively, safaris could be tailored to include eland and roan antelope in (Northern Cameroon) woodland savannas and Bongo in (Southern Cameroon) rainforest. At the other extreme, an increase in the percentage quota use of low-valued species could be achieved by supplying bags of small game. Further in most traditional societies, hunting fulfils a cultural function (coronation ceremonies, traditional healing, and rites of passage). It can therefore be argued that some hunting quotas be allocated to local communities. This normative goal, however, would have to be identified at a political level. Suffice it to say that this allocation of hunting rights could be restricted in space (non-leased concessions), time (out of the tourism period), and/or to less prestigious species (to preserve the exclusivity sought by safari clients).

Turning now to the allocation of economic resources, we note that the proposed capital outlay of US$200,000 would be reasonable only if the concession term is at least 10 years and the interest rate does not exceed 10% (scenarios 1 and 2) or 15% (scenario 3). Otherwise, in the face of considerable risks as reflected by short-term concessions (e.g., 5 years as is presently the case) and/or high interest rates (20% or more), the maximum investment should be kept under US$100,000 (scenarios 1 and 2) or US$130,000 (scenario 3).

Even granted a longer concession ($\geq$15 years) and a low interest rate ($\leq$10%), the excessive state levies are liable to hamper the profitability of the safari companies. In effect, wildlife use is often burdened by market distortions–including (indirect) resource taxation–which hinder its competitiveness with other forms of land use such as farming and livestock production (Child, 2000). Thus the substitution of a single business tax to the numerous fees and taxes aims at correcting this market distortion so as to put wildlife use and agro-pastoral production on equal footing. Further, a removal of the extraneous fees would enable safari companies to use these monies for either paying back bank loans or improving service quality.

4.2. Distribution of social benefits of wildlife harvesting

Of the three stakeholders, the state reaps the lion's share of wildlife benefits. On its part, the local community derives its income mostly from wages. But as with the meat, this benefit accrues to a small number of individuals. Therefore, to many villagers poaching remains the only way to benefit from wildlife. Indeed, this is a form of income redistribution from one group of agents (the state and safari companies) to another group (villagers). However, for both groups a net income loss occurs due to either an emphasis on meat rather than trophy (subsistence hunting) or illegal harvest by outsiders (commercial poaching).

In an attempt to induce local support for conservation areas, the government decided to apportion land royalties to the neighbouring communities. This policy is, however, marred by several deficiencies. Chief among these is a loose linkage of the proposed incentive and the target resource (see further Mayaka, 2002).

In this work, we expound an improved incentive structure based on a triple principle. The first principle requires that the incentive link closely with the target resource (i.e., wildlife stock). It should also provide the beneficiary (in casu the local community) with a reward that is commensurate with its stewardship efforts of the resource. The second principle is economic sustainability which means "avoiding major disruptions and collapses, hedging against instabilities and discontinuities" (Costanza and Patten, 1995, p. 194). The third and last principle recommends the retrocession of land property right to the local community. This request is minimal compared to the

"ownership" right of wildlife advocated by some (Child and Chitsike, 2000). Nevertheless, it would suffice to bestow on the community a status of shareholder to safari companies (after appropriate negotiations) and hence to a share of the business profit.

It follows from principles 1 and 3 that a better incentive structure would apportions a share of trophy fee (scenario 2) and/or a share of the profit made by the safari company (scenario 3). Bringing principle 2 to bear, the safari company should pay in advance the community share of trophy fees, exactly 25% of the expected total value according to our optimisation model.

As seen in this study, the shareholding option may very well earn the community a smaller income compared to other incentive structures. The proposed blueprint remains attractive, however, if only for its underlying principles, the substitution of a single business tax to the current myriad of levies, and a less-skewed income distribution among the stakeholders. With each successive scenario, the share of the state kept reducing in favour of local communities. This option may not readily appeal to politicians as they stand to loose money, income, and power. Nevertheless, a reduction of the costs entailed in monitoring and enforcing protection would be a good economic incentive for such a concession. Further, the increase in the community revenues compensates for the sharing of monitoring and protection duties under the co-management convention (Mayaka, 2002).

Both game viewing and safari hunting provide local communities with revenues from direct use fees, job creation, and an extended market for local produce and handicraft (Kiss, 1990, Child, 2000, Hurt and Ravn, 2000). Further, assuming a careful management, both use forms can be combined to maximise the economic value of wildlife. The small number of sport hunters is more than compensated for by the large safari fees, up to tenfold those of game viewing. Indeed, safari hunting is the most lucrative use of wildlife stocks, except perhaps in a few areas that can support intensive or expensive tourism (Child, 1990; Lewis and Alpert, 1997). There are other comparative advantages of sport hunting over game viewing. Firstly, unlike game viewing sport hunting is possible in remote areas with low animal densities. Secondly, meat is highly valuable in meeting the protein requirements of rural populations and, together with skins, its processing may provide further opportunities for local development. Thirdly, contrary to most national parks, hunting areas can be held communally or privately. Either tenure system is compatible with wildlife proprietorship, whereby use and access rights may be limited to either the subsistence hunting of some species or the commercial harvesting based on state quotas.

The community share of safari revenues is contingent on wildlife abundance, market value of species, and constituency size. Thus, the importance of non-financial incentives (e.g., local democracy, pride, and sense of ownership) is now increasingly recognised (Roe et al., 2000). The proceeds of safari hunting usually help to fund development projects such as schools, clinics, water wells, and grinding mills (Gibson and Marks, 1995; Lewis and Alpert, 1997). These projects aim at enticing local populations away from poaching. However, such investments do not benefit all community members equally, also their public nature tend to encourage free-riding and immigration. To remedy such defects a number of institutional mechanisms could be envisaged through an effective authority system. The latter would have to, amongst others, (i) limit the number of right holders, (ii) determine their nature (i.e., individuals or households), (iii) allocate incentives according to a democratic process and the opportunity costs borne by community members (further see Norton-Griffiths, 1995; Child and Chitsike, 2000). Now let us turn to the benefits derived by safari companies. It emerged that extending the hunting concession from 5 to 15 years generates large economic incentives for private sector investment. Indeed, an extended tenure has at least three advantages as discussed by Child (1990). To begin with, this policy reduces the overhead costs of establishing a camp. Next, as the professional hunter becomes familiar with his area, reduced costs and improved hunting are likely to result. Finally, an extended tenure helps reduce marketing uncertainties, as hunts can be booked several years in advance. There are some drawbacks, however, such as getting stuck with an unsatisfactory operator for a considerable length of period. In this case, the co-management convention should provide the other two stakeholders with the right for an early termination of the lease contract. Another inconvenience is a

reduced flexibility and ability in capturing new opportunities, should the industry exhibit a fast development.

We have suggested a minimum investment of US$312,000 (scenario 3) to US$322,000 (scenarios 1 and 2) in aligning the local safari industry with the international standard. These amounts compare well with US$350,000 in Tanzania, where a profit margin of 20–25% is deemed satisfactory (Hurt and Ravn, 2000). In this study, the rate of return to investment ranged between 18.5% (scenarios 1 and 2) and 38.6% (scenario 3). The latter figure is quite reasonable considering the risks entailed (inadequate legislation, short-term concession, rampant corruption).

Throughout, we pointed a number of constraints to the safari business and co-management arrangement. These are now briefly reviewed together with some suggestions for improvement. To begin with, the overall business climate needs an amelioration of infrastructures (communications, transport, health, and lodging), in addition to a reduction of corruption and criminality. The safari industry should be regulated more stringently with respect to a formal training in lodge and wildlife management. Further the allocation of hunting concessions should be made transparent and competitive. Together with an extension of the lease term, the above conditions should stimulate an increase in investment level and service quality Next, the development of co-management institutions is lengthy, arduous, conflict prone, and costly thus raising concern over the organisation capacities of local communities. These aspects have been recently the subject of an extensive research (Pearse, 1988; Ostrom, 1990; Pinkerton, 1992; Wainwright and Werhmeyer, 1998; Fabricius et al., 1999; Leach et al., 1999; Songorwa, 1999; Adams and Hulme, 2001; Mayaka, 2002). Accordingly, we shall limit ourselves to a few guidelines.

Firstly, while the institutionalisation and implementation of co-management is messy, it cannot be side-stepped or fast-tracked without risking a disaster that would culminate in the extermination of the African wildlife. In the absence of a theory, researchers in cultural ecology still rely on empirical studies to predict inductively the most favourable conditions to the development of an effective co-management arrangement (Pinkerton, 1992). Secondly, though absent in our results, transaction costs nevertheless play a key role in institutional change. However, since we deal with high-valued resources, these costs would be relatively easier to meet, in the light of reported experience (Pearse, 1988; Adams and Hulme, 2001). Further, to some authors the role of organisations is precisely to minimise transaction costs (Harriss et al., 1995). In this respect, we posit that a successful co-management would in the long run reduce the transaction costs of law enforcement (arresting, prosecuting, jailing, and feeding the imprisoned poachers). Similarly, the costs borne by local populations in claiming their environmental entitlements, including by subversive actions, can also be expected to decline. Thirdly, co-management is a triadic convention between the civil society—including local communities and non-governmental organisations (NGOs), the private sector, and the state. Within this framework, the capabilities of the local communities can be enhanced by NGOs (Mayaka, 2002), but also the other two stakeholders (Leach et al., 1999) for the common purpose of conserving wildlife.

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