Factors influencing people's perceptions towards conservation of transboundary wildlife resources. The case of the Great-Limpopo Trans-frontier Conservation Area

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Abstract

Local people's perceptions of protected areas greatly determine the success of conservation efforts in Southern Africa as these perceptions affect people's attitudes and behaviour in respect to conservation. As a result, the involvement of local communities in transboundary wildlife conservation is now viewed as an integral part of regional development initiatives. Building on unique survey data and applying regression analysis, this paper investigates the determinants of local communities' perception towards wildlife conservation and the Great Limpopo Trans-frontier Conservation Area in Zimbabwe and South Africa. Our results show that the perception that management of the park is good positively affect the perception of benefits from the park, rules governing the park, and how people perceive wildlife in general. Perceptions of park management negatively affects people's perceptions of environmental crime, while household expertise positively affects the perceptions of environmental crime. Our results show that if people perceive the rules of the park in a negative way, then they are less likely to conserve wildlife and at the same time this will increase the likelihood of environmental crime. Receiving benefits from

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the park seem to have a positive effect on people's perception of the rules governing the park and wildlife, but not on perceptions about environmental crime. Surprisingly, perceived high levels of corruption positively affects people's perception of wildlife benefits and environmental crime. There is lack of evidence of the role of socioeconomic variables on people's perceptions towards wildlife. However, our data seems to support the idea that unobservable contextual factors could be responsible for explaining part of the variation in people's perceptions. Our results speak to the literature on large-scale collective action since people's perception of wildlife benefits, corruption, environmental crime, park management, and rules governing the parks affect their ability and willingness to self organize. These variables are interesting because they can be influenced by policy through training and awareness campaigns.

1 Introduction

The study of people's perceptions towards conservation of natural resources such as wildlife, forests and water resources is a popular vehicle for understanding the complex relationship between human beings and nature in the context of social-ecological systems (SES) (Allendorf et al. 2012; Allendorf 2007; Holmes 2003; Infield and Namara 2001). We define perception as the ability to see, hear or become aware of something through senses (Fischer and van der Wal 2007; Mansfeld and Ginosa 1994) and an attitude as a settled way of thinking or feeling about something (Ashok et al. 2017). Huong and Lee (2017) define a perception as the way in which something is regarded, understood or interpreted. Sociologists theorise that people start with perceptions and these perceptions translate into attitudes or behaviour over time (Beedell and Rehman 2000; Fisbien and Ajzen 1985). Therefore, understanding the determinants of people's perceptions can make us understand their attitudes and behaviour towards conservation.

To a greater extent, the success of Integrated Conservation and Development Projects (ICDPs) in many third world countries depends on the perception and attitudes of local people living adjacent to protected areas. The main aim of these ICDPs is to balance conservation and development goals in rural areas characterised by conflict between people and wildlife (Ntuli and Muchapondwa 2017). It is believed that local communities will protect wildlife if the benefits from conservation are greater than the costs of living with it, i.e., the design of the conservation scheme is incentive compatible. The creation of many Transfrontier Conservation Areas (TFCAs) involving several countries has increased both conflict and participation of local communities in conservation projects as the ancestral land on which they reside becomes corridors facilitating the movement of wildlife between parks.

This study uses purposefully collected primary data and instrumental variables estimation with heteroscedasticity-based instruments[1] to examine factors

[1] We employed instrumental variables estimation with heteroscedasticity-based instruments because of endogeneity issues. The endogeneity problem and this technique are discussed in more detail in the methodology section.

influencing local people's perception towards wildlife conservation in adjacent communities sharing a transboundary resource in South Africa and Zimbabwe. More specifically, the local people included in the study reside in communities located within the Great Limpopo Trans-frontier Conservation Area (GLTFCA). Viewed as an emerging way for managing transboundary resources, the GLTFCA is an interesting case study. In the TFCA, wildlife, such as elephants are roaming freely across the national borders. Thus, the wildlife resourse is shared by different local communities in all the three member countries, South Africa, Zimbabwe and Mozambique (however the latter not included in this study)[2] and these communities benefit from wildlife conservation in various ways. As a result, if a fugitive species is threatened in one country, say through poaching, then all communities are affected since we are in fact dealing with a common pool resource (CPR) (Ostrom 1990).

The main contribution of this paper is the comparison of perceptions about wildlife and wildlife management among indigenous communities in different countries. Up to date, there are few studies that compare such perceptions among local people across countries. This is mainly due to data limitation. As a result, the literature is populated with single or localized case studies of a national park done in a single country. In contrast, this paper contributes to the study of complex SESs and the behavioural underpinnings of the link between human beings and nature in the context of a TFCA shared by several developing countries. Moreover, since perceptions is argued to shape people's behaviour, instead of looking at collective action at community level, this study looks at large-scale collective action for managing transboundary resources between countries.

Understanding the determinants of people's perceptions also becomes imperative from a policy perspective because it provides information about the behaviour of resource users to both policymakers and development practitioners, who in turn will be able to interrogate their wildlife management and conservation strategies. This will also allow the managers of the TFCA to harmonize their policies and strategies in order to cater for these seemingly identical local communities, yet diverse in many different attributes. Furthermore, it is essential to seek the participation of local communities in conservation and to provide appropriate incentives in order to protect fugitive resources such as wildlife.

With this background, we ask the following questions:

1. Is there a significant difference in perceptions towards wildlife management and conservation of local people between communities in South Africa and Zimbabwe?

2. What are the factors driving the observed variation in perceptions of local communities in these two countries?

[2] Local communities around the Limpopo National Park (LNP) in Mozambique are also part of the GLTFCA and we are planning to collect data in these communities in the near future.

The potential differences in people's perceptions are important to detect because it could be the source of observed variations in conservation outcomes. We expect this variability to exist because of different experiences and contexts.

The remaining of the paper is divided into six sections as follows. Section 2 provides a review of literature and theoretical framework of this study. The research methods in section 3 presents information about the study site, nature of the data collected, sampling techniques and the empirical model specifications. Section 4 presents the results, while section 5 provides a discussion of these results. Finally, section 6 concludes.

2 Literature review

There is a tremendous amount of literature that seeks to enhance our understanding of the SES by focusing on the link between people and nature (Thondhlana and Muchapondwa 2014; Lindahl et al. 2012; Ntuli and Muchapondwa 2018; Ostrom 2007;; Shackleton and Shackleton 2006; Agrawal 2001). As many natural resources often share two common attributes: jointness of supply and difficulties in excluding outsiders, the management of natural resources often produce so called collective action dilemmas (Becker & Ostrom 1995). This means that, even though the rational behaviour would be to act in the interest of the collective, when resource users cannot be excluded from enjoying the benefits provided by others, resource users instead tend to freeride on the efforts of others (Ostrom 1990). Subsequently, this can have immense consequences for the environment as the expectations that others will overexploit the resource create incentives for every resource user to overexploit the resource (Ostrom 1998). Nevertheless, recent decades of research indicate that many resources actually can be governed sustainably through self-governing institutions of trust, reputation and norms of reciprocity (Ostrom et al. 1994; Baland and Platteau 1996; Gibson et al. 2005).

Several strands of the literature come from the field of behavioural economics and these studies use both lab and framed field experiments to examine the link between human behaviour and the ecological system. These include studies on the role of trust (Johnson and Mislin 2011; Cox 2004), monetary and non-monetary punishment (Masclet et al. 2003) and social ostracism (Akpalu and Martinsson 2011) in stabilizing large scale collective action in natural resource management. There is also an increase in experimental studies focusing on behavioural responses to latent endogenously driven regime shifts in ecosystems (Ntuli et al. 2018; Lindahl et al. 2017; Schill et al. 2015; Crépin et al. 2012). Resource economists are worried about endogenously driven regime shifts because these can be avoided when people coordinate their actions as opposed to exogenously driven regime shifts that are caused by nature (Crépin et al. 2012).

Human behaviour has also been at the centre of empirical studies that focus on the role of institutions on cooperation and conservation of natural resources such as forests (Agrawal 2009; Agarwal and Chhatre 2006), wildlife (Ntuli and Muchapondwa 2018; Frost and Bond 2008; Murphree 2004), rangelands (Woods

and Ruyle 2015) and water (Maganga 2002; Pollard and du Toit 2011). These studies link institutions to conservation through collective action and its role in curbing illegal harvesting of natural resources (Ntuli and Muchapondwa 2018), since institutions are devises meant to constrain human behaviour (North 1986). Regionally, poaching is a major challenge in the management of common pool resources (CPR) such as wildlife because of poor local institutions. Environmental crime[3] in developing countries is caused by many factors ranging from poverty to selfishness. Critics of conservation projects attribute failure or limited success of these initiatives to the design of most ICDPs that is not incentive compatible (Ntuli and Muchapondwa 2017). Other scholars attribute failure of ICDPs to lack of capacity to self-organize by communities managing a CPR and hence they recommend the use of coercive force by the state (Romero et al. 2012; Adams and Hutton 2007). Recent evidence reveals that some communities, particularly in Asia, were able to develop robust CPR institutions in order to manage their resources (Ostrom 2007).

There is also a huge chunk of literature focusing on the role of people's perceptions and attitudes towards natural resource management and conservation in the context of the developing world (Ciocăneaa et al. 2016; Bennett and Dearden 2014; Ebua et al. 2011; Lia et al. 2010; Newmark 1993). Both perceptions and attitudes form the basis of people's behaviour that in turn will affect the possibility of collective action (Karanth 2008). Perceptions and attitudes are in turn shaped by people's experiences with CPRs, i.e., ownership of the resource, fairness in terms of institutions governing resource access, whether households receive benefits from the resource, or whether they suffer loss through interaction with the resource. People gather information about their environment and form perceptions about the environment, which in turn affect their attitudes and finally their behaviour (Ingold 2000). People's perceptions and attitudes towards conservation of CPRs are also influenced by socioeconomic characteristics such as age, gender, level of education, training related to natural resource management, and the type of resource in question (Mutanga 2017; Levitt 2013; Ebua et al. 2011; Lia et al. 2010; Allendorf 2007; Mansfeld and Ginosar, 1994; Newmark 1993).

This paper takes existing accounts of people's perceptions towards wildlife onservation as a starting point and sets out to investigate their determinants empirically. People's perceptions towards wildlife conservation can be classified into several themes and measured by asking questions pertaining to i) their perceptions of the rules governing the park, wildlife, benefits and environmental crime. While most studies have been conducted at the local level, studying a small number of resource users (see Agrawal 2002), the empirical investigation conducted here focuses on a large-scale social-ecological system i.e., a transfrontier conservation area. As such, since perceptions are argued to translate into attitudes and in the long run shape people's behaviour, we contribute both empirically and theoretically to the research field by studying the foundations

[3] Environmental crime include all human activities that are classified as illegal, e.g, poaching, harvesting firewood in protected areas, gold panning.

for collective action in a large-scale setting.

Together, local people's perceptions affect the possibility of collective action (Kelly 2001) which is essential for the management and exploitation of CPRs in a sustainable manner. While transboundary conservation of natural resources and wildlife have the potential of increasing conservation effectiveness, these conservation arrangements could also face challenges in terms of reaching collective action, because of their increased scale and complexity (see Death 2016; Petursson et al. 2011). Comprehending fugitive resources such as wildlife straddling across borders, the possibility of large-scale collective action is for example complicated by different institutions and settings in different countries, such as differences in legislation, sanctions and administrative capacity. These different contexts potentially affect the perceptions and attitudes of local people in respect to a resource. As the interaction between wildlife and local communities around GLTFCA yields different experiences, this in turn affects perceptions and attitudes. For instance, CAMPFIRE communities in Zimbabwe lose livestock and suffer crop damages from wildlife intrusion on a regular basis, yet the benefits from conservation are negligible. In Mozambique, there are no institutional arrangements to facilitate the flow of benefits from wildlife conservation to local communities and as a result some communities may resort to poaching (Whande and Suich 2009). The South African case is unique since the Makuleke community generate revenue from land owned inside the Kruger National Park, which is managed by a safari operator on their behalf (Reid, H. 2017). These different contexts potentially affect and shape perceptions and attitudes towards conservation of local communities in the three different countries.

2.1 Conceptual framework

The conceptual framework used in this paper borrows from the theory and literature linking human behaviour and the environment (Levitt 2013; Sawitria et al. 2015; Ostrom 2007; Homburg and Stolberg 2006; Kollmuss and Agyeman 2002). Based on this strand of literature, we argue that people form perceptions about wildlife based on their experiences (e.g., present management regime and benefits in the past) and this in turn affects their attitudes towards conservation, which affects behaviour and final conservation outcomes. Interventions such as training and benefit sharing can influence the way people think about wildlife, which in turn affects conservation and welfare in the latter case. The role of information provisioning on community wildlife conservation should not be underestimated as this has potential to transform the way people think about a resource (Ntuli and Muchapondwa 2017). The argument that we make in this paper is that if we understand the determinants of people's perceptions in different contextual settings, then we will be able to develop sound CPR institutions that will change people's attitudes and thereby incentivising them to behave in a way that is consistent with sustainable development or show good environmental citizenry.

Though recognising the relevance of the full framework, we limit our focus to only inverstigate how the perceptions about the park management including

its ecology and benefits (i.e., policy variables), and individual characteristics influence people's perceptions towards wildlife conservation and the GLTFCA.

3 Research Methods

3.1 Study area

As already implied, in this study we focus on the Great Limpopo Trans-frontier Conservation Area (GLTFCA). Formally established in 2000, when a common treaty was signed, this is a collaboration between the governments of South Africa, Zimbabwe and Mozambique (Spenceley 2006). A new treaty was approved in 2002 recognizing the 'core protected areas' of the region and thereby establishing the Great Limpopo *Transfrontier Park (TP).* Today, the park stretches over an area of about 35.000 square kilometres including three national parks: the Kruger National Park in South Africa, the Limpopo National Park in Mozambique and the Gonarezhou National Park in Zimbabwe (SANParks 2018). The future plan is however for the trans-frontier park to become a trans-frontier conservation area, expanding into surrounding areas covering almost 100.000 square kilometres; thereby becoming one of the world's largest TFCAs.

The overall goal with GLTFCA is to foster transnational collaboration and increase the effectiveness of ecosystem management. Ideally, it was supposed to provide mobility of both people and wildlife within the TFCA. Aside from that, another important purpose is for the local communities ro receive economic benefits through increased eco-tourism in the region. The park further holds its own organizational structure with a Trilateral Ministerial Committee, a joint management board as well as management committees (SANParks 2018).

Figure 2 shows the map of the GLTFCA, where the national parks are shown in dark green and surrounding areas identified for future expansion in light green. The park is located between $22^0$22'S and $31^0$22'E, with arid conditions thus less suitable for rain fed agriculture (Gandiwa 2017; Ntuli and Muchapondwa 2017). The mode of production is predominantly subsistence in nature combining livestock and crop cultivation. Furthermore, the study area is dominated by Shangani speaking people (approx. 95%) although other languages such as Shona, Ndau and Ndebele in Zimbabwe and Venda and Zulu in South Africa are also spoken.

On the Zimbabwean side, local communities are organized into Communal Areas Management Programme for Indigenous Resources (CAMPFIRE) projects, which are dotted around the Gonarezhou National Park, while in South Africa the Makuleke community own land inside the Kruger National Park, but hires a safari operator to manage wildlife on the community's behalf. CAMPFIRE communities do not own land but manage wildlife traversing the buffer zone through their respective Rural District Councils (RDCs). The proceeds from wildlife conservation are in turn shared between the RDC (47%) and the CAMPFIRE communities (50%), while the remaining balance goes to the

CAMPFIRE association.

3.2 Data and sampling

This paper uses unique household survey data collected between May and September 2017 from local communities residing closely to the Great Limpopo TP. The data is based on face-to-face interviews and includes 1351 respondents, with 769 respondents from the Zimbabwean side and 582 respondents from the South African side respectively. The survey consists of questions on the respondents' socio-economic conditions[4] and themes such as willingness to follow formal rules, perceptions of corruption and law enforcement, the function and management of the park, poaching trends, and the respondent's attitudes towards different strategies and policies to combat poaching.

Simple random sampling was applied to select 11 out of 29 CAMPFIRE projects located near Gonarezhou National Park. These were all identified by the Rural District Council (RDC) in Zimbabwe. In South Africa, a full sample of 5 villages closely situated to Kruger National Park was identified by the local chief. Thereafter, the chair persons of each CAMPFIRE project and each chief respectively, provided a list of beneficiaries in each project and community. We then performed a simple random sampling procedure starting with a random household on the list. Each household was chosen after every $n$households where n is the sampling interval calculated as the total number of households in the project divided by the required sample size. The selection procedure continued until the required number of households in the sample was achieved.[5]

The enumerators were trained for two days during which they got the opportunity to go through the survey and get familiar with the questions. A pilot round was also carried out in one village before the data collection started, testing applicability of the questionnaire. This study does not however include a sample of respondents from the Mozambican side of the park. Even though this would be of high interest, this was not possible because of logistical aspects at the time the survey was conducted. Still, the project is now under its way to collect data in communities located in Mozambique which could be used and supplement future studies in the research field.

3.3 Empirical model specification

We model the attitudes and perceptions of local people around the GLTFCA in South Africa and Zimbabwe towards the rules of the park. In particular, the paper focuses on the determinants of people's attitudes and perceptions, and how these factors differ across the two countries. We cannot observe people's

[4] The socio-economic variables included the respondent's age, gender, level of education, employment status and household income.

[5] If reaching the end of the household list before collecting the required number of households, we restarted the sampling process selecting a different starting point at random on the list. The target sample was exceeded in all communities except in three, i.e. Dopi, Gondweni and Mugiviza.

attitudes, but we can ask questions about their perceptions and infer their attitude or behaviour from this information as suggested by the framework that we developed earlier. Thus, we ask a number of questions for each of the different themes highlighted above and then use factor analysis to recover the latent variables measuring people's attitudes and perceptions.

We use instrumental variables estimation with heteroscedasticity-based instruments to model the determinants of people's perceptions. Consistent with theory and empirical literature, we assume that people's perceptions are linked to their attitudes and behaviour and if this is the case then the same factors that influence perceptions also influence attitudes, whether directly or indirectly via the former. The dependent variables used in the regression models are related to people's perceptions of benefits from conservation, rules governing the GLTFCA, wildlife and environmental crime. Table A1 in the annexes shows the types of questions that were asked under each theme. We asked a number of questions related to each theme and then used factor analysis to recover the variables. All categorical variables and variables that require respondents to rate from 1 to 5 were converted into binary variables and the computed index expressed as a fraction between zero and one for ease of interpretation. For instance, a question that asked respondents either to rate between 1 and 5 or order categories were recorded into two values, i.e., zero if the response is negative and 1 if it is positive in a sense. Before the indices were computed, negative questions were recorded to match questions that were asked in a positive sense, i.e., zero becomes one and one becomes zero. This was done so that the index lies between 0 and 1 and it is easy to read, where zero signifies a negative outcome or a bad situation and one stands for a positive outcome.

Table 1 shows the explanatory variables used in our regression models and their expected signs. Theoretical, empirical and experimental studies suggest that both socio-economic variables and governance or management outcomes affect peoples's perceptions about natural resources (Agrawal et al. 2008; Ostrom et al. 2007; Kemp et al. 2005). However the results are mixed because the effects of socio-economic variables on perceptions depend on contextual factors and the type and size of resource under consideration (Ostrom 2007; Agrawal 2001). Empirical literature seems to suggest that groupsize, livestock ownership and employment are negatively associated with perceptions, while women are more likely to perceive natural resources in a positive way than men since they are involved in harvesting resources such as firewood, insects, weaving material and wildlife vegetables on a daily basis (Ntuli and Muchapondwa 2017; Thondlana and Muchapondwa 2015; Shackleton and Shackleton 2006).

Other studies demonstrate that education, age, employment and access to electricity have a positive effect on people's perception towards natural resources (Pollnac, 2000; Nazarea et al., 1998; Samdahl & Robertson, 1989). Theoretical studies predict that benefits from conservation affect people's perceptions in a positive way (Marks and Davis 2012; Fisher et al. 2008; Ostrom et al. 2007), while corruption affects perceptions negatively (Sandker et al. 2009; Ostrom 2007; Smith and Walpole 2005). The effects of management outcomes and institutional variables such as rules on perceptions are mixed since the impact of

these variables also depend on the context under consideration (Kitthananan 2006; Kemp et al. 2005; Stephen et al. 2000). The effects of household size, social grants, whether households sold assets during difficult times and expertise on people's perception towards natural resources could not be determined apprior from the literature.

We suspect the problem of endogeneity in our regression models. For instance, perceptions about wildlife benefits affect how people perceive the rules of the park, wildlife in general and environmental crime. On the other hand, these three variables also affect how people perceive wildlife benefits in one way or another. Because of this problem, we employ instrumental variables estimation with heteroscedasticity-based instruments, which methodologically deals with the problem of endogeneity (Lewbel 2016; Prono 2014; Baum et al. 2013; Lewbel 2012; Hausman et al. 2012; Chao et al. 2012). This method estimates an instrumental variables regression model providing the option to generate instruments and allowing the identification of structural parameters in regression models with endogeneity in the absence of traditional identification information such as external instruments (Chao et al. 2012; Lewbel 2012; Rigobon 2003). Identification is in this context achieved by having explanatory variables that are uncorrelated with the product of heteroscedastic errors (Lewbel 2016; Baum et al. 2013). Instruments may be constructed as simple functions of the model's data (Lewbel 2012). As a result, the approach may be applied in cases where no external instruments are available or used to supplement weak external instruments in order to improve the efficiency of the instrumental variables estimator. Thus, Lewbel's approach can be a good substitute of the standard IV approach in terms of addressing the problem of endogeneity. The choice one uses depends on the availability of sound external instruments. If good external instruments are available, then the standard IV approach is superior. If external instruments are either weak or not available, then the method of heteroscedasticity-based instruments is superior to the conventional IV approach.

This technique is gaining popularity and it is being used widely in many studies (e.g. Ntuli and Muchapondwa 2018; Mishra and Smyth 2015; Banerjee et al. 2013; Emran et al. 2012). Using two data sets from China to compare the identification strategy which utilises a heteroscedastic covariance restriction to construct an internal IV and the standard IV, Mishra and Smyth (2015) found that Lewbel's method provides plausible estimates in datasets in which conventional IVs are not available. The major drawbacks of Lewbel's approach is that identification relies upon higher moments, and is likely to be less reliable than identification based on coefficient zero restrictions. For a detailed description and mathematics behind the method for constructing instruments as simple functions of the model's data, we refer the readers to Lewbel (2012) and Baum et al (2013). We also checked for multicollinearity, underidentification, weak-identification and over-identification of instruments using the VIF test, The Kleibergen-Paap test, the Cragg-Donald Wald F-statistic and the Hansen J statistic before proceeding with heteroscedasticity-based instruments in both models.

4 Results

Table 1 indicates that there is great variability between the two countries in terms of both socioeconomic characteristics and important policy variables. In both countries, there are more women than men in the samples, which is not surprising since most able-bodied males in both countries migrate from rural to urban areas in search for employment. Our results show that South Africa has more educated household heads, a higher employment rate and a greater number of households with access to electricity and social grants. Hence the welfare of households on the South African side is much higher than that for Zimbabwe. On the other hand, Zimbabwe has slightly more women headed households, more livestock per household suggesting a higher degree of agricultural orientation, slightly older household heads, and households that are more prone to food insecurity and frequently sell household assets during shock.

When we consider important variables about people's perceptions towards wildlife that matter for conservation, we observe less variability across the countries. Conventional tests using the standard t-test show significant differences between the two countries for expertise, benefits and environmental crime index. Nonparametic tests[6] suggest significant differences for the management index, expertise, wildlife, benefits, rule compliance, corruption and environmental crime index. Zimbabwe has slightly higher indices for expertise and wildlife benefits, while South Africa has slightly higher indices for management, wildlife perception, rule compliance, environmental crime and corruption. We expected the index for environmental crime to be higher in Zimbabwe because the CAMPFIRE communities are relatively poor and thus rely more on less valuable environmental resources such as firewood and wildlife vegetables. However, studies have shown that richer communities actually consume more environmental resources than relatively poor households because they have the means (Ntuli and Muchapondwa 2017; Thondhlana and Muchapondwa 2014; Shackleton and Shackleton 2006).

We run four models shown in table 2 with people's perception of benefits, rules, wildlife and environmental crime as dependent variables. Our results show that perceptions of management of the park positively affect the perceptions of benefits from the park, rules governing the park, and how people perceive wildlife. The results show that park management negatively affects people's perceptions of environmental crime, while people's expertise positively affects people's perception of environmental crime. Perceptions of benefits positively affect how people perceive the rules governing the park and wildlife. Our results show that if people perceive the rules of the park in a negative way, then they are less likely to conserve wildlife and at the same time this will increase the likelihood of environmental crime.

Benefits seem to have a positive effect on people's perception of the rules governing the park and wildlife, but not environmental crime. Surprisingly, higher corruption levels positively affects people's perceptions of wildlife benefits

[6] The Mann-Whitney U test was used to test for significance differences between two medians.

and environmental crime. Communities in Zimbabwe value benefits from wildlife conservation more than communities in South Africa, are more compliant to the rules of the GLTFCA, while at the same time they are the ones who engage in environmental crime. This might be true given that CAMPFIRE communities are very poor and more dependent on the environment. Although they might value wildlife more than communities in South Africa, they are more likely to be caught loitering, harvesting firewood and certain food items from the park.

In our regression models, we also controlled for other socioeconomic characteristics of the respondents. Most socioeconomic variables were insignificant suggesting that they are not important in explaining variation in people's perceptions. Thus unobservable contextual factors could be responsible for explaining part of this variation. These contextual factors are absorbed by the constant in model 2, 3 and 4 thereby making it large and highly significant. There is therefore a need to interpret our results with caution. We interpreted only those variables that are significant. Although the significant level is low or approaching insignificance, the age of a person affects his or her perception of the benefits of conservation. The variable age seems not to affect a person's perception of the rules governing the park, wildlife and perception of environmental crime. Group size seems to have a negative effect on people's perceptions of benefits and environmental crime.

Our results show that social grants negatively affect people's perceptions about wildlife benefits suggesting that households that receive grants value wildlife benefits less than non-beneficiary households. This result is strongly driven by one country since social grants are only administered by the government of South Africa. Food insecurity at the household level negatively affects people's perception about wildlife, while positively affecting perceptions of environmental crime. Although people might value wildlife benefits, households that have sold assets in the past year because of a shock have a negative perception of the rules of the GLTFP.

5 Discussion

Following the results from our regression analysis, several observations are worth discussing in relation to our two research questions, i.e., i) Is there a significant difference in perceptions towards wildlife management and conservation of local people between communities in South Africa and Zimbabwe? ii) What are the factors driving the observed variation in perceptions of local communities in these two countries?. The communities on the Zimbabwean side are organized into CAMPFIRE projects and each project has a wildlife management committee responsible for managing wildlife income. We identified over 29 CAMPFIRE communities in the study area through the help of the RDC, while 11 of these communities were actually sampled. The fact that appropriation rights belong to the RDC makes CAMPFIRE communities weaker in terms of their bargaining power and, as a result, they are viewed as mere beneficiaries by other stakeholders. In South Africa, we identified about five communities, namely,

Makuleke, Mabilikwe, Makahlule, Kombo and Humula. Out of these five communities only Makuleke is directly involved in wildlife management through its community board and its hiring of a safari operator. Although the main language used in the study area is the same (i.e., Shangani speaking communities in both countries), our study show that people may have different perceptions both within and across communities and countries. These differences in perceptions could be driven more by policy and unobserved contextual factors than by other socioeconomic variables.

Our results show that people's perceptions about the management of the park positively affect their perception of benefits from the park, rules governing the park, and how people perceive wildlife, but negatively affect perceptions about environmental crime. There is a very strong policy message behind this result, which calls for respect of local communities as important stakeholders by park management and increased dialogue between the two parties in order to improve people's perception of wildlife (Mutanga et al. 2017; Teferra and Beyene 2014).

Household expertise actually increases the likelihood that people will engage in environmental crime. Mukul et al. (2014) reported that households with expertise or knowledge of environmental resources have greater incentives to engage in illegal harvesting of resources. Studies have shown that rule compliance and conservation attitudes depend on whether people perceive benefits as fair or not (Arias et al. 2015). The idea of ICDP is strongly tied to incentives which in turn translate to rule compliance and conservation.

Wildlife benefits can influence rule compliance and improve the way communities view wildlife, but might not stop people from illegal harvesting of less valuable resources like firewood. From a moral point of view, people do not feel ashamed when they harvest firewood and do not even consider it as an environmental crime (Ntuli and Muchapondwa 2017). Child and Child (2015), Goldman (2011), Muchapondwa (2003) and Songorwa et al. (2000) argue that wildlife benefits create the necessary incentives for wildlife conservation through their role in promoting and shaping the way people view wildlife and rules governing the park. Balint and Mashinya (2006) argue that wildlife benefits derived by local communities in Southern Africa are too small to achieve such impacts suggesting that there is a threshold that is unknown to authorities and if benefits were to increase or reach this point, then people's perceptions would change.

Different sources of income were identified in the study area and these include agriculture, employment, wildlife, environmental income and social grants. Most rural households in South Africa are eligible for different types of social grants including disability, old age, children under the age of five (Maitra and Ray 2003). If social grants contribute significantly towards total household income then this may greatly affect household perception of wildlife benefits. Studies done in South Africa report that social grants support well over 33% of the population in the country, while the majority of the beneficiaries are found in rural areas (Du Toit A and D. Neves, 2009; Booysen and van der Berg 2005). Furthermore, most communities on the South African side do not have direct access to wildlife benefits as this privilege is monopolized by only one

community, namely, Makuleke. Key informant interviews revealed that wildlife benefits are not fairly distributed across communities as some community leaders were disgruntled by the status quo. The land inside the Kruger National Park that belongs to the community is managed by a private company, while the board responsible for administering and managing wildlife benefits is based in Makuleke.

Ntuli and Muchapondwa (2017) reported a negative relationship between group size and wildlife benefits or conservation. The negative relationship between group size and environmental crime is not surprising since extensive resources such as wildlife need a larger group for easy monitoring. However, enforcement is still a challenge for both small and large group sizes because of poor institutions in local communities (Ostrom et al. 2007). Along this line, previous studies demonstrate that external monitoring and enforcement by the state is much worse compared to the case when it is done by local communities due to limited state resources (Ostrom 2007; Murphy and Cardenas 2004). It is worthwhile to invest in local common pool resource institutions in order to strengthen capacity of communities so that they are able to reach effective monitoring and enforcement.

Thus the most important determinants of people's perception towards transfrontier conservation areas are related to their perception of park management, benefits, crime, institutional rules and unobservable constextual factors. All these factors are interwoven and they should not be considered in isolation, but as part of the bigger picture. Theory and empirical evidence suggest that these variables are important for stabilizing large-scale cooperation in the management of common pool resource that involve indigenous communities. When we compare our results, looking from a broader lense of large-scale conservation activities in the GLTFCA to the results of other studies on collective action involving individual case studies, we observe striking similarities in terms of the influence of these key variables, which could be a target of policy interventions.

Our results speek to both large-scale collective action and wildlife conservation in the GLTFCA in different ways. Theory and empirical evidence seem to suggest that people's perceptions and attitudes affects collective action, which in turn influence behaviour towards wildife conservation (Ostrom 2000). From a policy perspective, both park management and the distribution of benefits are critical to conservation and deserve to be executed in a manner that people perceive as fair. Furthermore, variables such as household expertise, group size and people's perception of the park, wildlife and rules governing the park should be given priority in future policy reforms, since they have bearing on local community involvement. Wildlife management training and awareness campaigns might play an important role in changing people's perception towards conservation, and thus influencing large-scale collective action. Ntuli and Muchapondwa (2018) found a positive and significant effect of training on cooperation in local communities around the GNP in Zimbabwe. Understanding the circumstances under which wildlife conservation occurs in the GLTFCA is of prime importance since this has bearing on people's perceptions and attitudes, which in turn is essential for stabilizing large-scale collective action.

6 Conclusion

Based on a conceptual framework linking human behaviour and the environment, the paper set out to examine the determinants of perceptions of local communities sharing a transboundary wildlife resource around the Great Limpopo Trans-frontier Conservation Area bordering South Africa, Zimbabwe and Mozambique. Our study is important because perceptions shape people's attitudes in the very short-run and behaviour in the long-run. This study further contributes to the literature when focusing on people's perceptions towards conservation in a larger socio-ecological system, in contrast to the majority of studies within the field that often studies a small number of resource users within a geographically well-defined and comparatively small area. As perceptions is argued to translate into attitudes and in the long run shape people's behaviour, this study investigates the foundations for collective action in a large-scale setting – in this case the Great Limpopo Trans-frontier Conservation Area.

Our results show that perceptions of the park management positively affect both the perception of benefits from the park, the rules governing the park and how people perceive wildlife more in general. Simultaneously, park management appears to negatively affect people's perceptions of environmental crime, while people's expertise instead affects environmental crime in a positively direction. Furthermore, perceptions of benefits positively affect how people perceive the rules governing the park and the wildlife.

Our results imply that if people perceive the rules of the park in a negative way, then they are less likely to conserve wildlife and at the same time this will increase the likelihood of environmental crime. Benefits seem to have a positive effect on people's perceptions of the rules governing the park and wildlife, but not environmental crime. Somewhat surprisingly, we also find that corruption seems to positively affects people's perception of wildlife benefits and environmental crime.

Most socioeconomic variables were insignificant, which suggests that they are not important in explaining variation in people's perceptions. Thus, unobservable contextual factors could instead be responsible for explaining part of this variation. These contextual factors are absorbed by the constant thereby making it large and highly significant. Subsequently, there is a need for further studies, both in the Great Limpopo TFCA and in other trans-frontier parks, in order to fully understand the determinants of people's perceptions towards wildlife across time and space in larger socio-ecological systems.

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Table 1: Expanatory variables and their definition

Variable	Explanation	Expected sign
Gender	0 = Female, 1 = Male	-
Education	Number of years in School	+
Age	In years	+
Hholdsize	Number of household members	Undetermined
Employment	Is household head employed?	±
Electricity	Is your house electrified? 0 = No, 1 = Yes	+
Group size	How big is your community?	-
Livestock	Does household own livestock? 0 = No, 1 = Yes	-
Socialgrant	Does household receive a socialgrant?	Undetermined
Foodinsecure	Number of days household slept without eating	-
Sellassets	Has household been forced to sell assets? [0, 1]	Undetermined
Manageindex	Management index	±
Expetindex	Expertise	Undetermined
Benefitindex	Wildlife benefits	+
Rulesindex	Rule compliance	±
Corruptindex	Corruption	-

Source: Empirical literature and theory

Table 1: Characterization of the sample

Variable	**Zimbabwe**			**South Africa**			**Total**		
	Obs	**Mean**	**Std**	**Obs**	**Mean**	**Std**	**Obs**	**Mean**	**Std**
Gender	769	0.39	0.49	582	0.28	0.45	1351	0.34	0.48
Education	769	5.82	3.83	582	8.59	4.43	1351	7.01	4.32
Age	769	43.03	15.14	582	42.12	15.15	1349	42.64	15.14
Hhold size	769	6.21	2.53	581	4.63	2.12	1351	5.53	2.49
Employment	769	0.13	0.33	581	0.28	0.45	1351	0.19	0.39
Electricity	769	0.02	0.13	581	0.91	0.29	1350	0.40	0.49
Group size	769	60.20	53.22	582	937.19	208.28	1351	439.69	457.49
Livestock	769	0.72	0.72	582	0.15	0.21	1351	0.47	0.56
Socialgrant	768	0.10	0.30	581	0.76	0.43	1350	0.39	0.49
Foodinsecure	768	2.27	4.83	581	1.04	3.83	1351	1.73	4.47
Sellassets [0,1]	768	0.55	0.50	581	0.14	0.35	1351	0.37	0.48
Manageindex	768	80.57	7.13	581	81.88	5.21	1349	81.13	6.40
Expetindex	768	2.98	7.57	581	0.56	2.07	1349	1.94	5.98
Wildlifeindex	768	96.86	6.43	581	97.36	5.09	1349	97.07	5.90
Benefitindex	768	69.64	23.27	581	60.16	19.47	1349	65.49	22.18
Rulesindex	768	97.93	3.99	581	98.40	0.85	1349	98.13	3.07
Environindex	768	83.51	20.54	581	85.59	16.47	1349	84.40	18.92
Corruptindex	768	94.63	6.17	581	95.58	1.73	1349	95.04	4.82

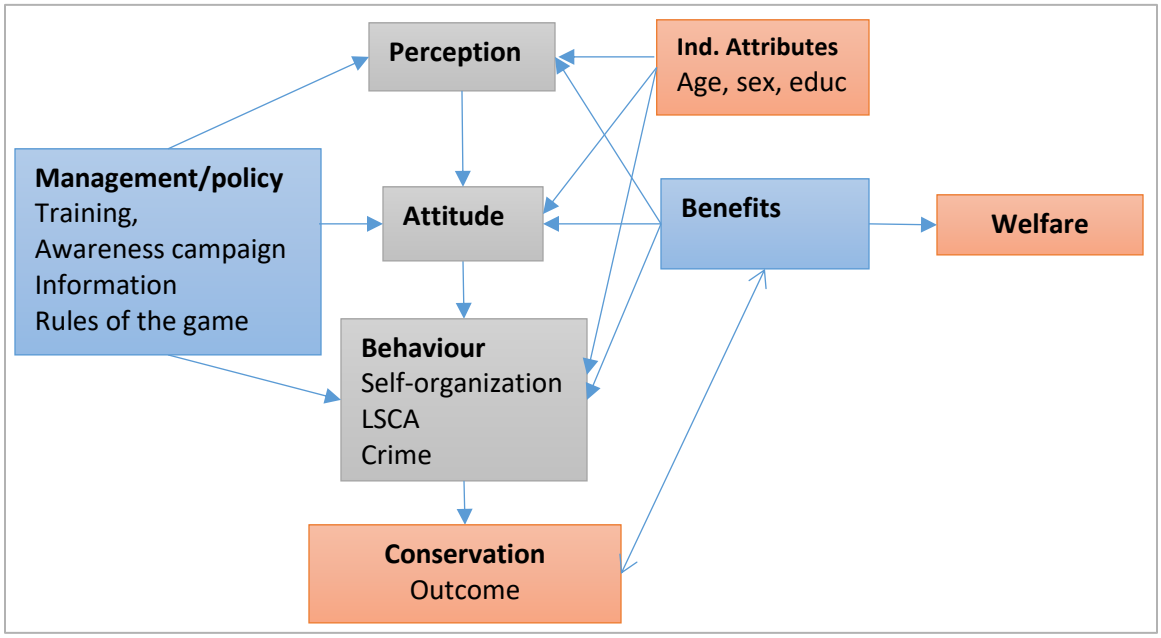
Source: Survey data May – Sept 2017

Table 2: Results of IV estimation with heteroscedasticitybased instruments

Explanatory variables	Benefits Index	Rules index	Wildlife Index	Environmental Crime index
Number of obs	1,316	1,316	1,316	1,316
Prob>F	0.0000	0.0001	0.0000	0.0000
F-statistic	232.45	320.20	160.71	92.23
Centred R2	0.122	0.0314	0.0586	0.0619
Uncentred R2	0.134	0.0451	0.0590	0.0727
Management index	0.288**	0.0522***	0.190***	-0.110**
	(0.0926)	(0.0136)	(0.0264)	(0.0859)
Expertise index				0.407***
				(0.0866)
Benefits index		0.00732*	0.0170**	-0.00546
		(0.00407)	(0.00763)	(0.0241)
Rules index			-0.0045**	0.753***
			(0.0593)	(0.187)
Corruption index	0.301**			2.433**
	(0.121)			(1.150)
Country	32.87***	2.410**	1.531	8.374**
	(7.088)	(1.048)	(1.294)	(4.099)
Gender	-0.852	0.123	0.174	-1.036
	(1.255)	(0.183)	(0.349)	(1.110)
Education	0.0899	0.0244	-0.00779	-0.0045
	(0.178)	(0.0260)	(0.0496)	(0.158)
Age	0.0909*	-0.00421	-0.00965	-0.00563
	(0.0487)	(0.00716)	(0.0136)	(0.0432)
Groupsize	-0.00851**	-0.000600	-0.00172	-0.0082**
	(0.00404)	(0.000595)	(0.00114)	(0.00361)
Electricity	-3.322	0.446	0.425	0.0976
	(2.650)	(0.389)	(0.740)	(2.336)
Livestock	-2.190	0.116	-0.293	-0.121
	(1.661)	(0.244)	(0.465)	(1.471)
Employment	0.592	0.0591	0.149	-0.674
	(1.535)	(0.225)	(0.427)	(1.350)
Social grant	-7.639***	-0.180	-0.0993	-1.267
	(1.630)	(0.241)	(0.457)	(1.447)
Food insecurity	-0.0306	0.00523	-0.0938**	0.447***
	(0.133)	(0.0196)	(0.0372)	(0.117)
Sell asserts	2.892**	-0.341*	0.367	1.135
	(1.365)	(0.201)	(0.380)	(1.200)
Constant	1.843	1.89***	4.73***	1.79***
	(14.10)	(1.396)	(5.579)	(18.88)
Under identification LM test	82.208	56.450	139.319	95.452
$\chi2(10)$ P-val	0.0001	0.0000	0.0000	0.0000
Weak identification F-test	18.373	26.281	25.420	31.568
Overidentification test	11.574	8.584	6.0430	7.561
$\chi2(9)$ P-val	0.2308	0.2623	0.8352	0.543
Breusch-Pagan test	18.543	29.172	21.954	19.753
Prob> $\chi2$	0.0000	0.0000	0.0000	0.0000

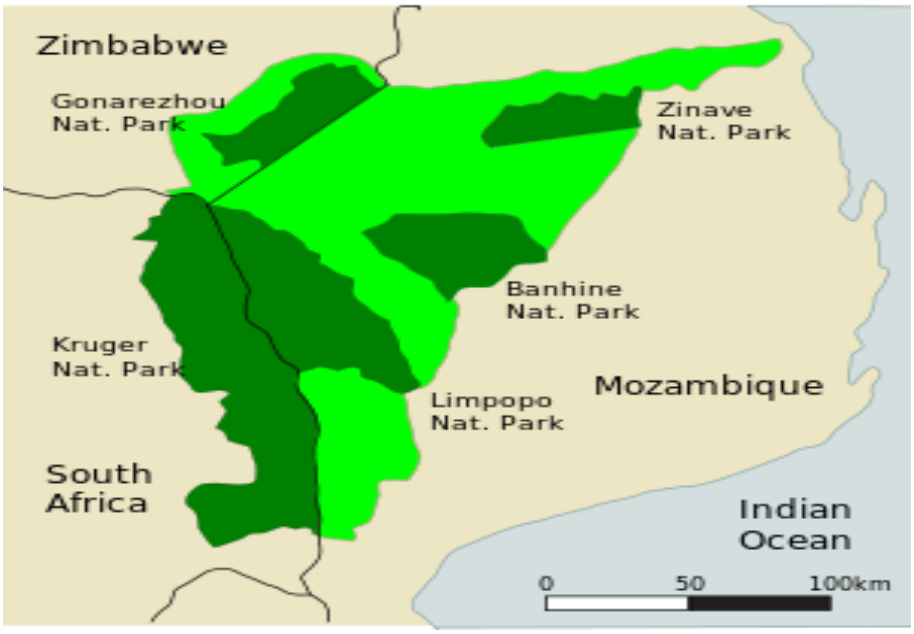
Source: survey data May – Sept 2017

Figure 1: Conceptual framework



Source: Own diagram

Figure 2: Map of the Great Limpopo Trans-frontier Conservation Area



Source: Wikipedia, 21 January 2018

ANNEXES

Table A1: Type of question asked by theme

Theme	Type of questions
Dependent variables	
Perception of benefits	Does the rules from "the park" benefit you, for instance by generating income or employment? 0 = No 1 = Yes
	Does your community receive any income from recreational hunting in the area? 0 = No 1 = Yes
	To what extent do you believe that these economic benefits will be distributed fairly? 1 = Not at all 2 = To a limited extent 3 = To some extent 4 = To a great extent
Perception of rules	How willing are you to follow the rules of the park? 1 = Not at all willing 2 = Not willing 3 = Neither willing nor reluctant 4 = Willing 5 = Very willing
	To what extent do you consider violating the rules of the park? 1 = do not consider it at all 2 = do not consider it 3 = neither willing nor reluctant 4 = to some extent 5 = to a large extent
	In general, to what extent do you actually obey the regulations of the park? 1 = Not at all 2 = To a limited extent 3 = To some extent 4 = To a large extent 5 = To a complete extent
	Rules governing the park are clear and simple to understand 0 = No, 1 = Yes
	You are well informed about the park and its rules? 0 = No, 1 = Yes
	Rules governing the park intend doing the right thing 0 = No, 1 = Yes
	Rules governing the park are enforced fairly 0 = No, 1 = Yes
	There is a moral obligation to comply with the rules governing the park [0,1]
	A person would feel shame if caught for violating the rules governing the park
	Local communities are involved in the making of rules governing the park [0,1]
	Authorities listen to local communities when designing rules governing the park
Perception of wildlife	What the people and its livestock need is more important than saving plants and wild animals? 0 = No, 1 = Yes
	It is important to protect wildlife for our children 0 = No, 1 = Yes
	There are so many wild animals nowadays that the laws to protect them are no longer necessary 0 = No, 1 = Yes
	Wildlife and nature in the area of the park is in risk of being depleted
	Wildlife is nowadays more abundant than it used to be
	In recent time, the overall threats to wildlife and resources have increased
	Has your property or any person you know been damaged by wildlife? [0,1]
Perception of environmental crime	Collecting firewood in a protected area 1 = Not wrong 2 = Wrong but understandable 3 = Wrong and should be punished
	Collecting firewood in a protected area 1 = Not wrong 2 = Wrong but understandable 3 = Wrong and should be punished
	Shooting an animal that destroys your crops 1 = Not wrong 2 = Wrong but understandable 3 = Wrong and should be punished
	Fishing although there is a closed season

	1 = Not wrong 2 = Wrong but understandable 3 = Wrong and should be punished
	Poaching inyalas or impalas for bushmeat 1 = Not wrong 2 = Wrong but understandable 3 = Wrong and should be punished
	Has illegal hunting increased or decreased during recent years? 1 = decreased 2 = not changed 3 = Increased
	How many poaching events have you heard about during the recent year? 0 if less than three and 1 if greater than 3
	Most poachers in this area never get caught
	It is sometimes justified to harbour a poacher in your house
	You would tell authorities if you had information that could send a poacher in front of the legal system to face sanctions
	Poaching for commercial use is morally wrong
	Poaching for subsistence use is morally wrong
	Collecting firewood, although illegal, is morally acceptable
	People engaged in poaching should face harder sentences
	If a poacher comes from another country then it is more acceptable to tell the police about this person
Explanatory variables	
Park management	What are your opinions about the current management of the park? 5 = Very good 4 = Good 3 = Neither good nor bad 2 = Bad 1 = Very bad
	How common is it that local communities are involved in monitoring rules governing the park? 1= Very rare 2 = Rare 3 = Common 4 = Very common
	How effective is enforcement to reduce violations? 1 = Not effective at all 2 = Somewhat effective 3 = Effective 4 = Very effective
	How much of illegal behaviour related to conservation in your area will the rangers generally be able to hinder? 1 = Nothing 2 = Hardly anything of it 3 = Some of it 4 = Most of it
	How often are you in contact with rangers or other state employees enforcing the park rules? 1 = Less than once a year 2 = On some occasions over a year 3 = Every month 4 = Every week 5 = Almost daily
	Rangers from your country are more efficient than rangers from neighbouring countries
	Help park rangers in their surveillance by telling them of suspicious activities
	A joint ranger force with staff from all the countries engaged in the TFCA
	Surveillance of poaching activities should be increased
	Are you ever in contact with enforcement officers from other countries? 0 = No 1 = Yes
Corruption	Offering a bribe to avoid being arrested by the police 1 = Not wrong 2 = Wrong but understandable 3 = Wrong and should be punished
	You personally know some of the rangers [0, 1]
	Rangers are on friendly terms with your community [0, 1]
	You can pay rangers them to make refrain to impose sanctions for rule violations
	Rangers from your country are more easily bribed than rangers from neighboring countries

Expertise	Do you consider yourself or anyone else in the household to be a hunter? 0 = No 1 = Yes
	Do you consider yourself or anyone else in the household to be a fisherman? 0 = No 1 = Yes
	Do you consider yourself or anyone else in the household to be reliant on activities that consist of using natural resources? 0 = No 1 = Yes
	How many times have you eaten bushmeat within the previous month? (state a number) 0 if less than 5 times and 1 if greater or equal to five