



Research

Assessing long-term conservation impacts on adaptive capacity in a flagship community-based natural resources management area in Botswana

Lin Cassidy¹ , Narcisa G. Pricope^{2,3} , Forrest R. Stevens⁴ , Jonathan Salerno⁵ , David C. Parry⁶ , Michael Murray-Hudson¹ , Joel Hartter⁷  and Andrea E. Gaughan⁴ 

ABSTRACT. Over the past three decades community-based natural resources management (CBNRM) has sought to address the concurrent needs of economic development and ecological protection at the local level, but there is often strong divergence between development and conservation interests and successes. In particular, CBNRM has not always led to expected socioeconomic outcomes, while information of its impact on human well-being at household level is sparse. In Botswana, most communities do not disburse benefits from CBNRM ventures to households. This leads to an inherent scale mismatch that arises because the costs of living with wildlife are felt at the household level, while the benefits are paid out at the community or village level. We use longitudinal data from two household surveys conducted 22 years apart to assess if benefits from the Botswana model of CBNRM have increased household-level adaptive capacity for those living with wildlife. We take a livelihoods capital approach to develop indicators of adaptive capacity and measure how livelihood diversity, inequality, and adaptive capacity have changed in five communities in northern Botswana between 1995 and 2017. Our analyses confirm the findings of qualitative reviews and suggest that CBNRM is under-performing in its contribution to improved household-level adaptive capacity. CBNRM cannot be said to benefit communities if the majority of community members do not experience increased well-being. We therefore recommend restructuring the governance models of CBNRM and other community conservation approaches to ensure that benefits are more directly targeted to actively participating households.

Key Words: *community-based conservation; governance; human well-being; rural livelihoods; scale mismatch; wildlife conservation*

INTRODUCTION

Community-based natural resources management (CBNRM) has been promoted globally since the 1990s, largely in response to the recognition that earlier national-level legislative protection of biodiversity had alienated those living alongside conservation areas and created conditions of conflict (Agrawal and Gibson 2001). Although CBNRM has sought to address the concurrent needs of human development and ecological protection at the local level, there is often strong divergence between development and conservation interests (Berkes 2004). In many instances, CBNRM has been largely successful ecologically, but has not always led to the expected social advancements (Galvin et al. 2018). However, when tenure regimes, cultural beliefs, and institutions are supportive, CBNRM has generally been effective in meeting both ecological and socioeconomic expected outcomes, irrespective of the national context (Brooks et al. 2013). Increasingly, CBNRM is recognized as a social process nested in a broader set of complex social-ecological interactions (Alexander et al. 2016, Salerno et al. 2021a), with important implications for livelihood outcomes and long-term sustainability.

Examining the overall impact of CBNRM on livelihoods and human well-being is especially important, given that CBNRM programs may have mixed social outcomes even where financial revenue may appear high (Galvin et al. 2018). Yet evidence to support claims of success or failure is limited because opportunities to measure change over time in the same community are rare. A rigorous understanding of the real impact of CBNRM programs can only be achieved by analyzing long-term effects on livelihoods and human well-being (Brockington

2021), which we set out to do here, through a broad set of measures relating to livelihood capitals and their contribution to adaptive capacity (AC) as the operationalization of human well-being (Chan et al. 2007).

In natural resource-dependent social systems, AC can be seen as a characteristic of communities or households that helps them to counter vulnerability by conferring the ability to cope with stressors and respond to shocks (Smit and Wandel 2006, Engel 2011). In variable social-ecological systems, AC correlates with, and helps to maintain, general human well-being (see White and Ellison 2007, Collomb et al. 2012, Milner-Gulland et al. 2014, Woodhouse et al. 2015, McKinnon et al. 2016). AC connotes a sense of durability over the long-term through its focus on a system's ability to adjust, modify, or change its characteristics in response to shocks or stress (Jones et al. 2010). Human well-being itself can be defined as general prosperity across multiple dimensions of life, including human, social, and environmental aspects (Collomb et al. 2012, Mohanty and Tanton 2012, Woodhouse et al. 2015). In communities with conservation programs, an assessment of AC may be a more useful measure of whether the program has increased general household well-being over the longer term than would, for example, an assessment of whether a specific, once-off benefit was deployed, because the latter may serve to compensate for an immediate cost (e.g., crop loss) but may not change the overall, more continuous, socioeconomic circumstances of a household.

Intangible characteristics such as human well-being, vulnerability, and AC cannot, however, be quantified directly (Hinkel 2011), and as such, proxy measures or indicators must be

¹Okavango Research Institute, University of Botswana, ²Department of Geosciences, Mississippi State University, ³Office of Research and Economic Development, Mississippi State University, ⁴Department of Geographic and Environmental Sciences, University of Louisville, ⁵Department of Human Dimensions of Natural Resources, Graduate Group in Ecology, Colorado State University, ⁶Ecosurv Environmental Consultants, ⁷Department of Environmental Studies, University of Colorado Boulder

used to infer them (Gaughan et al. 2019). The well-established Sustainable Livelihoods Framework (Scoones 1998) shows that livelihood diversity and productivity depend directly on access to and use of a range of resources, conventionally grouped into different “capitals,” including social, human, natural, physical or economic, and financial (Scoones 1998, Chowdhury 2021). These capitals overlap well with the objective indicators typically used in well-being assessments (Collomb et al. 2012, Woodhouse et al. 2015). Similarly, Turner et al.’s (2003) vulnerability framework shows how generalizable constructs such as resilience, vulnerability, and AC can be grounded to specific localized conditions through a focus on livelihood capitals. Access to these different capitals influences livelihood diversity and household productivity (Turner et al. 2003, Thulstrup 2015), which in turn affect a household’s ability to adapt to shocks and stresses (Vincent 2007, Cassidy and Barnes 2012). Unequal access to different capital types, whether through market forces, government policies or other socio-cultural attributes, creates a set of pre-existing inequalities across households and communities that, in turn, create unequal levels of AC (Oshbahr et al. 2010). At the same time, with increased integration of rural communities into the cash economy, income remains a reliable indicator of current economic well-being (Wolff and Zacharias 2009, Bilan et al. 2020), albeit one that may change rapidly under external shocks such as experienced during the COVID-19 pandemic (Paganini et al. 2020).

Communities are not homogeneous entities, and community support for conservation, such as is intended by CBNRM programs, means the support of the individual households within a given community. If CBNRM’s purpose is to procure support from the households within a community, it should ensure that, and evaluate whether, those households are actually better off because of the presence of the program. To date, such measurements have not been done. The extent to which CBNRM may contribute to household-level AC and human well-being has largely been examined only in qualitative terms, primarily because of the limited opportunities for longitudinal analyses. Qualitative commentaries on the 30-year rise and fall and rise, as well as successes and failures, of CBNRM in southern Africa exist (Nelson et al. 2021), but these mainly document the governance model or administrative challenges at community level (Blaikie 2006, Cassidy 2021). A major challenge is that, in policy making and some research contexts, the community level is often viewed as the local level, without considering the considerable variation that is found within communities at the even lower level of the household. Too often, examination of scale mismatch issues have been focused on national vs. community levels, and few papers have addressed the issue of the inherent scale mismatch within communities that arises in programs where the costs of living with wildlife are felt at the household level through crop and livestock depredation or through the risk to human life, while the benefits are paid out at the community level (Berkes 2006, 2007, Drake et al. 2021, Salerno et al. 2021a). In the same way as the question can be asked if findings of CBNRM can be scaled up to generalized about the national level (Berkes 2006), it is pertinent to inquire whether such findings (for example, of success or failure) can be scaled down to the household level. What is certain is that the costs of living with wildlife are felt unequally (Jordan et al. 2020), even within specific communities.

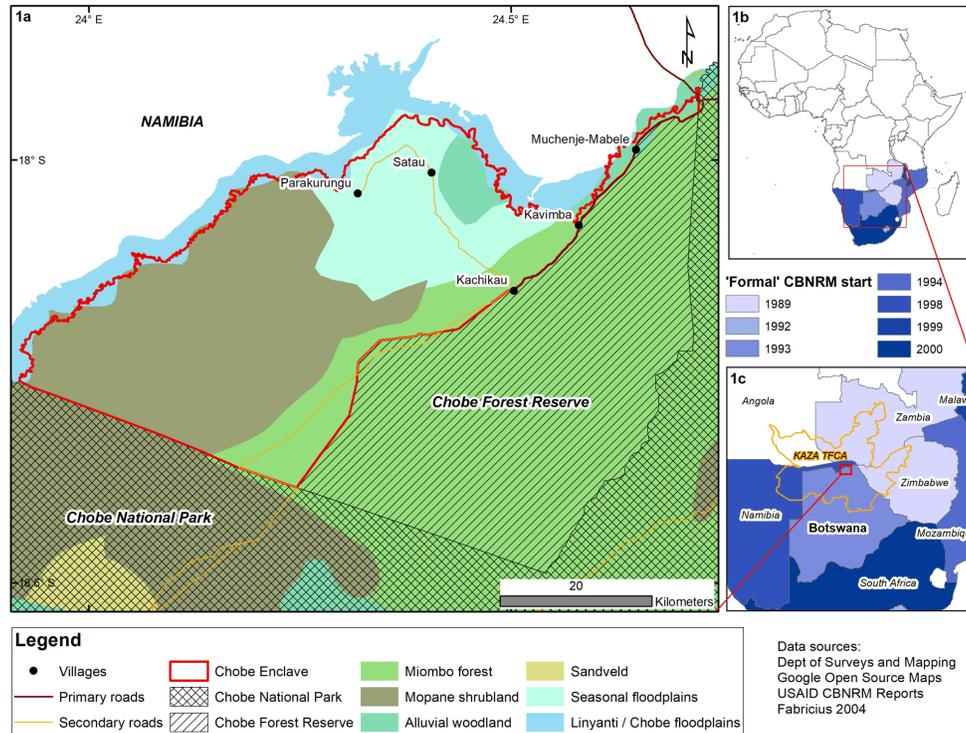
Although many development interventions, including donor-funded CBNRM projects, often carry out socioeconomic baseline surveys prior to their intervention (such as the one used for the first wave of this study), it is much less common to conduct follow-up surveys to verify whether intended interventions have indeed achieved their objectives. There are almost no longitudinal quantitative evaluations of the impacts of such programs, particularly at the household level. In this study, we draw on a rare opportunity provided from two household surveys conducted in the same communities two decades apart to test the validity of qualitative reports (such as those of Blaikie 2006, Galvin et al. 2018, and Nelson et al. 2021) that suggest CBNRM underperforms in terms of socioeconomic benefits, particularly at the household level.

Problem statement and research questions

In southern Africa, CBNRM follows a wildlife-based model that assumes that those bearing the costs of living with wildlife should receive benefits from it (Nelson 2012). The predominant approach has focused on commercial hunting and wildlife-based tourism activities outside of existing community natural resource use activities (which are primarily for subsistence and include several important plant resources). In Botswana, whose highly centralized and bureaucratic governance system has led to a very top-down approach to CBNRM (Cassidy 2021), this model has further narrowed over time to focus on highly lucrative, village-level economic partnerships with tourism corporations, with strong oversight by national government that tends to view rural communities as homogeneous units (Stone 2015). In addition to challenges related to governance, or whether management is truly community based, or if benefits outweigh costs (Beebe 2003, Blaikie 2006, Gupta 2014, Chevallier and Harvey 2016), there is an additional, unaddressed concern in Botswana about the distribution of benefits to member households, and whether the level at which benefits accrue is matched to the level at which costs from wildlife coexistence are felt (Cassidy 2021). Although some community-based organizations (CBOs) in neighboring countries have understood the need to ensure benefits are felt at household level, disbursements have typically been token amounts, and have been the same for all members regardless of the extent to which their livelihoods have been impacted by wildlife (Taylor 2009, Silva and Mosimane 2013). In Botswana, such token household-level disbursements have recently started taking place but only in three communities. Generally, in the majority of CBNRM communities, benefits have been directed toward village-level development projects that may not serve all members equitably, such as football kits for young men, or a grinding mill for those growing crops, as opposed to the provision of household-level sanitation (Mbaiwa 2011, Centre for Applied Research 2016). Beyond these projects, the majority of the CBO’s revenue has gone to its operating costs (vehicles, offices, board member sitting fees) and the provision of day-care centers (Jones 2002, Mbaiwa and Tshamekang 2012, Mbaiwa 2018). In this model, an elderly household that experiences crop depredation by elephants may suffer food shortages that cannot be offset by sports gear or community interventions that do not directly involve that household.

The difference between the level at which costs are experienced and the level at which benefits are disbursed raises the question of whether the Botswana CBNRM model confers resilience and

Fig. 1. Location of Chobe Enclave and context of regional development of community-based natural resource management (CBNRM) in southern Africa. Chobe Enclave's communities are situated between protected areas and among various landcover types (a). The Chobe Enclave trust was formally established in 1993 amidst the progression of CBNRM programs across southern Africa (b, c).



strengthens AC at the household as well as community level, since the former is the level experiencing the costs (Armitage 2005, Berkes 2006). Clearly, the issue is not that benefits are received at community level; instead, the challenge is that in Botswana, there are no mechanisms for appropriate disbursement of benefits below community level to households who have most carried the costs of living with wildlife. The Botswana government's view is that if the community has benefited, everyone has benefited. Given the broader findings of weak social impact found in reviews such as that of Galvin et al. (2018), there is a clear need to assess if benefits from the top-down, government-controlled Botswana model of CBNRM have increased household-level AC for those living with wildlife.

We use a case study from the country's first and longest-standing CBNRM project to explore the extent to which household AC, as a measure of human well-being and benefits off-setting costs, has changed in the past two decades, and whether CBNRM can be inferred to have contributed to such change. Although hundreds of thousands of U.S. dollars are earned annually by CBNRM trusts in Botswana (Centre for Applied Research 2016), there is, because of the lack of longitudinal studies, no certainty that benefits devolve to those households most affected by wildlife. To address that gap, we use data from two separate studies in the same five villages, conducted 22 years apart (1995, the original baseline study for the CBNRM project, and 2017) to understand the following:

- the extent to which financial benefits associated with CBNRM activities have reached rural households,
- how livelihood diversity and economic activities have changed in the intervening years, and whether the changes in key indicators of human well-being differ noticeably from aggregate measures for rural Botswana,
- how overall levels of household income and assets, and their distribution, have changed over the past two decades, and
- how AC, as measured through livelihood capital indicators, has changed over time.

Chobe Enclave and history of CBNRM in the area

Chobe Enclave is situated in the north of Botswana, bounded by Namibia's Zambezi Region and Chobe River to the north, Chobe National Park (CNP) to the southwest, and Chobe Forest Reserve to the south and southeast (Fig. 1). Its location at the core of the Kavango-Zambezi Transfrontier Conservation Area (KAZA TFCA) highlights the importance of the Enclave for wildlife conservation and tourism. Major vegetation types in the area are thorn-tree woodlands along the river, grasslands in low-lying floodplains, and mixed woodlands on the higher-elevation ridges. These habitats provide a variety of timber and non-timber forest resources to local inhabitants. The nearest large town is Kasane, accessed only by traversing CNP. Kasane has in the past 20 years become a major tourism hub that supports wildlife tourism in

Table 1. Population figures for the past five decades in the Chobe Enclave villages.

Census	Muchenje-Mabele	Kavimba	Kachikau	Satau	Parakurungu	Enclave Total	Estimated no. of households	Average annual % pop'n change
1971	510	305	243	454	390	1902	unknown	--
1981	489	145	364	420	424	1842	unknown	-0.32
1991	351	366	513	612	439	2281	700	2.38
2001	878	619	1072	923	1050	3664	800	6.06
2011	1005	652	1498	622	1086	4863	1080	3.27
2022 [†]	950	567	1214	710	1005	4446	990	-0.86

[†] 2021 Census delayed because of COVID-19. Data sources: Statistics Botswana website and publications.

CNP. However, tourism developments within the Enclave remain few, resulting in some out-migration from the Enclave in search of work in more recent years (Gupta 2015).

The Enclave community comprises a string of five villages that follow the Chobe River along a floodplain that widens considerably from: Muchenje-Mabele, Kavimba, and Kachikau to Satau and Parakurungu. Muchenje-Mabele and Kavimba in particular are tightly constrained for settlement expansion by the Chobe River to the north-west, which forms the national border, and the forest reserve to the southeast (Fig. 1). Satau and Parakurungu are “islands” on the seasonally flooded floodplain, and Satau’s dryland area is small with limited opportunities for settlement growth (Pricope et al. 2015). The landscape accommodates traditional Subiya livelihoods centered around fishing and rainfed agriculture, as well as livestock grazing in woodier areas farther away from perennial water sources (Shamakuni 1972, Pricope et al. 2015, Salerno et al. 2018). Human population growth in the Enclave (Table 1) over that past half-century has been slower than the national average, because of the area’s remoteness as well as limited surface water in the mopane shrubland to the south (Fig. 1). Human-wildlife conflict is high because of Chobe Enclave’s location between protected areas and the perennial surface water of the Chobe River, and because the area serves as important migration corridors for elephant, buffalo, zebra, and other wildlife species (Gupta 2013, Naidoo et al. 2016, Purdon et al. 2018, Salerno et al. 2018, Dunnink et al. 2020, Vittoz et al. 2020). Conflict is mainly associated with crop trampling and raiding primarily by elephant and buffalo (Gupta 2013), but smaller species such as jackal, porcupine, and birds also account for substantial crop loss (Gontse et al. 2018). Hyena, lion, and leopard are the main source of livestock predation (Dunnink et al. 2020). Other causes of conflict are the destruction of river-bed wells during the dry season, and, though infrequent, attacks on humans walking between villages, fields, and cattle-post areas (Stone 2015).

CBNRM was first introduced to Botswana in 1992, after the initial successes of the CAMPFIRE program in neighboring Zimbabwe (Frost and Bond 2008), to mitigate such conflict and increase tolerance for living with wildlife. Despite the rhetoric, both CAMPFIRE and Botswana’s CBNRM program were introduced from the outside primarily as a conservation tool, whereas the interests of participating communities have been more on the perceived development opportunities associated with increased income (Cassidy 2000, Murphree 2009, Magome and Fabricius 2013). Given their proximity to protected areas and the

need for sharing an important landscape with wildlife (Salerno et al. 2018), the Botswana Government’s Department of Wildlife and National Parks targeted the Chobe Enclave villages as Botswana’s pilot project for a CBNRM project.

Central government control over the development of CBNRM is very strong, with the type and structure of the community organization being dictated, and with management decisions largely being made by government for the community to implement (Blaikie 2006, Gupta 2014, Cassidy 2021). Village level governance is limited to the implementation of central government directives, or to the handling of customary or civil matters (Chevallier and Harvey 2016, Mogende and Kolowole 2016). The Botswana Government has chosen the model of a trust, which it has assisted selected communities to form, or forced other organizations to adopt, if they want to participate in the program. All adults resident for more than one year in the community are automatically members of the trust, regardless of their interest or degree of engagement. Local village headmen are ex officio members of the trust board, which is considered a non-governmental structure. Under the Botswana CBNRM model, communities or their trust neither own the land nor the resources; instead, they are given formal lease rights to benefit from the commercial use of selected resources (such as wildlife) in a given area and for a defined period of time, and under supervision of a government-staffed technical advisory committee (Cassidy 2000, Jones 2002).

The Chobe Enclave Conservation Trust (CECT) was initiated in 1993 and formalized in 1994 (Jones 2002), with equal representation from each of the five villages in the area. Starting in 1993, CECT was allocated the pre-determined commercial hunting quota for the adjacent Chobe Forest Reserve. Its benefits have for most of its history until the 2014 moratorium on hunting, been from the sale of the hunting quota to a professional hunting safari company, supplemented by some donor funding (Mbaiwa 2018). Benefits increased from US\$4800 for the sale of a single elephant in 1993 (roughly US\$1 per trust member) and US\$13,000 in 1994, to US\$200,224 in 2003 (Jones 2002), US\$590,000 in 2008 (Mbaiwa 2011), and US\$700,000 in 2013 immediately prior to the hunting moratorium (Blackie 2019). In 2010, CECT also entered into a tourism lodge development with a private sector joint venture partner to which the trust contributed 15% of the infrastructure costs, and in return for which it receives land rental fees and a percent of revenue (Mbaiwa and Tshamekang 2012). Nevertheless, the extent of active participation in commercial CBNRM ventures remains limited, with most income derived

from sub-leasing tourism or hunting rights (Stone 2015). Since 2019, CECT's revenue has been limited to lease fees and commissions from the tourism lodge (Mbaiwa and Tshamekang 2012).

METHODS

Approach

We drew on primary data from two existing quantitative CECT household surveys conducted in 1995 and 2017. Although the surveys were independent, the approach used in the 1995 CBNRM baseline was followed in 2017 to allow for replication precisely to accommodate the possibility of this cross-temporal analysis. Comparable indicators across surveys represent different livelihood capital types of the Sustainable Livelihoods Framework. These overlap well with the resources and strategies that households use to respond to their environment and are therefore useful indicators of latent characteristics such as AC and resilience (Cassidy and Barnes 2012, Gaughan et al. 2019). We built on established work showing that greater amounts of the five types of livelihood capital—financial, physical, human, social, and natural—confer greater AC and consequently increased resilience and reduced vulnerability (Adger 2003, Heijmans 2004, Vincent 2007).

Because the 2017 survey did not target the same households as 1995, the two datasets are not longitudinal at the household level. Furthermore, it is not possible to ascribe causality to a particular factor (such as the introduction of CBNRM) in any changes that are observed. Instead, we worked on the assumption that in the absence of CBNRM, change in the Enclave communities would have followed that for all rural areas in Botswana, which are similarly remote, but which lack sufficient wildlife or ecological characteristics for government to have considered as viable for tourism or hunting CBNRM. We therefore used available metrics of development to infer whether there are differences to national rural trends that can be attributed to the presence of the CBNRM project.

Primary data

Sampling

The household was considered the economic unit of interest and therefore the unit of sampling and analysis. In 1995, the sample size was based on recent population data for the study area and calculated (after Bernard 1994) using assumptions of maximum heterogeneity and 5% confidence intervals. This calculation resulted in a minimum sample size of 248 for the population of 706 households (CSO 1992). The overall sample was then divided proportionally over the five villages. In 2017 it was decided to aim for a sample size large enough to give 10% confidence limits at village level, while still meeting 5% confidence limits at study area level (all five villages combined). Final sample sizes were 283 households in 1995 and 240 in 2017.

The same systematic random sample selection protocol (Bernard 1994) was followed at both waves. In each village section or cattlepost area, the number of samples required for that area was divided across the estimated number of households in that area to determine n , the “skip” factor, that is, how many households should be skipped between samples. Randomness was introduced by selecting the initial household at random from between 1 and

n . From there, linear transects were walked up and down the village section, selecting every n th household for interviewing. Additional protocols for absent or refusing households were also followed, returning up to 3 times for the former, interviewing next door for the latter.

Both datasets collected information on demographic characteristics (household gender and age structure and composition, ethnicity, education), economic activities (small businesses, wage employment, crop and livestock production, remittances, pensions, government subsidies), wealth and assets (household tools, cropland and livestock ownership), natural resource reliance, participation in community groups, knowledge and awareness of the community trust governance, and market integration.

Survey design and administration

Both the 1995 and 2017 survey instruments were prefaced by an informed consent to be read to each respondent, and necessary academic and government permissions were obtained. Because the language used for data entry and analysis was different from that spoken in the study area, each question was presented in both Tswana (language of enumeration) and English (languages of analysis and interpretation). Both questionnaires were piloted for last-minute adjustments to content and language.

Enumerators were hired from the study area villages, but where possible no enumerator worked in their home village to ensure confidentiality in these smaller communities. Training was linked to the piloting of the questionnaires and took two days. Three enumerators worked under one field team leader, who rotated among the enumerators to ensure consistency and adherence to question delivery. All respondents were given the right of refusal. In 1995 no rewards were offered for participation, while in 2017 a token thank-you gift was given to each respondent. At the end of each day, completed survey instruments were field-checked so that any omissions or clarities could be followed up on through a return visit to the relevant household the following day.

Data entry

For both waves, survey instruments were re-checked on return to the office, and coded responses then captured in the database, with codebooks developed simultaneously. Database entry was checked to find input errors, and to look for trends that might suggest enumeration bias or error. No location or personal identifiers were recorded in 1995 (ensuring anonymity but precluding panel follow-up), while in 2017 household GPS coordinates were randomly offset in all but the master-copy of that database.

Secondary data

Existing papers and government reports were consulted to provide (a) socioeconomic data at regional and national level for comparison, and (b) supplementary sources of information on non-household level aspects such as trust income and benefit distribution. Disaggregated data for rural areas in two government surveys (Central Statistics Office 1995, Statistics Botswana 2018), which are the closest to our survey years, provide a more reasonable national-level comparison to our local rural villages than would overall national averages.

Table 2. Input variables for composite indices.

1. Livelihood diversity index	2. Income index	3. AC index based on livelihood capitals
No. of jobs	[†] Total income from all jobs in HH	Human capital (20%)
No. of small business activities	Total income from small businesses in HH	No. of adults (40%); Inv. dependency ratio (30%); Highest education (30%)
Remittances y/n (1/0)	Total income from remittances to HH	Social capital (20%)
Pension y/n (1/0)	Total income from pensions to HH	Ethnicity (25%); Gender of HH head (25%); Attendance at comm. meetings (20%); No. comm. organisations involved in (20%); Church y/n (10%)
Crop production y/n (1/0)	Total income from sale of NRs by HH	Natural capital (20%)
Livestock production y/n (1/0)		No. of NR (100%)
No. of natural resource types collected		Economic capital (20%)
		No. cattle (30%); No. smallstock (20%); Cropland Ha (20%); Household assets (30%) (Also used (before standardization) stand-alone to assess asset wealth)

[†]All variables for all 3 indices refer to “past 12 months,” i.e., annual income, or currently owned.

Data analysis

Benefits from CBNRM

Measures of central tendency or general descriptives were used to track change in key indicators relating to awareness of and benefits from the CBRNM trust.

Livelihood diversity and human well-being

Engagement in different economic activities and measures of human well-being were also described in terms of general descriptives or central tendency. Building on economic activity, we developed the first of a series of composite indices, a livelihood diversity index (Table 2), which is a simple summation of all jobs, small businesses, natural resources collected, and crop and livestock farming, independent of the amount earned from these activities. For human well-being, we drew on those few indicators that overlapped with national rural data to compare qualitatively whether Chobe Enclave was at a similar level as the national rural average. The comparison is intended to provide additional context, and not to suggest causality.

Economic capital distribution and income inequality

For economic capital and income distribution, we modified work such as Cassidy and Barnes (2012) and Brockington (2021) to develop an income index and an economic capital index, both created by summing selected key indicators (Table 2). These indices are compound indicators, and do not set out to include all incomes or assets, but only those that best place the household in the overall community economy. Financial values for 1995 were converted to 2017 equivalents by using World Bank consumer price index (<https://data.worldbank.org/indicator/FP.CPI.TOTL?locations=BW>) values for each year, essentially resulting in a conversion factor of 4.783. Values were then expressed in US\$ at the exchange rate of 10:1 that prevailed in 2017. The series of assets compiled to determine economic capital as a measure of durable wealth, also contribute to the AC index (Table 2). We used the household income index and economic capital values to determine measures of inequality by calculating Gini coefficients and plotting these as Lorenz curves (Gastwirth 1972). Spearman’s rho was used to test for correlations between these indices and other key indicators.

Adaptive capacity

The third index, AC, follows the general approach and weightings of different input variables developed in work such as that of Vincent (2007) and Cassidy and Barnes (2012). First, variables were combined in groups related to the capital types associated with the Sustainable Livelihoods Framework, but using the structure of four capital types (Scoones 1998) to ensure that only durable characteristics were included, because it may be considered that income, often used in financial capital (Knutsson and Ostwald 2006, Serrat 2017), does not contribute to AC as it is less permanent (Mills et al. 2011). The “capitals” were then standardized and assigned equal weighting in their contribution to AC (Table 2). Categorical variables in the AC index, such as gender of household head and ethnicity, were assigned rank values according to traditional or known positions of social influence in Botswana. The dependency ratio was inverted after calculation to align its valency to that of the AC index.

Bivariate tests for statistically significant differences were run to evaluate relationships between key indicators and AC, or to compare differences in the indices between waves. These tests used included: Kendall’s tau-b or Spearman’s rho for correlations for ranked data; Pearson’s correlation coefficient for continuous data; ANOVA for variance between groups; and Mann-Whitney U to test for equality of means.

RESULTS

Benefits from CBNRM activities

In 1995, two years after the trust’s formation, 46.3% of household respondents stated they had heard of CECT. By 2017, 87.1% of household respondents had heard of CECT, leaving 12.9% of household respondents not knowing of the trust to which they are by default members. In 1995, 95.4% of respondents said they were not involved with CECT, with a similar proportion (95.1%) not attending a meeting of the trust in the past year. In 2017, in response to the question “are you a member of the trust,” 97.1% said “no,” suggesting that they see only the trust board as being the organization, and not themselves as community members. This is despite 63.2% of households having members attending a

meeting of the trust in the past year. This limited understanding of the trust suggests that the broad participation in and a sense of ownership over the trust has not developed over time and with increasing revenue.

In 1995, one year after trust formalization, four jobs through the trust were recorded by the survey. These trust jobs accounted for 1.66% of all jobs recorded and provided income for 2.9% of those households recording jobs (n = 136), and income for 1.4% of all households. In 2017, no jobs were recorded through the trust, a statistically significant reduction (Fisher's exact t-test = 0.1286, p = 0.047). In 1995, 6.4% of households had a family member on the trust board or village trust committee with some revenue from sitting fees, whereas in 2017 2.1% of households reported having a member on the trust board (Fisher's exact t-test = 0.0272, p = 0.015). Given the 2014–2019 moratorium on hunting in Botswana, jobs previously associated with trophy hunting (escorts, camp hands) had disappeared by 2017 and were not replaced with other jobs, further undermining any expectation that this CBNRM project would bring in broader engagement and benefit distribution.

No individual member-based payments are disbursed from the trust other than sitting allowances for board members. Instead, trust revenue has largely been invested in infrastructure and equipment, with the number of jobs created reaching less than 5 % of adults, largely associated with the joint-venture lodge development (Jones 2002, Mbaiwa and Tshamekang 2012, Mbaiwa 2018).

Change in household livelihood diversity and human well-being

Livelihood diversity

The livelihood diversity index, a key correlate of AC, has decreased significantly (Mann-Whitney U 13916.0; p < 0.001), with households pursuing on average a third fewer strategies in 2017 than in 1995 (Table 3). Increased specialization, and reliance on a single livelihood strategy appears to be increasing, with a higher proportion of households relying solely on wage employment or on livestock keeping, but not on crop production (Table 3). Although the Subiya are traditionally crop farmers, it is striking to note how few households reported that they still usually grow crops in 2017. The data suggest a major shift from most households, to less than half now growing crops (Table 3). There has also been a reduction in livestock-keeping, particularly of cattle, in the area. Over the past two decades, there was an increase in the proportion of households entering the cash economy through wage employment (likely working in new government schools and clinics as settlements have increased in size), but a reduction in households earning money from small businesses. Although reliance on government-subsidized labor-based public works (LBPW) decreased slightly, this is still a key source of cash for many households (Table 3). The proportion of livelihood derived from natural resources, as characterized by different types of resources collected, also dropped for a large proportion of households.

Key indicators of human well-being

Finding comparable indicators for checking Chobe Enclave conditions against a national average was challenging. Although Botswana disaggregates data for rural areas, which provides a useful benchmark, the available indicators that overlapped with survey data were few. Although Chobe Enclave lags slightly

Table 3. Changes in key economic activities.

Households	1995 (n = 283, unless otherwise stated)	2017 (n = 240, unless otherwise stated)
Economic diversification and specialization		
Ave. no. of livelihood strategies per HH	9.6	6.2
% of HH that only grow crops	8.1	2.1
% of HH that only keep livestock	3.2	7.1
% of HH that only have wage employment	7.1	17.5
Engagement in key economic sectors		
% usually growing crops	85.5	42.9
% of crop-growers who planted crops in past season	91.3 (n = 241)	87.4 (n = 103)
% keeping livestock	77	64.2
% of livestock-owning HH keeping cattle	78.6 (n=218)	57.8 (n=154)
% of livestock-owning HH keeping goats	42.4 (n=218)	40.9 (n=154)
% of livestock-owning HH keeping poultry	55.5 (n=218)	77.1 (n=154)
% with any waged employment (part- or full-time)	48.6	59.2
% of all HH with permanent income from tourism [†]	9.2 (26 jobs recorded)	8.2 (22 jobs recorded)
% of all HH with income from part-time tourism work [†]	2.1	7.1
% with income from small businesses	68.2	32.5
% relying on LBPW as income source in past year	53.7	45.8
% relying on 4 or more natural resources (excl. firewood)	93.6	27.5

[†] Note these two figures should not be summed, because the same HH with permanent income may also have someone doing casual or part-time work in tourism.
 LBPW = labor-based public works.

behind the national rural average for switching from reliance on fuelwood (Table 4), the difference is small, and may be due to factors other than CBNRM-related economic conditions. The area's households have had a rapid increase in access to private water connections, although again this was possibly in response to a non-CBNRM related intervention. Given that tourism is the main economic industry in Chobe District, and that the increase in tourism-related employment was quite small (Table 3), the strong increase in households with someone in full-time wage employment (Table 4) is surprising; clearly other sectors are important. It is possible that some family members have left the household to live in the region's tourism hubs. Even though Chobe Enclave's wage employment rate was already higher than the national rural average in 1995, in 2017 it was more than double the national figure. At the same time, the proportion of households relying on LBPWs remains much higher in 2017 than the national average for rural areas, suggesting that although households may be abandoning subsistence farming (Table 3), insufficient alternative livelihoods are available. Poverty and inequality also remain above the national rural average (Table 4). Levels of inequality in Chobe Enclave are surprisingly much higher than the national average (Table 4), and appear to have been so even before the introduction of the CBNRM project.

Changes in economic capital distribution and income inequality

There has been a moderately significant (Mann-Whitney U 30475.0; p = 0.043) decrease in economic capital in 2017 relative to 1995 (Fig. 2a, Table 5). A similar, but more significant (Mann-Whitney U 29566.0; p = 0.011) decrease, was recorded for income. The reduction appears to have affected mainly better-off

Table 4. Comparison of selected indicators of human well-being against national rural averages.

Indicators of human well-being	Source	1995	2017
% of HHs using fuelwood for cooking	Survey data	87.6	77.1
	National rural areas data [†]	85.7	72.4
% of HHs with private water connection	Survey data	10.6	81.7
	National rural areas data	9.1	42.9
% of HHs with full-time wage employment	Survey data	18.4	47.5
	National rural areas data	11.6	20.8
% of HHs relying on labor-based public works	Survey data	53.7	45.9
	National rural areas data	45.0 [‡]	13.9
Income inequality GINI coefficient	Survey data	0.900	0.850
	National rural areas data	0.411	0.597
% of HHs experiencing food insecurity	Survey data	No data	52.9
	National rural areas data	No data	50.2

[†] Central Statistics Office (1995) and Statistics Botswana (2018).

[‡] Estimate based on Valentine (1993).

households, with those in the top 10% showing a strong reduction in their indicators of economic capital and income whereas those in the bottom 10% showed a nominal increase. The reduction in economic capital and income for the top 10% is reflected in the changes in the Gini coefficients and Lorenz curves, which show that the distribution of these two measures of wealth is slightly less skewed in 2017 compared to 1995 (Fig. 2c and Fig. 2d). Although economic inequality has decreased in Chobe Enclave, it is still considerably higher than the national average for rural areas, which experienced an increase in inequality over the study period (Table 4). This reduction in inequality does not necessarily reflect improved conditions; in Chobe Enclave it appears to be associated with a reduction in total overall economic capital and income particularly among the wealthiest, instead of an increase in income for the poorest.

Bivariate analyses of key indicators reveal important correlations that individually explain variance in income. In 1995, ranked gender of household head (male, absent male, female) was significantly correlated with income, and had a positive relationship with the livelihood diversity index (Table 6). In 2017, gender of household head was less strongly correlated to income, and not at all with livelihood diversity. This change can be attributed both to the increase in the proportion of households headed by women (see Table 5) as well as to changes in the socioeconomic status of such households. Highest formal education in the household remained moderately correlated with the income index at both waves and was not correlated with livelihood diversity at either. In part this may be because subsistence farming and natural resources use are activities that draw on traditional skill sets.

It is noteworthy that the income and livelihood diversity indices are moderately but significantly correlated at both waves (Table 6). It is likely that households with more adults (a dimension of human capital) can diversify income streams while also generating a greater combined inflow.

Change in adaptive capacity

There were statistically significant (at 0.05 level) differences between the 1995 and 2017 values of all capital types except social (Table 5 and Fig. 3). Natural capital, in particular, was strongly

reduced. The AC index, which sums standardized values for each of the four capital indices, is significantly lower for 2017 than for 1995 (Mann-Whitney U 23417.0; $p < 0.001$). The reduction is greater for the 10% of households with the highest economic capital, but unlike that measure, there is also a marked reduction in AC for the lowest 10% (Fig. 4a). The reduction in AC is similarly noticeable for the highest and lowest 10% of households when assessed in terms of income (Fig. 4b).

AC has a moderate but significant and positive correlation to livelihood diversity in both 1995 and 2017, although the association is weaker at the latter wave (Table 7). Given that livelihood diversity appears to be decreasing as specialization emerges (Table 3), and that at face value lower diversity suggests lower AC, this raises concerns for household AC in the study area. At the same time, the linkages between different specializations and AC have changed over time (Table 7). In 1995, those with only wage employment had significantly lower AC than those with other or multiple livelihood strategies; this difference fell away in 2017. In contrast, in 1995 households with small business income as their only livelihood source had significantly higher AC than those without; again, this difference was no longer significant in 2017. Crop farmers with no other livelihood sources had significantly lower AC in 1995, as did those only keeping livestock. Those keeping livestock only were in 2017 still likely to have lower AC (Table 7). However, although relying on mixed (crops and livestock) farming only was negatively associated with AC in 1995, by 2017 mixed farming was positively and significantly associated with AC.

DISCUSSION

The critical literature in conservation science has long suggested that CBNRM is under-performing, and this study provides empirical evidence on how such shortcomings play out at the household level. Although our findings do not suggest that CECT's CBNRM project has had a detrimental effect on people's livelihoods, the project does not appear to have lived up to the high expectations of either the participating villages or supporting agencies (Blaikie 2006, Cassidy 2021).

Given no direct financial disbursements below village level, and limited employment opportunities, it is unsurprising that CBNRM supports negligible gain in household-level well-being, despite the community trust earning high revenues annually. Indeed, one of the first community-level projects from the trust was a grinding mill, but given the substantial reduction in crop-producing households it now benefits even fewer households. The 2014 hunting ban may have caused a reduction in community level income (Mbaiwa 2018), but this cannot be said to have affected household human well-being directly, because the trust's revenue from hunting has never been disbursed directly to households. The number of households with someone in wage employment has increased at a rate far higher than the national average, suggesting greater economic opportunities. For instance, wage employment in 2017 appeared to be associated primarily with livestock herding, and it is possible that the out-migration of household members in search of tourism work has facilitated in-migration of farm workers from neighboring countries, as survey data showed an increase in speakers of Zambian and Namibian languages. However, such opportunities do not appear to be high-earning, nor are there many related to tourism, the expected

Fig. 2. Comparison of 1995 and 2017 (a) overall economic capital, and (b) income, for all households and for top and bottom 10% of households of each measure, with (c) and (d) showing the associated Lorenz curves.

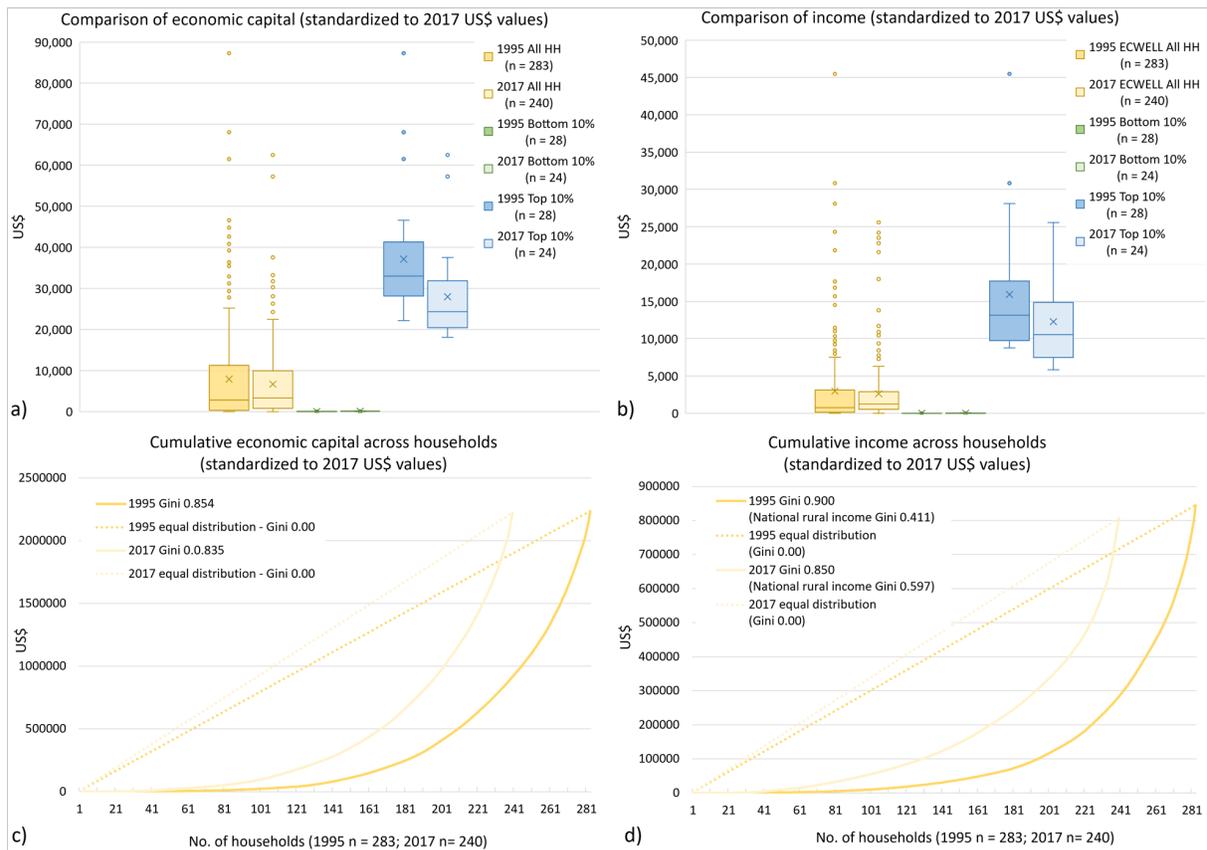


Table 5. Comparison of capital indices between 1995 and 2017.

Capital indices	Mann-Whitney test value	2-tailed significance
Human capital index	U = 29358.0	p = 0.008
Social capital index	U = 31600.5	p = 0.171
Natural capital index	U = 11990.5	p < 0.001
Economic capital index	U = 30475.0	p = 0.043

industry associated with CBNRM. With a few exceptions, jobs in tourism do not appear to be emerging within the Enclave itself. Instead, they tend to be located far from the five communities, a factor that is possibly adding to the out-migration of household members.

Further, the reduction in mean economic capital and mean income, combined with the fact that close to half of households in the area, far above the national rural average, still rely on subsidized public-works labor, suggests that economic conditions have not improved greatly, and reinforces the notion that only limited opportunities are currently available in the area. The reduction in household income is especially noteworthy given the rapid integration of Botswana into the cash economy over the past 20 years (Wikan 2004, Hjort 2010) and given the CNBRM focus in Chobe on high revenue joint partnerships. Indeed, it is

Table 6. Changes in relationships between key demographic characteristics, and income and livelihood diversity.

	Income index		Livelihood diversity index	
	1995	2017	1995	2017
Gender of HH head†	$\rho = 0.141$; p = 0.018	$\rho = 0.146$; p = 0.023	$\rho = 0.100$; p = 0.092	$\rho = -0.019$; p = 0.773
Highest education in HH†	$\rho = 0.395$; p < 0.001	$\rho = 0.385$; p < 0.001	$\rho = 0.037$; p = 0.537	$\rho = 0.070$; p = 0.283
Livelihood diversity index†	$\rho = 0.358$; p < 0.001	$\rho = 0.126$; p = 0.051	--	--

† Spearman's correlation; two-tailed significance.

disconcerting to see Chobe households lag Botswana's rural averages in several key measures. Overall, household level conditions in the Chobe communities do not appear to be markedly greater than those for rural communities generally in Botswana, the large majority of whom do not have CBNRM projects, let alone high-earning ones such as Chobe Enclave's (Mbaiwa 2018).

The reduction in overall economic capital and income, while problematic, occurred mainly for wealthier households while poorest households saw little change in their economic situation. This can be viewed as a modest closing of, on the one hand, gender

Fig. 3. Comparison of differences in capital indices between 1995 and 2017, with boxplots capturing upper and lower quartiles and showing median as line and mean as “x.”

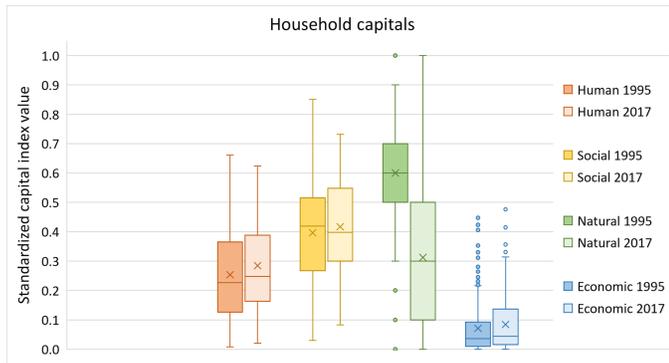
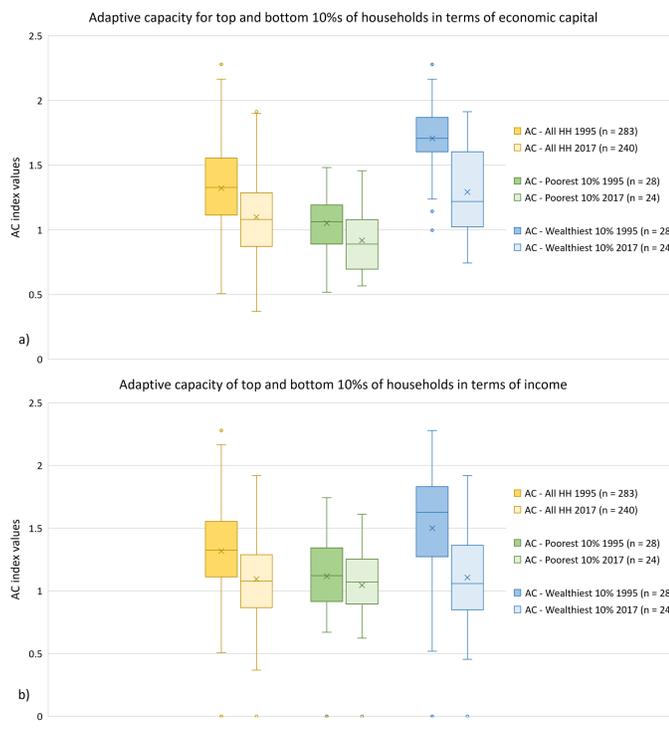


Fig. 4. Comparison of adaptive capacity between 1995 and 2017 for all households and for poorest and wealthiest 10% of households in terms of (a) economic capital and (b) income, with boxplots capturing upper and lower quartiles and showing median as line and mean as “x.”



and education gaps, and on the other, the wealth gap. The reduction in inequality observed in the Chobe villages is somewhat problematic to evaluate in a positive light, given that it does not relate to improved conditions for those most in need of economic upliftment. Indeed, inequality may play a major role in disrupting economic growth in these communities (Shen and Zhao 2023), and it is likely that opportunities that had been dominated by the elite (see Hilbom 2012,

Mogalakwe and Nyamnjoh 2017, Molosi-France and Dipolo 2019, Cassidy 2021) have dwindled in recent years. This factor may also be important when considering whether the pre-existence of an economic elite may have led to some “capture” of the participatory and benefit distribution processes, and may have undermined efforts to devolve benefits to household level. Further, it suggests that participation in a project under the Botswana CBNRM model does not confer household-level benefits or development over and above what might be expected from general national economic growth as experienced in other rural areas in Botswana.

The decrease in mean household AC is also of concern, as is its continued correlation with livelihood diversity, which is also decreasing. Although some of the reduction in households usually growing crops can be attributed to the increase in wage employment, the latter does not fully account for the almost halving of the number of all farming households. It is possible that crop and livestock depredation by wildlife is an important covarying factor (Salerno et al. 2020). As conditions in rural Botswana become more unpredictable through both climate change and increased human wildlife conflict (Salerno et al. 2021b), the importance of diversified livelihoods as a buffer to shocks should not be underestimated (Siders 2019). After two decades of increasing community-level revenue from CBNRM in Chobe, it is disturbing to note that this revenue does not appear to have contributed to overall human well-being at household level. Although the communities themselves may be more resilient because of their CBNRM income, it is not clear that this benefit has crossed scales to reach the household level or been distributed equitably among constituent families (Vincent 2007, Patnaik and Das 2017).

We were able to measure household AC using repeat socioeconomic survey data with the same input criteria at the different waves, working with parameters that have been shown elsewhere to be important, and that were available at both waves to allow for direct comparison. We do not believe that changing the weightings or tweaking input variables would change the significance of our results. Although the choice of input variables is subjective, these have been proven to be useful indicators in other studies and are selected based on known parameters influencing livelihood outcomes. Important to note is that our datasets did not allow for panel analysis, and our interpretations of change in the context of CBNRM are based on Chobe Enclave being an area with access to natural and economic resources beyond those found in many places in Botswana. CECT is also considered the highest-earning CBNRM project among only a handful in the country. We therefore believe it is a fair assumption to expect economic conditions in the area to out-perform national rural averages. At the same time, national rural data as points of reference were less useful than hoped, because common variables between our study site and the national surveys were fewer than expected. Although they might lack the same historical context, additional studies that contrast current livelihood and AC conditions in a non-CBNRM rural area with those in Chobe Enclave, could provide additional insights.

Nevertheless, our focus on household-level AC allows for the complexities of socioeconomic change to be assessed (Armitage 2005) and confirms qualitative assessments that suggest

Table 7. Changes in relationships between livelihood diversity, specialization, and adaptive capacity.

Livelihood strategy	Adaptive capacity	
	1995 (n = 283)	2017 (n = 240)
Livelihood diversity index [†]	$\rho = 0.634; p < 0.001$	$\rho = 0.567; p < 0.001$
Wage income only y/n [‡]	F = 15.391; p < 0.001	F = 2.841; p = 0.093
Small business income only y/n [‡]	F = 16.790; p < 0.001	F = 1.822; p = 0.178
Crop production only y/n [‡]	F = 15.440; p < 0.001	F = 0.612; p = 0.435
Livestock production only y/n [‡]	F = 5.070; p = 0.025	F = 4.383; p = 0.037
Only crop and livestock production y/n [‡]	F = 0.170; p = 0.680	F = 12.625; p < 0.001

[†] Spearman's correlation; two-tailed significance.

[‡] ANOVA; two-tailed significance.

CBNRM, particularly where communities are seen as homogeneous units, is underperforming (Dressler et al. 2010). The formation of a community trust based on natural resources management could reasonably be expected, if successful, to strengthen human well-being across multiple dimensions and levels. If it does not, this would suggest design flaws that limit its efficacy (Brooks et al. 2013). It is also of strong concern that abandonment of livelihood strategies that draw on the environment (natural resources, crops, livestock) could be due to risk aversion associated with climate unpredictability and wildlife conflict (Salerno et al. 2021b), even as the shrinking of diversified livelihoods and natural capital reduces AC, particularly for poorer households (Barbier 2012, Choden et al. 2020).

Although much attention has been diverted to community-level issues such as governance or active resource management (Blaikie 2006, Cassidy 2021), less research has been done linking community governance to household impacts (Salerno et al. 2021a). Our analyses provide empirical evidence to support review findings across Africa that point toward mixed results from CBNRM, particularly with regards to human well-being (Brooks et al. 2013, Galvin et al. 2018). Household level human well-being or AC is not automatically enhanced by the presence of a CBNRM project. It could be argued that this is particularly the case for projects that focus on high-earning commercial wildlife-based tourism, as opposed to actual management of resources, or on plant and other resources of direct utilitarian value to community members, because high revenues obscure the need for interventions that target the level where costs are most felt. The Botswana government's premise, that if the community is benefitting, all are benefitting, is problematic because not all households are equal, nor are the costs of living with wildlife equal for all households. In the current Botswana CBNRM model, benefits do not trickle down to all households equitably, nor do such benefits appear to be addressing existing inequalities by improving livelihoods for the poorest. Such structural and scale considerations must be included in project designs if CBNRM is to bring success in both ecological and social spheres (Berkes 2006, Brooks et al. 2013).

Our findings suggest it is important and urgent to restructure CBNRM in Botswana, and perhaps more widely in Africa, to focus on activities that would directly reach the household level, including stewardship programs or direct payments for ecosystem services (Ferraro 2011, Cassidy 2021). CBNRM projects need to

aim at supporting multiple livelihood streams as a way of accommodating high levels of unpredictability associated with climate change or tourism constraints associated with global upheavals. This should include revitalizing and diversifying the crop production sector using wildlife- and conservation-focused approaches (Vogel et al. 2022). Targeted household disbursements could support micro-enterprises, including those based on sustainable plant resource use. Should high-earning community-level ventures continue as a focus, but with a decision to distribute benefits to member households, appropriate mechanisms for independent auditing and oversight would need to be instituted, to ensure equitable distribution (Mosimane and Silva 2015).

CONCLUSION

The wildlife-based economic model of CBNRM has been challenged globally to demonstrate direct benefits to households enduring negative impacts from conservation. We apply a livelihoods capital approach and longitudinal household survey data spanning 22 years in northern Botswana to assess livelihood diversity and CBNRM impacts to AC and human well-being. Our findings echo large-scale qualitative reviews showing the lack of direct economic benefits disbursed by CECT, while going further to demonstrate limits to indirect or community-level benefits in contributing to improved household-level AC or broader well-being.

Evaluating CBNRM progress toward social and ecological goals must be conducted in the context of broader social change and evolving institutions and livelihoods (Salerno et al. 2021a). Future methodological work could test different permutations of input variables to see how this might affect interpretation. In addition, new studies targeting the linkages between livelihood capitals and AC should seek empirical measures for differences at household, community, and wider scales, while the theoretical concepts of the capitals should be revisited to better understand the role of less tangible characteristics such as ecosystem services or social networks. At the same time, an empirical understanding of such conditions would be greatly enhanced by people's own perceptions of their household's AC, and of a given project's contribution to it. Finally, socioeconomic baseline studies that truly seek to understand the impact of an intervention should be designed with the follow-up survey in mind by already defining the timing for the repeat visit, and ensuring safe capture of sample household identifiers to allow for direct assessment of change for individual households. Such planned temporal datasets are critical to understanding changing systems. Ideally, longitudinal studies should be set up in multiple sites (such as comparing Botswana to Tanzania or Namibia) that would allow comparison of the impacts under different CBNRM models. An important topic to include in such future research might be to understand how existing inequalities and elite control at community level may affect not only the development of appropriate CBNRM models, but also benefit distribution structures that ensure that households that bear the costs of living with wildlife, are also directly benefiting from it.

In southern Africa and beyond, it is time to debunk the idea that if communities benefit from conservation, their member households automatically do too. Less centralized approaches would improve CBNRM, so that projects can be appropriate to their location and respond to changing conditions. Participation

based on each individual's interest in a given natural resource, instead of on the basis of residence in a community, would enhance both conservation and provide a better match of scale between project benefits and environmental costs (Cassidy 2021). An approach that encompasses several small projects is also likely to ensure greater equity than one where the elite in a community control funds "for the benefit of all."

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Data Availability:

The datasets that support the findings of this study are available on request from the corresponding author, LC, and can also be found for download at LC's ResearchGate page. The 1995 survey was part of a USAID development initiation, and was not submitted for academic institutional review. Instead, the lead social scientist on the USAID CBNRM program (Project #690-0251.33) evaluated the instrument for ethical consideration. Ethical approval for the 2017 survey was granted by University of Colorado Institutional Review Board (#16-0126).

LITERATURE CITED

Adger, W. 2003. Social capital, collective action, and adaptation to climate change. *Economic Geography* 79(4):387-404.

Agrawal, A., and C. Gibson, editors. 2001. *Communities and the environment: ethnicity, gender, and the state in community-based conservation*. Rutgers University Press, New Brunswick, New Jersey, USA.

Alexander, S. M., M. Andrachuk, and D. Armitage. 2016. Navigating governance networks for community-based conservation. *Frontiers in Ecology and the Environment* 14 (3):155-164. <https://doi.org/10.1002/fee.1251>

Armitage, D. 2005. Adaptive capacity and community-based natural resource management. *Environmental Management* 35 (6):703-715. <https://doi.org/10.1007/s00267-004-0076-z>

Barbier, E. B. 2012. Natural capital, ecological scarcity and rural poverty. World Bank Policy Research Working Paper, 6232. <https://doi.org/10.1596/1813-9450-6232>

Beebe, M. 2003. Community development trust(s) in Botswana: institutional arrangements and social policy for savanna sustainability. *South African Geographical Journal* 85(1):58-68. <https://doi.org/10.1080/03736245.2003.9713785>

Berkes, F. 2004. Rethinking community-based conservation. *Conservation Biology* 18(3):621-630. <https://doi.org/10.1111/j.1523-1739.2004.00077.x>

Berkes, F. 2006. From community-based resource management to complex systems: the scale issue and marine commons. *Ecology and Society* 11(1):45. <https://doi.org/10.5751/ES-01431-110145>

Berkes, F. 2007. Community-based conservation in a globalized world. *Proceedings of the National Academy of Sciences* 104 (39):15188-15193. <https://doi.org/10.1073/pnas.0702098104>

Bernard, H. 1994. *Research methods in anthropology - qualitative and quantitative approaches*. First edition. Rowman and Littlefield, Walnut Creek, California, USA.

Bilan, Y., H. Mishchuk, N. Samoliuk, and H. Yurchyk. 2020. Impact of income distribution on social and economic well-being of the state. *Sustainability* 12(1):429. <https://doi.org/10.3390/su12010429>

Blackie, I. 2019. The impact of wildlife hunting prohibition on the rural livelihoods of local communities in Ngamiland and Chobe District Areas, Botswana. *Cogent Social Sciences* 5:1558716. <https://doi.org/10.1080/23311886.2018.1558716>

Blaikie, P. 2006. Is small really beautiful? Community-based natural resource management in Malawi and Botswana. *World Development* 34(11):1942-1957. <https://doi.org/10.1016/j.worlddev.2005.11.023>

Brockington, D. 2021. Persistent peasant poverty and assets. Exploring dynamics of new forms of wealth and poverty in Tanzania 1999-2018. *Journal of Peasant Studies* 48(1):201-220. <https://doi.org/10.1080/03066150.2019.1658081>

Brooks, J. S., K. A. Waylen, and M. B. Mulder. 2013. Assessing community-based conservation projects: a systematic review and multilevel analysis of attitudinal, behavioral, ecological, and economic outcomes. *Environmental Evidence* 2:2. <https://doi.org/10.1186/2047-2382-2-2>

Cassidy, L. 2000. CBNRM and legal rights to resources in Botswana. IUCN and Netherlands Development Organisation (SNV) CBNRM Support Programme Occasional Paper Series No. 4. IUCN, Gland, Switzerland.

Cassidy, L. 2021. Power dynamics and new directions in the recent evolution of CBNRM in Botswana. *Conservation Science and Practice* 3(1):e205. <https://doi.org/10.1111/csp2.205>

Cassidy, L., and G. D. Barnes. 2012. Understanding household connectivity and resilience in marginal rural communities through social network analysis in the village of Habu, Botswana. *Ecology and Society* 17(4):11. <https://doi.org/10.5751/ES-04963-170411>

- Central Statistics Office (CSO). 1992. Population of towns, villages and associated localities in August 1991. Botswana Government Printer, Gaborone, Botswana.
- Central Statistics Office (CSO). 1995. Household income and expenditure survey 1993/4. Botswana Ministry of Finance and Development Planning, Gaborone, Botswana.
- Centre for Applied Research. 2016. Review of community-based natural resource management in Botswana. Report prepared for USAID's Southern African Environmental Programme (SAREP), Gaborone, Botswana.
- Chan, K. M. A., R. M. Pringle, J. A. I. Ranganathan, C. L. Boggs, Y. L. Chan, P. R. Ehrlich, P. K. Haff, N. E. Heller, K. Al-Khafaji, and D. P. Macmynowski. 2007. When agendas collide: human welfare and biological conservation. *Conservation Biology* 21 (1):59-68. <https://doi.org/10.1111/j.1523-1739.2006.00570.x>
- Chevallier, R., and R. Harvey. 2016. Is community-based natural resource management in Botswana viable? Policy Insights 31, South African Institute of International Affairs, Johannesburg, South Africa.
- Choden, K., R. J. Keenan, and C. R. Nitschke. 2020. An approach for assessing adaptive capacity to climate change in resource dependent communities in the Nikachu watershed, Bhutan. *Ecological Indicators* 114:106293. <https://doi.org/10.1016/j.ecolind.2020.106293>
- Chowdhury, T. A. 2021. Applying and extending the sustainable livelihoods approach: identifying the livelihood capitals and well-being achievements of indigenous people in Bangladesh. *Journal of Social and Economic Development* 23(2):302-320. <https://doi.org/10.1007/s40847-021-00163-z>
- Collomb, J.-G. E., J. R. Alavalapati, and T. Fik. 2012. Building a multidimensional wellbeing index for rural populations in northeastern Namibia. *Journal of Human Development and Capabilities* 13(2):227-246. <https://doi.org/10.1080/19452829.2011.645532>
- Drake, M. D., J. Salerno, R. E. Langendorf, L. Cassidy, A. E. Gaughan, F. R. Stevens, N. G. Pricope, and J. Hartter. 2021. Costs of elephant crop depredation exceed the benefits of trophy hunting in a community-based conservation area of Namibia. *Conservation Science and Practice* 3(1):e345. <https://doi.org/10.1111/csp2.345>
- Dressler, W., B. Büscher, M. Schoon, D. Brockington, T. Hayes, C. Kull, J. McCarthy, and K. Shrestha. 2010. From hope to crisis and back again? A critical history of the global CBNRM narrative. *Environmental Conservation* 37(1):5-15. <https://doi.org/10.1017/S0376892910000044>
- Dunnink, J. A., R. Hartley, L. Rutina, J. Alves, and A. M. Franco. 2020. A socio-ecological landscape analysis of human-wildlife conflict in northern Botswana. *Oryx* 54(5):661-669. <https://doi.org/10.1017/S0030605318001394>
- Engle, N. L. 2011. Adaptive capacity and its assessment. *Global Environmental Change* 21(2):647-656. <https://doi.org/10.1016/j.gloenvcha.2011.01.019>
- Fabricius, C. 2004. The fundamentals of community-based natural resource management. Pages 3-43 in C. Fabricius and E. Koch, editors. *Rights, resources and rural development*. Routledge, London, UK.
- Ferraro, P. J. 2011. The future of payments for environmental services. *Conservation Biology* 25(6):1134-1138. <https://doi.org/10.1111/j.1523-1739.2011.01791.x>
- Frost, P. G. H., and I. Bond. 2008. The CAMPFIRE programme in Zimbabwe: payments for wildlife services. *Ecological Economics* 65(4):776-787. <https://doi.org/10.1016/j.ecolecon.2007.09.018>
- Galvin, K. A., T. A. Beeton, and M. W. Luizza. 2018. African community-based conservation: a systematic review of social and ecological outcomes. *Ecology and Society* 23(3):39. <https://doi.org/10.5751/ES-10217-230339>
- Gastwirth, J. L. 1972. The estimation of the Lorenz curve and Gini index. *Review of Economics and Statistics* 54(3):306-316. <https://doi.org/10.2307/1937992>
- Gaughan, A. E., F. R. Stevens, N. G. Pricope, J. Hartter, L. Cassidy, and J. Salerno. 2019. Operationalizing vulnerability: land system dynamics in a transfrontier conservation area. *Land* 8 (7):111. <https://doi.org/10.3390/land8070111>
- Gontse, K., J. E. Mbaiwa, and O. T. Thakadu. 2018. Effects of wildlife crop raiding on the livelihoods of arable farmers in Khumaga, Boteti sub-district, Botswana. *Development Southern Africa* 35(6):791-802. <https://doi.org/10.1080/0376835X.2018.1495061>
- Gupta, A. C. 2013. Elephants, safety nets and agrarian culture: understanding human-wildlife conflict and rural livelihoods around Chobe National Park, Botswana. *Journal of Political Ecology* 20(1):238-254. <https://doi.org/10.2458/v20i1.21766>
- Gupta, A. C. 2014. Wildlife paying its way? A critical analysis of community-based natural resource management in the Chobe Enclave, Botswana. Pages 110-130 in M. Sowman and R. Wynberg, editors. *Governance for justice and environmental sustainability*. Routledge, London, UK. <https://doi.org/10.4324/9780203120880-6>
- Gupta, A. C. 2015. Spatial scaling of protected area influences on human demography and livelihoods in Botswana. *Environmental Conservation* 42(1):51-60. <https://doi.org/10.1017/S0376892914000095>
- Heijmans, A. 2004. From vulnerability to empowerment. Pages 115-127 in G. Bankoff, G. Frerks, and D. Hilhorst, editors. *Mapping vulnerability: disasters, development and people*. Routledge, London, UK.
- Hillbom, E. 2012. Botswana: a development-oriented gate-keeping state. *African Affairs* 111(442):67-89. <https://doi.org/10.1093/afraf/adr070>
- Hinkel, J. 2011. "Indicators of vulnerability and adaptive capacity": towards a clarification of the science-policy interface. *Global Environmental Change* 21(1):198-208. <https://doi.org/10.1016/j.gloenvcha.2010.08.002>
- Hjort, J. 2010. Pre-colonial culture, post-colonial economic success? The Tswana and the African economic miracle. *Economic History Review* 63(3):688-709. <https://doi.org/10.1111/j.1468-0289.2009.00495.x>

- Jones, B. T. B. 2002 Chobe Enclave, Botswana lessons learnt from a CBNRM Project 1993-2002. IUCN and Netherlands Development Organisation (SNV) CBNRM Support Programme Occasional Paper Series No. 7. IUCN, Gland, Switzerland.
- Jones, L., E. Ludi, and S. Levine. 2010. Towards a characterisation of adaptive capacity: a framework for analysing adaptive capacity at the local level. Overseas Development Institute, London, UK. <https://odi.org/en/publications/towards-a-characterisation-of-adaptive-capacity-a-framework-for-analysing-adaptive-capacity-at-the-local-level/>
- Jordan, N. R., B. P. Smith, R. G. Appleby, L. M. van Eeden, and H. S. Webster. 2020. Addressing inequality and intolerance in human-wildlife coexistence. *Conservation Biology* 34(4):803-810. <https://doi.org/10.1111/cobi.13471>
- Knutsson, P., and M. Ostwald. 2006. A process-oriented sustainable livelihoods approach—a tool for increased understanding of vulnerability, adaptation and resilience. *Mitigation and Adaptation Strategies for Global Change* 28:1-20. <https://doi.org/10.1007/s11027-006-4421-9>
- Magome, H., and C. Fabricius. 2013. Reconciling biodiversity conservation with rural development: The Holy Grail of CBNRM? Pages 108-127 in C. Fabricius and E. Koch, editors. *Rights, resources and rural development*. Routledge, London, UK.
- Mbaiwa, J. 2011. CBNRM stocktaking in Botswana. Report prepared under USAID contract EPP-I-00-06-00021-00/01 by DAI in collaboration with WWF. USAID, Washington, D.C., USA.
- Mbaiwa, J. E. 2018. Effects of the safari hunting tourism ban on rural livelihoods and wildlife conservation in Northern Botswana. *South African Geographical Journal* 100(1):41-61. <https://doi.org/10.1080/03736245.2017.1299639>
- Mbaiwa, J., and T. Tshamekang. 2012. Developing a viable community-based tourism project in Botswana: the case of the Chobe Enclave Conservation Trust. Pages 519-536 in A. Ahmed, editor. *World sustainable development outlook 2012*. Routledge, London, UK. <https://doi.org/10.47556/B.OUTLOOK2012.10.33>
- McKinnon, M. C., S. H. Cheng, S. Dupre, J. Edmond, R. Garside, L. Glew, M. B. Holland, E. Levine, Y. J. Masuda, D. C. Miller, et al. 2016. What are the effects of nature conservation on human well-being? A systematic map of empirical evidence from developing countries. *Environmental Evidence* 5:8. <https://doi.org/10.1186/s13750-016-0058-7>
- Mills, D., C. Béné, S. Ovie, A. Tafida, F. Sinaba, A. Kodio, A. Russell, N. Andrew, P. Morand, and J. Lemoalle. 2011. Vulnerability in African small-scale fishing communities. *Journal of International Development* 23(2):308-313. <https://doi.org/10.1002/jid.1638>
- Milner-Gulland, E. J., J. A. McGregor, M. Agarwala, G. Atkinson, P. Bevan, T. Clements, T. Daw, K. Homewood, N. Kumpel, J. Lewis, et al. 2014. Accounting for the impact of conservation on human well-being. *Conservation Biology* 28(5):1160-1166. <https://doi.org/10.1111/cobi.12277>
- Mogalakwe, M., and F. Nyamnjoh. 2017. Botswana at 50: democratic deficit, elite corruption and poverty in the midst of plenty. *Journal of Contemporary African Studies* 35(1):1-14. <https://doi.org/10.1080/02589001.2017.1286636>
- Mogende, E., and O. Kolawole. 2016. Dynamics of local governance in natural resource conservation in the Okavango Delta, Botswana. *Natural Resources Forum* 40(3):93-102. <https://doi.org/10.1111/1477-8947.12098>
- Mohanty, I., and R. Tanton. 2012. A wellbeing framework with adaptive capacity. NATSEM Working Paper 12/17. National Centre for Social and Economic Modelling, University of Canberra, Canberra, Australia.
- Molosi-France, K., and K. Dipholo. 2019. Re-thinking participatory rural development in Botswana: Is the enemy in the theory or in the implementation process of the theory? *International Journal of Community and Social Development* 1(4):295-309. <https://doi.org/10.1177/2516602619894411>
- Mosimane, A. W., and J. A. Silva. 2015. Local governance institutions, CBNRM, and benefit-sharing systems in Namibian conservancies. *Journal of Sustainable Development* 8:2. <https://doi.org/10.5539/jsd.v8n2p99>
- Murphree, M. W. 2009. The strategic pillars of communal natural resource management: benefit, empowerment and conservation. *Biodiversity and Conservation* 18:2551-2562. <https://doi.org/10.1007/s10531-009-9644-0>
- Naidoo, R., M. J. Chase, P. Beytell, P. Du Preez, K. Landen, G. Stuart-Hill, and R. Taylor. 2016. A newly discovered wildlife migration in Namibia and Botswana is the longest in Africa. *Oryx* 50(1):138-146. <https://doi.org/10.1017/S0030605314000222>
- Nelson, F., editor. 2012. *Community rights, conservation and contested land: the politics of natural resource governance in Africa*. Routledge, London, UK.
- Nelson, F., P. Muyamwa-Mupeta, S. Muyengwa, E. Sulle, and D. Kaelo. 2021. Progress or regression? Institutional evolutions of community-based conservation in eastern and southern Africa. *Conservation Science and Practice* 3(1):e302. <https://doi.org/10.1111/csp2.302>
- Osbahr, H., C. Twyman, W. N. Adger, and D. S. G. Thomas. 2010. Evaluating successful livelihood adaptation to climate variability and change in southern Africa. *Ecology and Society* 15(2):27. <https://doi.org/10.5751/ES-03388-150227>
- Paganini, N., K. Adinata, N. Buthelezi, D. Harris, S. Lemke, A. Luis, J. Koppelin, A. Karriem, F. Ncube, E. Nervi Aguirre, et al. 2020. Growing and eating food during the COVID-19 pandemic: farmers' perspectives on local food system resilience to shocks in Southern Africa and Indonesia. *Sustainability* 12(20):8556. <https://doi.org/10.3390/su12208556>
- Patnaik, U., and P. K. Das. 2017. Do development interventions confer adaptive capacity? Insights from rural India. *World Development* 97:298-312. <https://doi.org/10.1016/j.worlddev.2017.04.017>
- Pricope, N., A. Gaughan, J. All, M. Binford, and L. Rutina. 2015. Spatio-temporal analysis of vegetation dynamics in relation to

- shifting inundation and fire regimes: disentangling environmental variability from land management decisions in a Southern African Transboundary Watershed. *Land* 4(3):627-655. <https://doi.org/10.3390/land4030627>
- Purdon, A., M. A. Mole, M. J. Chase, and R. J. Van Aarde. 2018. Partial migration in savanna elephant populations distributed across southern Africa. *Scientific Reports* 8:11331. <https://doi.org/10.1038/s41598-018-29724-9>
- Salerno, J., K. Bailey, A. E. Gaughan, F. R. Stevens, T. Hilton, L. Cassidy, M. D. Drake, N. G. Pricope, and J. Hartter. 2020. Wildlife impacts and vulnerable livelihoods in a transfrontier conservation landscape. *Conservation Biology* 34(4):891-902. <https://doi.org/10.1111/cobi.13480>
- Salerno, J., L. Cassidy, M. Drake, and J. Hartter. 2018. Living in an elephant landscape. *American Scientist* 106:34-42. <https://doi.org/10.1511/2018.106.1.34>
- Salerno, J., C. Romulo, K. A. Galvin, J. Brooks, P. Mupeta-Muyamwa, and L. Glew. 2021a. Adaptation and evolution of institutions and governance in community-based conservation. *Conservation Science and Practice* 3(1):e355. <https://doi.org/10.1111/csp2.355>
- Salerno, J., F. R. Stevens, A. E. Gaughan, T. Hilton, K. Bailey, T. Bowles, L. Cassidy, P. Mupeta-Muyamwa, D. Biggs, N. Pricope, et al.. 2021b. Wildlife impacts and changing climate pose compounding threats to human food security. *Current Biology* 31(22):5077-5085. <https://doi.org/10.1016/j.cub.2021.08.074>
- Scoones, I. 1998. Sustainable rural livelihoods - a framework for analysis. Institute of Development Studies Working Paper No. 72. University of Sussex, Brighton, UK.
- Serrat, O. 2017. The sustainable livelihoods approach. Pages 21-26 in *Knowledge solutions: tools, methods, and approaches to drive organizational performance*. Springer Singapore. https://doi.org/10.1007/978-981-10-0983-9_5
- Shamukuni, D. M. 1972. The baSubiya. *Botswana Notes & Records* 4(1):164-184.
- Shen, C., and X. Zhao. 2023. How does income inequality affects economic growth at different income levels? *Economic Research-Ekonomiska Istraživanja* 36(1):864-884. <https://doi.org/10.1080/1331677X.2022.2080742>
- Siders, A. R. 2019. Adaptive capacity to climate change: a synthesis of concepts, methods, and findings in a fragmented field. *Wiley Interdisciplinary Reviews: Climate Change* 10(3):e573. <https://doi.org/10.1002/wcc.573>
- Silva, J. A., and A. W. Mosimane. 2013. Conservation-based rural development in Namibia: a mixed-methods assessment of economic benefits. *Journal of Environment & Development* 22(1):25-50. <https://doi.org/10.1177/1070496512469193>
- Smit, B., and J. Wandel. 2006. Adaptation, adaptive capacity and vulnerability. *Global Environmental Change* 16(3):282-292. <https://doi.org/10.1016/j.gloenvcha.2006.03.008>
- Statistics Botswana. 2018. Botswana multi topic household survey report 2015/16. Government Printers, Gaborone, Botswana.
- Stone, M. T. 2015. Community empowerment through community-based tourism: the case of Chobe Enclave Conservation Trust in Botswana. Pages 81-100 in R. van der Duim, M. Lamers, and J. van Wijk, editors. *Institutional arrangements for conservation, development and tourism in Eastern and Southern Africa: a dynamic perspective*. Springer, Dordrecht, The Netherlands. https://doi.org/10.1007/978-94-017-9529-6_5
- Taylor, R. 2009. Community based natural resource management in Zimbabwe: the experience of CAMPFIRE. *Biodiversity and Conservation* 18(10):2563-2583. <https://doi.org/10.1007/s10531-009-9612-8>
- Thulstrup, A. W. 2015. Livelihood resilience and adaptive capacity: tracing changes in household access to capital in Central Vietnam. *World Development* 74:352-362. <https://doi.org/10.1016/j.worlddev.2015.05.019>
- Turner, B. L., R. E. Kasperson, P. A. Matson, J. J. McCarthy, R. W. Corell, L. Christensen, N. Eckley, J. X. Kasperson, A. Luers, M. L. Martello, C. Polsky, A. Pulsipher, and A. Schiller. 2003. A framework for vulnerability analysis in sustainability science. *Proceedings of the National Academy of Sciences* 100(14):8074-8079. <https://doi.org/10.1073/pnas.1231335100>
- Valentine, T. 1993. Drought, transfer entitlements, and income distribution: the Botswana experience. *World Development* 21(1):109-126. [https://doi.org/10.1016/0305-750X\(93\)90140-5](https://doi.org/10.1016/0305-750X(93)90140-5)
- Vincent, K. 2007. Uncertainty in adaptive capacity and the importance of scale. *Global Environmental Change* 17(1):12-24. <https://doi.org/10.1016/j.gloenvcha.2006.11.009>
- Vittoz, P., F. Pellacani, R. Romanens, A. Mainga, E. P. Verrecchia, and R. W. Fynn. 2020. Plant community diversity in the Chobe Enclave, Botswana: insights for functional habitat heterogeneity for herbivores. *Koedoe: African Protected Area Conservation and Science* 62(1):1-17. <https://doi.org/10.4102/koedoe.v62i1.1604>
- Vogel, S., A. Songhurst, G. McCulloch, and A. Stronza. 2022. Understanding farmers' reasons behind mitigation decisions is key in supporting their coexistence with wildlife. *People and Nature* 4(5):1305-1318. <https://doi.org/10.1002/pan3.10397>
- White, S., and M. Ellison. 2007. Wellbeing, livelihoods and resources in social practice. Pages 157-175 in I. Gough and J. McGregor, editors. *Wellbeing in developing countries: from theory to research*. Cambridge University Press, Cambridge, UK. <https://doi.org/10.1017/CBO9780511488986.008>
- Wikan, G. 2004. Cash, crops and cattle: a study of rural livelihoods in Botswana. *Botswana Notes & Records* 36(1):91-105.
- Wolff, E. N., and A. Zacharias. 2009. Household wealth and the measurement of economic well-being in the United States. *Journal of Economic Inequality* 7:83-115. <https://doi.org/10.1007/s10888-007-9068-6>
- Woodhouse, E., K. M. Homewood, E. Beauchamp, T. Clements, J. T. McCabe, D. Wilkie and E. J. Milner-Gulland. 2015. Guiding principles for evaluating the impacts of conservation interventions on human well-being. *Philosophical Transactions of the Royal Society B: Biological Sciences* 370(1681):20150103. <https://doi.org/10.1098/rstb.2015.0103>