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Integrating the Management of Ruaha Landscape of Tanzania with Local Needs and Preferences

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Abstract Sustainable management of landscapes with multiple competing demands such as the Ruaha Landscape is complex due to the diverse preferences and needs of stakeholder groups involved. This study uses conjoint analysis to assess the preferences of representatives from three stakeholder groups—local communities, district government officials, and non-governmental organizations—toward potential solutions of conservation and development tradeoffs facing local communities in the Ruaha Landscape of Tanzania. Results demonstrate that there is little consensus among stakeholders about the best development strategies for the Ruaha region. This analysis suggests a need for incorporating issues deemed important by these various groups into a development strategy that aims to promote conservation of the Ruaha Landscape and improve the livelihood of local communities.

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Introduction

The continuous loss of biodiversity has led to the creation of protected areas in many developing countries. The establishment of more than 44,000-protected areas, covering nearly 14 million square kilometers (km^2) in virtually every country of the world may well be one of the most stunning conservation successes of the twentieth century (Terborgh et al. 2002; Ervin 2003). However, the conventional "fences and fines approach" to management that prohibits local access to protected areas has escalated conflicts between local communities and management authorities in developing countries (Wells and Brandon 1992; Schwartzman et al. 2000; Cernea and Schmidt-Soltau 2006; McElwee 2010). These conflicts are most pronounced for communities that depended on resources from these areas for their subsistence prior to the areas being gazetted as protected. Growing populations are also increasingly drawn to the borderlands of protected areas, because they provide some of the last supplies of ecosystem goods and services for expanding human populations, including firewood, bush meat, clean water, medicinal plants, and areas of safety during civil strife. Wittermyer et al. (2008) found that average annual population growth rates were higher in lands bordering protected areas than in other rural areas of the same country in Africa and Latin America.

The long history of conservation in Africa has been characterized by the exclusion of human use of resources in protected areas as the dominant management strategy.

Post-colonial African governments continued to embrace and carry on these strategies (Gbadegesin and Ayileka 2000). Because many protected areas have been proposed on lands that are legally or customarily owned and managed by local people it has often been difficult and often unfair, to consider these lands off-limits to human use (Wilkie et al. 2010). Furthermore, in countries where remote populations endure structural social and economic inequities, protected areas have further restricted their livelihood options (Salafsky and Wollenberg 2000; Wilkie et al. 2006). As a result, the protectionist approach has caused skepticism, lack of trust, and even hatred between protected area managers and surrounding communities. There is also a growing consensus among conservationists and international conservation organizations that the protectionist approach by itself cannot conserve wildlife over the long-run in Africa (Ite 1996; Barret and Grizzle 1999).

In recent years, in many parts of Africa, and specifically in Southern Africa, different models of community-based conservation (CBC) programmes have been undertaken that seek to link conservation with the alleviation of rural poverty, as well as encouraging community participation (Gbadegesin and Ayileka 2000). CBC stresses the need to include local people, either physically in protected area management or politically from conservation policy process (Western and Wright 1994). Despite hopes for success, the literature on biodiversity conservation suggests that first generation CBC approaches have failed to achieve their goals (Blom et al. 2010). Songorwa (1999) notes that failure to meet communities' expectations and the unwillingness of national governments to devolve ownership and management responsibility to local communities were the main reasons for lack of CBC program success in Tanzania. In addition, the lack of training and empowerment of local communities to manage CBC projects by communities were also found to be an obstacle to success (Wainwright and Wehrmeyer 1998; Songorwa et al. 2000). Furthermore, according to Wells and McShane (2004) CBC approaches have been unable to address the complex and diverse interests of the people and institutions with claims on land and resource access in and around protected areas.

This research suggests that without the cooperation and support of local populations, protected areas will have limited prospects for sustainable conservation. Community-based initiatives are often based on studies and characterization of the problem by outside experts, while in practice the knowledge and priorities of local people should also inform resource management decisions. Conservation and development organizations have often made unwarranted assumptions about what is desired by, or good for, local people without engaging local stakeholders (Sayer and Wells 2004). Hutton and Leader-Williams (2003) suggest a major challenge for the next generation of CBC is to find more effective ways to engage people whose livelihoods, interests and future are linked to those of a protected area, as well as institutions with relevant jurisdiction (e.g., community-based organizations, local government, national government agencies, research organizations, and churches). There have been few systematic attempts to help stakeholders identify and then make rational choices between competing scenarios in conservation or development (Wells and McShane 2004; Zia et al. 2011).

This study uses conjoint analysis (CA) to identify areas of similarity and difference among perceptions of different stakeholder groups—including non-governmental organizations (NGOs), village government, agro-pastoralists, and agriculturalists—regarding root causes and potential solutions for challenges related to balancing conservation and development needs in the Ruaha Landscape of Tanzania. Identifying stakeholder priorities and evaluating trade-offs before implementation of management can reduce the chance of undesirable consequences and provides a framework for engaging and creating buy-in amongst multiple stakeholders at different spatial scales (e.g., local, regional and national).

The paper is divided into five sections. The first section provides the rationale for the study; the second section introduces the study areas and the context of conservation and development in the Ruaha Landscape; the third section gives details of the CA framework for evaluating stakeholders' preferences; the fourth section presents the results and discusses differences of preferences among stakeholders; and finally, the fifth section concludes the study.

Background and Study Area

The Ruaha Landscape covers over 45,000 km^2—including the 10,300 km^2 Ruaha National Park (RNP), four Game Reserves, two forest reserves, and the community-based Pawaga-Idodi wildlife management area (PIWMA)—an area with outstanding biodiversity and significant potential for livelihood improvement through ecotourism, hunting, and the provision of ecosystem services (WCS 2005). It is situated within one of the World Wide Fund for Nature's 'Global 200' ecoregions (Olson and Dinerstein 1998), and encompasses two Important Bird Areas and two proposed Ramsar sites (WCS 2005). The area harbors an intact large carnivore fauna, including the continent's third largest population of African wild dogs, and is part of a priority 'hotspot' for African carnivore conservation (Mills et al. 2001; WCS 2005).

The Great Ruaha River (GRR) is the main source of water in the southern part of the Ruaha Landscape and is a

critical resource to the livelihood of local communities and to the country's economy. This river is a main tributary to the Rufiji River, which forms the largest drainage basin in Tanzania, covering some 174,800 km^2 or about 18 % of Tanzania's Mainland. The GRR originates in Tanzania's southern highlands and flows through the Usangu Plains and the Ihefu wetland along the southern border of the RNP, serving as the main source of water for the park. The GRR also provides 56 % of the supply to the Mtera reservoir and hydroelectric plant, the source of 70 % of Tanzania's electricity (Kadigi et al. 2004).

While conservation activities have the potential to improve local livelihoods, wildlife is an under-developed resource in the southern portion of the landscape. Less than 10 % of the RNP is developed for photographic tourism, and communities are poorly integrated into the wildlife economy (Coppolillo and Dickman 2007), with fewer than 2 % of local residents involved in or deriving revenues from tourism. Recognizing similar patterns throughout Tanzania, legislation was established to allow villages to directly benefit from wildlife by establishing "wildlife management areas (WMA)" with portions of village lands (Tz MNRT Wildlife Policy 2005). Historically, communities have also been separated from the governance and management of wildlife and protected areas (see Neumann 1998 for a historical perspective in Tanzania), thus the community-based WMA process was designed to integrate and improve local governance. As part of the WMA process, villages must establish and adopt land-use plans so that conservation and development objectives are balanced at the village level and the necessary governance structures are established (URT MNRT 2005). WMAs are intended with the joint objectives of conservation and development, but tradeoffs between these objectives are also apparent at the village (Coppolillo and Dickman 2007) and national levels (Coppolillo et al. 2006). While these tradeoffs increasingly receive international attention (Himmelfarb 2007), the low rainfall in this portion of the Ruaha landscape (between 350 and 550 mm p.a.) makes dryland agriculture and livestock production only marginally competitive land-use strategies relative to other places within Tanzania.

To better understand village-level priorities, this study applied a combination of focus group meetings and a conjoint survey workshop with representatives of villages of Idodi and Pawaga divisions around RNP. Idodi and Pawaga divisions comprise villages that belong to the community wildlife management associations (MBOMIPA) responsible for managing the Pawaga-Idodi WMA. We also surveyed government, business, and NGO organizations at the regional level to analyze their preference alignment with priorities of village government and stakeholders. The next section describes the theoretical background of the CA and details the methodologies used for data collection.

Conjoint Analysis and Study Design

CA is a technique for establishing the relative importance of different attributes in the provision of a good or a service (Ryan 1999). Along with its now popular variant, choice modeling, CA has its origin in market research, where it has been used to identify factors influencing the demand for commodities (Cattin and Wittink 1982). It has also been used widely in transport economics (Wardman 1988), in the area of health care to examine factors important to patients in the provision of health care systems (Ryan and Farrar 2000; Bishop et al. 2004; Fitzpatrick et al. 2007), and recently in assessing public preferences for environmental resources and estimating the value of non-market environmental goods and services (Boxall et al. 1996; Hanley et al. 1998; Rolfe et al. 2000; Farber and Griner 2000; Hermans et al. 2007). Although widely applied in the developed world, its applications in developing countries are more limited, particularly in Africa. Some notable exceptions include the Baidu-Forson et al. (1997) assessment of farmer's preferences for socioeconomic and technical interventions in groundnut production systems in Niger. Also Kouadio et al. (2003) used CA to estimate farmer's preferences for cattle traits in Africa.

In a typical CA study individuals are presented with hypothetical scenarios involving different levels of attributes which have been identified as important in the provision of a good or service and asked to rank the bundles of attributes. The conceptual foundation of CA arises from consumer theory developed by Lancaster (1991) which assumes that utility is derived from the properties or characteristics of goods (Ratchford 1975). A central feature for this approach is that the utility derived from a good or service can be decomposed into part-worths relating to different attributes of that good or service (Louviere 1994). These partial utilities indicate the relative importance of each attribute's contribution to overall preference or utility, and can be combined to estimate relative preferences for any combination of attribute levels. A technical Appendix details the conjoint model used in this study.

To develop the choice modeling exercise, a four-phase analytical strategy was used. First, focus groups meetings were conducted at both the village and district levels where representative stakeholders identified critical problems facing local communities. Second, attributes of potential solutions to the problems identified were formulated to address community needs and concerns. These attributes were based on the results of the focus group meetings. Third, a conjoint ranking survey solicited public preferences for management

alternatives that included varying investment levels of five attributes: farmer's cooperatives, water infrastructure, tourism infrastructure, extension services, and health and education infrastructure. Fourth, an ordered probit model and other statistical techniques were used to assess and identify differences in preferences for potential solutions to address the problems identified in phase 1. These phases are described in turn below.

Identification of the Issues/Problems

The goal of this step was to identify critical problems voiced by communities from the local and district level stakeholders' perspectives. To do so, focus group meetings were organized at both village and district levels with the aim to explore the most critical issues for communities in the Idodi and Pawaga divisions by economic sector—identified as agriculture, livestock, education and health—as well as other potential economic activities that could generate income in each village. At the village level, a Tanzania research assistant met with village leaders (typically the Village Executive Officer) to inform them about the purpose of the focus group meetings and then requested the VEOs to invite key stakeholders. Key socioeconomic groups in each village were pre-identified by researchers in consultation with VEOs and then VEOs were requested to invite one representative of each stakeholder's group. Stakeholder representatives included pastoralists and agro-pastoralists, religious leaders, tribal leaders, local government representatives, business owners, and representatives from water users' associations and women's groups, with particular attention paid to gender representation. At the district level, key stakeholders were selected based on their relationship with or involvement in the four economic sectors identified, including representatives of government at the district level (e.g., NGOs), e.g., the Wildlife Conservation Society, and business operators. Government representatives included crop officer, district administrative officer, district agriculture and livestock development officer, district education officer, district commissioner of AIDS, district executive director, district medical officer, MBOMIPA, RNP, Rufiji Water Basin Management and a Wildlife Officer. NGOs were represented by international and local conservation organizations, respectively, the Wildlife Conservation Society and Friends of Ruaha, as well as development NGO represented by VITA. Businesses were represented by TATANKA tour operator. District stakeholders were interviewed in Iringa, which is the largest town in the region, where local government officials, NGOs and tour operators are located.

The village focus groups were organized in 20 out of 21 villages (one village was unable to meet). While representation varied from village to village, all meetings had representatives of women, pastoralists, agriculturalists, and village officials. Discussions were focused on identifying the three most critical/important issues in each economic sector, with ranking of the issues by economic sector (by consensus when possible). The top issues were then ranked across sectors to determine the order of importance. In addition, participants were asked to identify other economic activities or livelihood strategies that exist in the village. To insure active participation of all representatives, the moderator asked questions equally to men and women, as well as agriculturalists and pastoralists, to stimulate the ideas and engage all interests in the conversations. The general trend was that women, and at times, pastoralists were not voluntarily vocal in the meetings.

The topics for district level discussions were the same as for village-level focus groups. While there was significant overlap of issues identified between the village and district level focus groups, there were some key differences (Table 1). District focus groups highlighted key issues that were not mentioned or discussed at the village-level including the lack of skills, limited awareness of the importance of education and traditional husbandry and agriculture practices as source of environmental problems and poverty in rural areas. In addition, district focus groups mentioned tourism and other wildlife-based economic activities such as game hunting as key sectors with much potential for developing rural communities around RNP.

Formulation and Selection of Attributes or Alternatives

Drawing on the results of focus group discussions, a set of attributes or management alternatives were formulated that take into account the management concerns, public issues and resource use and development opportunities in the Ruaha Landscape. They included investment in village farmer's cooperatives, water infrastructure, tourism infrastructure, extension services, and health and education. These attributes were formulated as potential solutions to address the major problems identified in focus groups, and each attribute had two or three possible options for adaptive management of the Ruaha Landscape (Table 2). One of the options represented the most likely conditions expected to exist in the future if the current situation continues unchanged. All other options were considered in relation to the current (base option) situation.

Assessment of Preferences for Alternatives Using Conjoint Ranking Survey

The goal for this phase was to assess, analyze and compare public preferences and acceptable tradeoffs for various levels of investment categories using CA. A conjoint ranking survey was designed to solicit preferences for the

Table 1 Summary of most important issues by economic sector identified by focus group meetings at local (village) and district levels for communities in Idodi and Pawaga divisions bordering Ruaha NP, Tanzania

Village level	District level	Overall
Agriculture: insufficient and poor irrigation system	Agriculture: inaccessibility to the market	Agriculture: insufficient and poor irrigation system
	Lack of skills	
	Poor irrigation system	
Education: insufficient infrastructure for teachers and classrooms	Education: insufficient number of teachers	Education: insufficient infrastructure for teachers and classrooms
	Poor infrastructures	
	Lack of awareness of the importance of education	
Health: lack of health care facilities	Health: limited number of medical staff	Health: lack of health care facilities
No access to clean and safe drinking water	Lack of health care facilities	Limited medical staff
Limited number of medical staff	Poor sanitation	Poor sanitation
Poor sanitation		
Livestock: lack of access/insufficient watering points	Livestock: lack of education in current husbandry practices	Livestock: lack of access/insufficient watering points
Lack of dipping areas	Lack of access/insufficient watering points	

five attributes and various levels listed in Table 2. Ten alternatives, each depicting a unique bundle of attribute levels, were designed for participant ranking based on an orthogonal design that allows estimation of linear and quadratic main-effect components over the entire range of 108 ($3^3 \times 2^2$) possible alternatives with the least number of trials (Kuhfeld et al. 1994). The survey was translated into Kiswahili and pre-tested on local staff from diverse educational and demographic backgrounds of participating research partners, including the Wildlife Conservation Society and Sokoine University of Agriculture. Based on the pre-testing, the survey was revised to minimize technical terms and reduce length.

To complete the conjoint survey, two participants from each of 21 villages from Pawaga and Idodi divisions, the village executive officer and one other stakeholder available to represent key socioeconomic groups, were invited to participate in an all day workshop. Thirty-eight of 42 invitees attended, including 10 women. The intent of the workshop was to provide a forum for key stakeholder's groups to express their preferences and concerns for management of the Ruaha Landscape. The group was designed to be both representative of village stakeholder positions and manageable in size.

Following a discussion of the focus group results, workshop participants were given descriptions of the final synthesis of issues and alternatives for improving the livelihood of local communities as well as for the adaptive management of the Ruaha Landscape. An overview of the nature and purpose of the conjoint study was also provided. The attributes and associated levels were described and respondents could ask questions or discuss their concerns. Finally, after explanations, participants were provided some directions with examples of how to rank the alternatives provided. Each participant was asked to individually rank 10 alternatives provided in Kiswahili on index cards by sorting and stacking them in order from most to least preferred alternative. Respondents who didn't know how to read were assisted by research assistants who were asked not to influence the choices but only to write down the choices made by the individual who was being assisted. Respondents also answered a series of attitudinal such as the dependency of communities on the health of RNP and demographic questions including household size, age, education, occupation and income of the head of the household.

Data Analysis

Details of the conjoint model specification are included in the Appendix. The dependent variable in the model is the ordinal ranking of the alternatives, which was coded from 1 to 10, with higher scores associated with greater utility. The attribute with three levels (1, 2, 3 in Table 2) for the independent variables were coded, −1, 0, 1 for the linear form and 1, −2, 1 for the quadratic form. Also, attributes with dummy variables were coded −1, 1 for the linear form. This coding scheme maintains the ordinal relationship for the linear term and provides for an orthogonal contrast with the quadratic term and constant (Dennis 1998).

An ordered probit procedure was used to estimate the parameters (β vector) associated with the various attributes detailed in Table 2 for village and district models using

Table 2 Description of attributes and their levels used in conjoint survey administered to stakeholders at village and district levels

Attributes	Description of the attributes	Levels	Description of levels
Village farmers cooperatives	Investments in creating village cooperatives to facilitate farmers' access to loans from donors (government and NGOs), irrigation, fertilizers, shared resources such as tractors and watering points, and capacity building programs. Village farmers' cooperatives will determine the price for rice paddy instead of middle men	Inadequate/low investment	No investment/inadequate support to local farmers cooperatives. The price for rice paddy is determined by middle men and 1 bag (100 kg) of rice paddy is sold at 20,000 Tanzanian Shilling (TShs) at the local market
		High	More investment/high priority investment in village cooperatives. The price for rice paddy is determined by farmer cooperatives and 1 bag (100 kg) of rice paddy is sold at 50,000 TShs at the local market
Water infrastructures	Investment to improve the quality of infrastructure for irrigation, livestock and domestic consumption as well as to facilitate regular flow of water throughout the year and reduce distance traveled to collect water	Inadequate/low investment	Water infrastructure (for irrigation, livestock and domestic use) is not sufficient. Less than 15 % of households have access to piped water and on average 30 % of households have access to irrigation canals. The distance traveled (one way) to watering points for livestock is 1 h on average
		Some/medium investment	Some improvement to water infrastructure. At least 30 % of households have access to piped water and 50 % have access to irrigation canals. The distance traveled (one way) to watering points remain the same, 1 h on average
		High/priority investment	Improvement to water infrastructure. Sixty percent of households have access to piped water and 60 % have access to irrigation canals. One (1) watering point per village for livestock is constructed
Tourism infrastructure	Investment in village capacities (built, financial and human capitals) to initiate community-based tourism activities to improve local livelihoods and reduce pressure on the park	Inadequate/ minimum	Inadequate tourism infrastructure to initiate community-based tourism activities
		High	Adequate tourism infrastructure exists in villages surrounding Ruaha national park to host tourists and game hunters
Extension services	Investment in developing quality information, training adequate number of staff to provide technical assistance to farmers on issues related to agriculture, livestock and human health	Inadequate/ minimum	The quality and availability of information and staff is minimum/inadequate to assist local farmers
		Medium	Extension services (information and number of qualified staff) exist to support/assist local farmers periodically
		High	Extension services (information and number of qualified staff) exist to support /assist permanently local farmers
Health and education infrastructure	Type/quality of buildings, number and quality of staff, equipments and distance traveled to get to the facility	Inadequate	The current state of health care and education facilities, staff and equipments inadequate to service local population within 15–20 km (or 4 h on average) of each village
		Medium	Some investments are made to improve the existing health care and education facilities. The quality of existing staff and equipments is improved to service local population within 10 km (or 2 h on average) of each village
		High/priority investment	High priority investments to improve and increase the number of health care and education facilities. The number and quality of staff and equipments is improved to service local population within 5 km (1 h or less on average) of each village

SAS. Values for μ_1 to μ_8, were estimated in addition to the parameters associated with the attributes The μ's delineate ranges in the unobserved underlying variable (utility) that corresponds to the observed response categories (ranks) as discussed in the Appendix. The estimated value of $X'_{ij}\beta$ for any given combination of attribute levels determines the position of the distribution of ranks over underlying scale.

The relative importance scores of each attribute (W_i) in a respondent's overall preference for an alternative were computed by dividing the utility range (I_i) for each attribute—the difference between the utility (a_{ij}) of the highest level and the lowest level of each attribute—by the sum of the utility ranges for all n attributes:

$$W_i = \frac{I_i}{\sum_{i=1}^{n} I_i}. \quad (1)$$

where $I_i = [\max(a_{ij}) - \min(a_{ij})]$, a_{ij} is the utility of the ith level of the jth attribute and

$$\sum_{i=1}^{n} W_i = 1.$$

As the degree of difference becomes larger, the importance of the attribute increases. The relative importance of each attribute reflects how large an influence a particular attribute has on the overall preference for an alternative but not whether changes in the level of the attribute had a positive or a negative influence on preference. The signs and magnitude of estimated coefficients (or part-worths) supply that information. The part-worths or partial utilities for each attribute level were computed by summing the linear and quadratic effects estimated in the model. The larger values indicate greater preference for a particular attribute.

Results and Discussion

Data were obtained from 49 respondents, 38 representatives from communities living in villages around the RNP in the Idodi and Pawaga divisions, and 11 Iringa district officials. Each respondent ranked 10 alternative scenarios for a total of 490 preference rankings.

Respondents' Characteristics

Most respondents listed agriculture as their main occupation (47 %), with agro-pastoralists representing 31 %, district government employees representing 18 %, and employees of NGOs representing 4 % of the respondents. The education level of respondents was 69 % primary school, 16 % high school, and 14 % university level. For stakeholders representing villages, 61 % identified as agriculturalists and 39 % as agro-pastoralists, with 74 % male and 26 % female.

Preferences for Attributes

Inferences about respondent preferences concerning each attribute can be made from the results shown in Table 3. The nature of the relationship between preference or utility (dependent variable) and an attribute level depends on the signs and relative magnitudes of the estimated coefficients for both the linear and quadratic contrasts. For example, the partial utility for water at level 2 in the ordered probit model (Model 1) is −0.2708, computed using the linear

Table 3 Results of the ordered probit model

Variable	Model 1: all respondents ($n = 490$)	Model 2: village representatives ($n = 380$)	Model 3: district representatives ($n = 110$)
Linear effects			
Cooperatives	0.5022*** (0.0513)	0.6086*** (0.0597)	0.5647** (0.1190)
Tourism	0.3456*** (0.0536)	0.2934*** (0.0604)	0.5647*** (0.1190)
Water	0.1903*** (0.0628)	0.1787** (0.0712)	0.2609* (0.1360)
Health and education	0.1354*** (0.0329)	0.2709*** (0.0732)	0.5705*** (0.1496)
Extension services	0.1729*** (0.0620)	0.1261* (0.0703)	0.3468*** (0.1329)
Quadratic effects			
Water	0.1354*** (0.0329)	0.1386*** (0.0374)	0.1437** (0.0709)
Health and education	0.1406*** (0.0330)	0.1246*** (0.0374)	0.2094*** (0.0711)
Extension services	−0.1087*** (0.0341)	−0.0835** (0.0385)	−0.2063*** (0.0767)
Boundaries parameters			
μ_1	−1.6939	−1.7339	−1.7504
μ_2	−1.0601	−1.1390	−0.9212
μ_3	−0.6521	−0.7312	−0.5009
μ_4	−0.3187	−0.3819	−0.1851
μ_5	−0.0087	−0.0511	0.1077
μ_6	0.2982	0.2768	0.3996
μ_7	0.6171	0.6197	0.6939
μ_8	0.9763	0.9995	1.0304
μ_9	1.4648	1.5085	1.5071
Log likelihood	−1028.3563	−787.97	−228.5344

Standard error in parentheses

***Significant at $P < 0.01$; **$P < 0.05$; *$P < 0.1$

Table 4 Partial utilities (partworth) for each attribute level by stakeholder's group

Attributes	Stakeholder utility by main occupation							
	Attribute levels	District officials		NGOs		Agro-pastoralists		Agriculturalists	
		Importance score (%)	Part-worth utility	Importance score (%)	Part-worth utility	Importance score (%)	Part-worth utility	Importance score (%)	Part-worth utility
Cooperatives		*10.24*		*9.17*		***33.2***		***37.3***	
	Low		−0.2301		**−0.2797**		−0.6809		−0.5742
	High		0.2301		0.2797		**0.6809**		**0.5742**
Health		***28.62***		***30.40***		*22.4*		*16.0*	
	Low		−0.2659		−0.8947		−0.1258		−0.1617
	Medium		−0.5102		−0.064		−0.396		−0.1654
	High		0.7761		0.9587		0.5216		0.3271
Water		*15.50*		*15.88*		*17.9*		*16.9*	
	Low		0.0541		−0.388		−0.1832		−0.0464
	Medium		−0.3212		−0.1924		−0.2756		−0.2838
	High		0.3753		0.5804		0.4588		0.2374
Tourism		*25.99*		*18.97*		*14.7*		*19.3*	
	Low		−0.584		−0.5783		−0.3003		−02969
	High		0.584		0.5783		0.3003		0.2969
Extension services		*19.66*		*25.60*		*11.8*		*10.5*	
	Low		−0.2081		−0.7859		−0.2217		−0.2081
	Medium		0.1152		0.7744		0.2638		0.1152
	High		0.0929		0.0115		−0.0421		0.0929

Values in italic represent importance score of attributes while values in bold and italic represent attributes with the highest importance scores. Non italic values in bold represent attribute levels with lowest utility (negative values) and highest utility (positive values)

and quadratic coefficients [(0.1903)*(0) + (0.1354)(−2))] shown in Table 3.

In ordered probit models, interpretation of the estimated parameters is different than interpreting standard regression parameters. The combined effects of the estimated parameters associated with the linear and quadratic effects for each independent variable represent the effect of a discrete change in that variable on the underlying scale given by $X'_{ij}\beta$.

The analyses indicate that all linear effects for models 1, 2, and 3 were statistically significant (Table 4). This suggests that investment in farmer's cooperatives, tourism infrastructure, water infrastructures (for irrigation, livestock, and domestic consumption), health care and education facilities, and extension services will result in a higher estimated probability of a response falling within the ranges associated with greater utility. The significance of linear and quadratic effects for water and health indicates that respondents preferred high investment in water infrastructure and disliked some improvement over inadequate investment to improve water infrastructures. For health and education infrastructure, respondents were indifferent between inadequate and some improvement of the existing facilities and services. However, they preferred high investment to improve the quality and increase number of health care and education infrastructures.

The negative coefficient for extension services of quadratic effects indicates that high investment in extension services results in less utility to local stakeholders. This suggests that respondents would like to see improvement in extension services over the current situation but have less preference for high investment (level 3) that would improve the quality of information as well as the number and quality of staff involved.

Overall Importance of Attributes

Figure 2 shows the relative importance of attributes when considering all respondents together. Investment in farmers' cooperatives was the most important attribute with a relative importance score of 28 %, followed by investments in health, tourism, water infrastructures and extension services. Investment in farmer's cooperatives was the most important attribute due to its highest utility (0.5022)

for "High priority investment" and lowest utility (−0.5022) for "Low priority investment". The remaining attributes of health, tourism and water were given almost equal weights by all stakeholders of 21, 20, and 17 %, respectively. Respondents had preferences for "high investment" levels with respect to health, tourism and water attributes. Extension services had a relative importance score of 14 % revealing that all stakeholders considered investment in extension services as not as important when compared to other pressing issues facing the community in the Ruaha Landscape. The lack of emphasis on extension services and the high preference for farmers' cooperatives may be explained by the fact that village focus groups were dominated by agriculturalists and agro-pastoralists without participation of individuals practicing mostly pastoralism.

Table 4 shows the utility of each attribute and represents what attribute level is most preferred by different occupation groups. The largest positive value indicates the most preferred level. A negative value of utility for each level does not indicate that this level is unattractive, but that it is less preferred than a level with a positive number (Wilhelm and Mottner 2005).

The results from district government employees and NGO respondents show that investment in health and education was the most important attribute with relative scores of 30.40 and 28.62 %, respectively. These stakeholders had the highest utilities for "high priority investment" level than agro-pastoralists and agriculturalist with respect to the health attribute. This indicates, for instance, that development projects that aim at reducing the prevalence of both common diseases and illiteracy in local populations will likely get support from local NGOs and district government officials. Based on focus group discussions, the inadequate supply of medicine and too few skilled health providers for human and livestock in rural areas were considered to be obstacles for the development in the Ruaha region. Coupled to that is a high level of illiteracy in villages due to the limited number of schools and teachers and lack of common knowledge of source of diseases and risk factors for zoonotic disease transmissions. A household survey conducted in 21 villages around the RNP previous to the focus group research found that only 6 % of head of households have been or had a primary school level education. In addition, approximately half of surveyed households reported not knowing the source of illness in their livestock and not knowing that some diseases affecting people in the households could come from livestock or livestock products. Furthermore, one in three households surveyed reported drinking raw blood from livestock which is one of the risk factors that influence the transmission of zoonotic diseases (Masozera et al. 2010).

Investment in tourism infrastructure was the second most important attribute for district government representatives. This stakeholder group had the lowest preference for "minimum investment" level (−0.584) in relation to the tourism attribute, indicating that this group considers the lack of off-farm income generating activities in rural areas to be a major concern. Investment in community-based tourism activities is likely assumed to improve local livelihoods and reduce pressure on natural resources in the park. Therefore high investment in these activities could attract support and collaboration of district leaders. However, this is in contrast to local stakeholder priorities. In fact, tourism was rarely mentioned as an economic activity during village focus group discussions, representing a key disconnect between district-level and local-level priorities. This disconnect comes from the fact that there are high expectations from local communities regarding the financial benefits from the WMA which, in reality, do not materialize. Most WMA revenues are generated from investors through royalties and taxes. These revenues mainly support community development projects (i.e., school, health facilities, roads, and water) but have little direct impact on individual household incomes and livelihoods. In addition there is a perception of lack of transparency and accountability in the management of WMAs (Institute of Resource Assessment (IRA) 2007).

For respondents representing NGOs, investment in extension services was the second most important attribute with a relative importance score of 25.60 %. This is due to the group's lowest preference for "minimum investment in extension services" level (−0.7859). Focus group discussions with NGOs reinforced this result, with prevalent views that traditional husbandry, agricultural practices and tribal customs serve as a major barrier to break the cycle of poverty in rural areas. However, this group had high preference for "medium investment in extension services" suggesting that some investment to improve the information and quality of extension officers in villages will attract support from NGOs. While the tourism attribute was ranked as the second most important for district government officials, it was ranked the third for NGOs with a relative importance score of 18.97 %. Investment in water infrastructure and farmer's cooperatives were not given much importance by government and NGOs representatives.

Unlike district government and NGO representatives, investment in farmers' cooperatives was the most important attribute for the agro-pastoralists and agriculturalists respondents with relative scores of 33 and 37 % respectively. As respondents from these two groups had the lowest partial utility for "minimum investment" and highest utilities for "high investment" in farmer's cooperatives, a development strategy that facilitates farmer's

access to loans, agriculture inputs and equipment will likely be much more successful in attracting support from local communities.

While the health and education attribute was the second most important attribute (22 %) for agro-pastoralists respondents, it was the fourth most important attribute for agriculturalists with a relative importance score of 16 %. This is not surprising given the fact that agro-pastoralists are suffering significant losses of livestock and reduced market value for livestock products due to infectious diseases (Clifford et al. 2008). As a result, they would prefer more investment in health and education infrastructure to increase the number and quality of facilities and personnel. Agriculturalists that live a sedentary life with less dependency on livestock production preferred more investment in community-based tourism activities that could create opportunities for off-farm employment and markets for their agriculture products.

The relative importance score of agro-pastoralists (17 %) was similar to those of agriculturalists (17 %) in relation to the water attribute, but the preference for "high investment" level was relatively higher for agro-pastoralists (with a partial utility value of 0.4588) than agriculturalists (with a value of 0.2374). This can be explained by the fact that, in general, agro-pastoralists are located farther from water sources and experience more water scarcity than agriculturalists who are settled near the sources of water. Results from the household surveys of agropastoralists and pastoralists communities around RNP revealed that households located further away from surface water sources were more likely to report chronic diseases in the households and report sick cattle in their herds (Masozera et al. 2010). For agriculturalists, investment in tourism infrastructure was the second most important attribute with a relative score of 19 %, while water and health attributes were given equal weights of 17 and 16 %, respectively.

These results reveal some differences in key priority areas for development to insure a better management of Ruaha Landscape and to improve livelihoods of local communities. These differences revolve around short-term versus long-term actions to address the issues facing communities in the Ruaha Landscape. The local stakeholder's group prefers immediate actions that could generate income, while district stakeholders prefer long-term

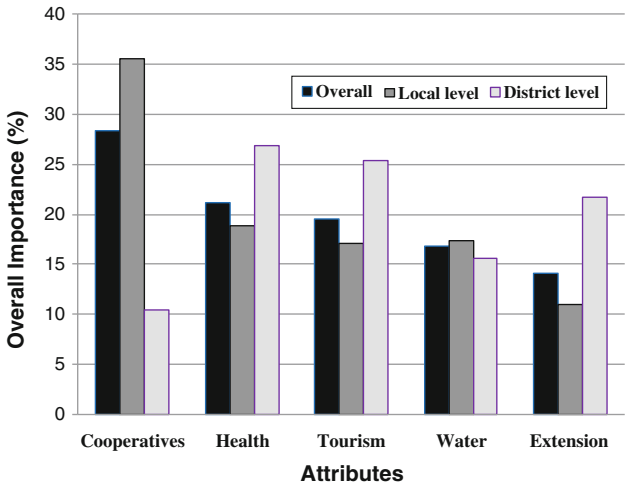
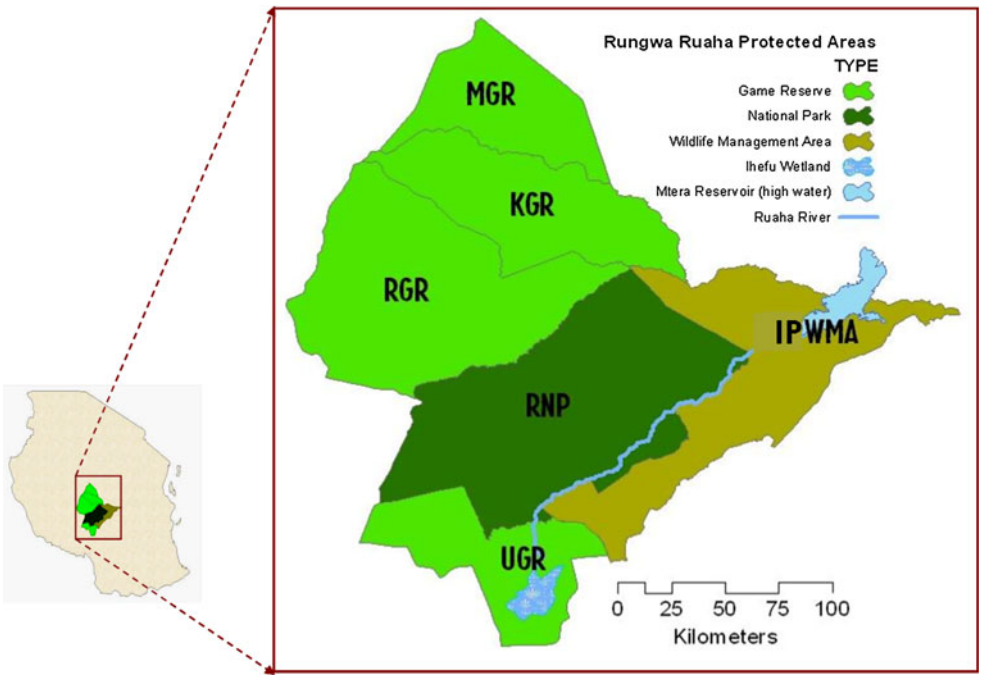


Fig. 2 Overall importance (all respondents and village and districts representatives)

Fig. 1 Ruaha landscape



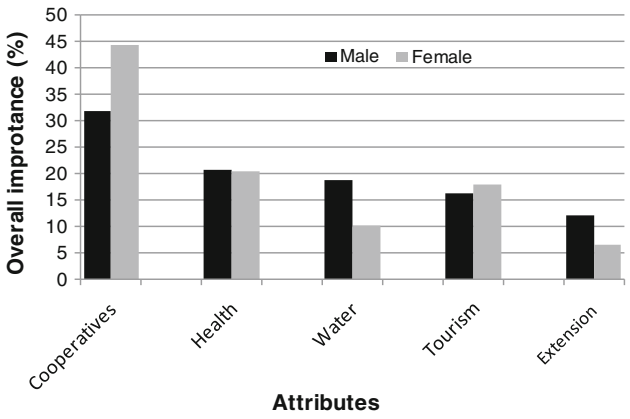


Fig. 3 Importance of attributes by gender at local level (village)

investment such as improvement of health, education and tourism sectors (Figs. 1, 2).

Lastly, Fig. 3 provides the perspectives of males and females representing village stakeholders toward potential solutions to problems facing communities in the Ruaha landscape. The scores reveal that while investment in farmers' cooperatives was the most important attribute for both males and females, it is relatively more important for females. The highest importance score (45 %) for females as a group is due to its highest utility (0.6253) for "High priority investment" in village farmer's cooperatives. The fact that females prefer more investment in farmer's cooperatives is not surprising. Wealth in agro-pastoral and agricultural societies is generally controlled by males, and females are assigned gender roles such as child care, water collection, animal and household husbandry, food preparation, and production of milk, egg and chickens (McPeak and Doss 2006). Through various support schemes to cooperatives (i.e. capacity building, access to loans through micro credit) females are empowered and therefore become less dependent on the wealth controlled by their husbands. Nguvava et al. (2009) found that females in the Ruaha Landscape are becoming more active in entities (females's associations and small enterprises) that enable them to collectively voice their concerns and foster greater social and economic independence.

Health and education was the second most important attribute and had equal weight for both males and females in villages, suggesting that lack of health care facilities and limited education infrastructures are major concerns for both males and females. Water infrastructure was more important for males than females, and tourism infrastructure was relatively more important for females than males. While males were more concerned by water issues as they are in charge of agriculture and livestock production, females were more interested in investments that create opportunities for income generating activities, such as handicraft making, opening a restaurant and jewelry fabrication. For instance 10 % of Maasai household surveyed were involved in selling jewelry as an off-farm income generating activities (Masozera et al. 2010).

Conclusion

Management of landscapes with multiple competing demands such as the Ruaha landscape is complex due to the diverse preferences and needs of stakeholder groups involved. Finding a management strategy that integrates community preferences at the local level with those of other stakeholders at both district and national levels is of paramount importance. There is a growing recognition that understanding community needs and preferences before implementation of a new management policy can reduce the chance of undesirable consequences, and provide a framework for managing and engaging multiple stakeholders at different spatial scales.

Over the last few decades land-use in the Ruaha landscape has been increasingly shaped by an approach akin to that of the problem–isolation paradigm, which breaks down a complex problem into a suite of small, easy-to-understand elements. From the biodiversity conservation perspective, the problem–isolation paradigm has proved unsatisfactory because biodiversity cannot be contained within the confines of a protected area, nor can people be easily kept out of areas required for biodiversity conservation. From the rural development perspective, the problem-isolation paradigm has also proved a particularly unsatisfactory model to shape land-use because the definition of the problem and the identification of the solution have tended to be top-down and centralized. For instance, the Usangu Rice Schemes, upstream of the focal villages examined here, were conceived to create opportunities for expanding crop agriculture, but because they were planned and implemented in isolation, they had the unintended consequences of undermining Tanzania's hydroelectric capacity and ecotourism industries (Coppolillo et al. 2006). To be successful, future projects—whether conservation or development—must reconcile objectives at local to global scales, and across sectors.

The CA demonstrates that there is little consensus among local communities (agro-pastoralists and pastoralists), district officials, and NGOs representatives about the best development strategies for the Ruaha region. At the local level, while a high priority was placed on investments in farmer's cooperatives through increasing accessibility to agriculture inputs, loans, and capacity building, there were some differences in relative importance of attributes between agro-pastoralists and pastoralists and

women and men. Representatives of district government officials and NGOs, on the other hand, perceive investment to improve health and education infrastructure, as well as the quality and number of personnel employed in health and education, as a highest priority for the region. This reveals that local communities are not homogeneous and they consist of different groups, defined by gender, age, ethnicity, class and religion, and contain a range of interests, aspirations for leadership and wealth (Doornbos et al. 2000). Flintan (1999) notes that outsiders have rarely recognized or taken into account these differences, basing their policies and views on the assumption that local communities are a homogeneous group, easily defined and recognizable, and that social cohesion allows the community to become allied as whole. Accordingly, any development strategy that aims to promote conservation of the Ruaha Landscape and improve the livelihood of local communities has to incorporate issues deemed important by these various stakeholder groups, while recognizing tradeoffs between short-term gains and long-term costs. District level perspectives are perhaps in a better position to evaluate the long-term impact of dozens of village-level investments, such as the impact of ill-planned irrigation at the village-level on region-wide water scarcity. A better communication and information sharing between local and national stakeholders could lead to more consistent priorities.

The CA presented here offers one potential approach to integrating objectives across these sectoral and scale boundaries. Results from the CA provide a starting point for the merging of local priorities with regional governance planning by estimating the relative importance of attributes and systematic trade-off analysis both within interest groups and between interest groups. While the priorities of each stakeholder group are an expression of a desirable situation based on their needs and interests, we do acknowledge that to achieve the ideal situation is a challenging task due to financial, ecological (resource), and human capacity (skills) constraints. Therefore, the relative importance of attributes will provide insights into priorities that should receive considerations and guide key players how to balance needs and expectations of stakeholders at these two scales tested in future regional development plans.

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Appendix: Conjoint Model Specification

A random utility model is used to explain local stakeholder preferences toward various environmental, economic and social aspects associated with designation and management of protected areas. When presented with a set of alternatives, individuals are assumed to make choices that maximize their utility or satisfaction. The utility that the *i*th individual derives from the choice of the *j*th alternative (U_{ij}) can be represented as:

$$U_{ij} = \overline{U_{ij}} + e_{ij} = X'_{ij}\beta + e_{ij} \tag{2}$$

where $\mathbf{X}_{ij}$ is a vector of variables which may include transformations of variables that represent values for each attribute of the *j*th alternative to the *i*th individual; $\boldsymbol{\beta}$ is a vector of unknown parameters; and e_{ij} is a random disturbance, which may reflect unobserved attributes of the alternatives, random choice behavior, or measurement error. In the empirical study under consideration, a respondent's utility level (U_{ij}) for each of the J alternatives is not observed but a ranking (r_j) is observed that corresponds to the order of his or her underlying utilities. For example, the probability of alternative 1 being ranked above other alternatives is:

$$\begin{aligned} P_{i1} &= \Pr(U_{i1} > U_{i2} \text{ and } U_{i1} > U_{i3} \ldots \text{and } U_{i1} > U_{ij}) \\ &= \Pr[(e_{i2} - e_{i1}) < (X'_{i1}\beta - X'_{i2}\beta) \text{ and } (e_{ij} - e_{i1}) \\ &\quad < (X'_{i1}\beta - X'_{ij}\beta)] \end{aligned} \tag{3}$$

Similar expressions hold for each of the remaining alternatives being chosen next in the choice set, and the P_{ij} values become well-defined probabilities once a joint density function is chosen for the e_{ij} (Judge et al. 1985).

McKelvey and Zavoina (1975) developed a polychotomous probit model to analyze ordinal level dependent variables. They assume that the e_{ij} values are distributed normally with mean 0 (the variance is standardized to unity), and that the observed variable (Y_{ij}, the ranks for the J alternatives) is related to the true unobserved utilities (U_{ij}) in the following way:

$$\begin{aligned} &Y_{ij} = 0 \quad \text{if} \quad U_{ij} \le \mu_{i1}, Y_{ij} = 1 \quad \text{if} \\ &\quad \mu_{i1} < U_{ij} \le \mu_{i2}, \ldots Y_{ij} = J - 1 \quad \text{if} \quad U_{ij} > \mu_{ij-1} \end{aligned} \tag{4}$$

The μ_{ik} values define the boundaries of the intervals for the unobserved utilities that correspond to the observed ordinal response. Since the μ are free parameters, there is no significance to the unit distance between the set of observed values of Y; they merely provide the ranking.

Estimates are obtained by maximum likelihood, and the probabilities entering the log-likelihood function are the probabilities that the observed ranks (Y_{ij} values) fall within

the J ranges defined by $J + 1$ μ values. The parameters to be estimated are $J - 2$ μ values plus the $\boldsymbol{\beta}$ vector; μ_0 and μ_J are assumed to be negative and positive infinity, respectively, and μ_1 is normalized to 0. Mckelvey and Zavoina (1975) describe the model and maximum likelihood estimators in greater detail.

In the polychotomus probit model the estimated value $(X'_{ij}\beta)$ for an observation determines the position of the mean of the distribution of response categories over underlying scale. The $\mu's$ delineate ranges of the unobserved underlying variable (utility) that correspond to the observed response categories. The estimated probability that a response falls in each category or rank in the case under consideration is measured by the area under the normal standard density curve $\left[f(X'_{ij}\beta)\right]$ and bounded by the respective μs. These probabilities can be computed using the estimated model parameters:

$$\begin{aligned}\Pr(Y_j = k-1) &= \Pr(U_j \text{ is in the kth range}) \\ &= F(\mu_k - X'_j\beta) - F(\mu_{k-1} - X'_j\beta) \end{aligned} \quad (5)$$

where k indexes the rankings and $F(\ldots)$ is the cumulative distribution function, assumed normal for the probit specification. Thus, the effect of a discrete change in the level of the nth independent variable (x_{nj}) on the estimated probability that a response will fall within each of the categories (ranks) can be calculated by substituting the estimated parameters (β and μ values) into Eq. (5). The magnitude of that change will depend on the values for all the estimated parameters and associated variables, as indicated by Eq. (5).

The probit formulation appears to offer the most theoretically sound technique, primarily because it does not exhibit the characteristic of independence of irrelevant alternatives (IIA). For this reason, it was chosen as the primary procedure for estimating the conjoint model.

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