Public Good Projects in Ngorongoro Conservation Area

Maasai Women's Valuation in Terms of Grain

H. Jo Albers, P. David Campoverde, Bethany King, Stephen Newbold, Erin Sills, Lemiani Alais, Victoria Bugni, and Erica Mtenga

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Public Good Projects in Ngorongoro Conservation Area: Maasai Women's Valuation in Terms of Grain[1]

H. Jo Albers, P. David Campoverde, Bethany King, Stephen Newbold, Erin Sills, Lemiani Alais, Victoria Bugni, and Erica Mtenga

Abstract

Protected areas restrict access to land and other natural resources, which can impose welfare losses on local communities. Governments and NGOs often invest in livelihood alternatives considered compatible with conservation and share revenues generated from activities such as tourism and hunting with such communities to compensate for burdens. Ngorongoro Conservation Area (NCA) in Tanzania is a well-known example of a human occupied protected area that both restricts the activities of and shares revenues with its traditional Maasai residents. The NCA Authority shares revenues by funding the Pastoralist Council to provide both a grain subsidy (compensating for the prohibition on crop production) and public good projects in predominately Maasai villages within the NCA. We assess local preferences for different types of public goods by surveying female heads of individual households within polygamous families living in the NCA. We use a dichotomous choice experiment to identify the relative values of different public goods in terms of grain. We find that women value scholarships for children and healthcare center projects most highly, while cattle dips and village offices are lower priorities.

Keywords: valuation; Maasai women; gender; biodiversity conservation; protected areas; pastoralists; well-being metrics; education; project rankings

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Introduction

Historically, many protected areas (PAs) were created to conserve wildlife in a "fence and fine" approach that did not always consider local community or indigenous peoples' needs. Recent research considers the impact of PAs on neighboring communities (Sills and Jones, 2018; Oldekop et al. 2016; Pullin et al. 2013). Economic analysis of that impact finds mixed results through a focus on land values and wage increases due to tourism (Robalino and Villalobos-Fiatt, 2015; Clements et al., 2014; Beauchamp et al. 2018). Some governments and NGOs define mechanisms such as benefit-sharing, payments, traditional development projects, and integrated conservation-development projects to address perceived burdens of PAs on local people and to promote cooperation with the PA restrictions (Oldekop et al. 2016; Spenceley et al. 2019, WWF 2020). To achieve these goals, it is relevant to understand local preferences across alternative mechanisms.

Ngorongoro Conservation Area (NCA) in northern Tanzania was established in 1959 to achieve multiple goals including conserving wildlife, promoting tourism, and supporting the indigenous people who live within its borders. Now a UNESCO World Heritage Site, this multiple use conservation area contains 25 villages of which 23 belong to the Maasai pastoralist community. The Maasai are known for their cattle herding lifestyle, although that is pursued primarily by the men in the community. The Ngorongoro Conservation Area Authority (NCAA) restricts grazing and other livelihood activities, including prohibiting all crop cultivation, limiting resource extraction, and banning modern building materials, vehicle ownership, and connections to the electricity grid. As compensation for these restrictions, the NCAA uses a fraction of tourist gate receipts to subsidize grain and fund public good projects (including schools, health clinics, and water supply and sanitation, community offices, and cattle dips) in

the villages. The restrictions paired with these benefits are important management tools for the NCA to achieve its varied goals.

The NCAA allocates funds for services and goods via the Pastoralist Council (PC), which has representatives from each village and thus is considered to represent local preferences. Between 2016 and 2018, NCAA spending on public good projects totaled approximately $260,000 per year.[2] Villages propose and vote on their priority for a project. Two to five villages are grouped into "wards" and the ward leadership typically rotates projects across villages. The NCAA and PC review all of the projects to ensure that they meet guidelines, and then each ward is given funding to support that ward's project in one village. Although women are represented on the PC and can attend the village meetings in which project priorities are established, our stakeholder interviews and surveys suggest that few village residents participate in the vote and women in particular rarely are present to vote. This lack of participation occurs despite the fact the NCAA lists households by their female heads of household, who are typically nested within polygamous families headed by men. In this setting, it is important to gauge women's values for alternative projects, or public goods, in order to assess and inform future funding allocations from the perspective of household well-being.

Toward that end, we conducted a dichotomous choice experiment to establish the relative values of different public goods, using grain as the numeraire. Our sample includes 458 Maasai women from the 23 Maasai villages in the NCA. We evaluated the five most common NCAA/PC funded projects in these villages: scholarships, new classrooms, dispensaries, cattle dips, and village offices. In 2016-2018, NCAA funding allocations through the PC were 38% to

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[2] Melita and Medlinger (2013) estimate that the NCAA spends 6% of tourist revenues on economic development. Slootweg (2016) estimates gate receipts at $70 million annually. PC project spending in 2016-2018 was $260,000 annually.

education, 31% to village offices, and 18% to health services (with smaller allocations to women's groups, micro-credit groups, and cattle dips). Because Maasai women in the NCA have limited involvement with cash and characterize food security as a critical issue, we used grain instead of Shillings as the valuation metric. Our analysis provides a per-woman valuation of each project type and an implied ranking across projects. We hypothesized that rankings would vary with factors such as number of children and number of cattle owned. However, we found that rankings are quite stable across women and across villages and thus provide clear guidance on how to prioritize projects to maximize benefits for the Maasai women living in the NCA.

Background

Established in 1959, NCA is now home to approximately 100,000 inhabitants, mainly Maasai pastoralists. Previous generations of Maasai pastoralists lived a semi-nomadic lifestyle and often used the area that is now Serengeti National Park to graze cattle. After Serengeti National Park was created in 1951, many Maasai and other nomadic groups were relocated to NCA (Galvin, et al., 2015). Contrary to the wildlife-protection and tourism goals of Serengeti National Park, NCA was created to support the needs of the Maasai residents, in addition to protecting wildlife and facilitating tourism. However, the multiple purposes of the NCA are often in conflict. For example, because wildlife tourists may find agriculture unsightly and because cropping can lead to human-wildlife conflict, crop cultivation has been banned in the NCA since 2009 (UNESCO, 2009). Additionally, to prevent the spread of disease between wildlife and domestic livestock and to protect particularly sensitive ecological areas, cattle grazing is restricted to limited areas. The Maasai are also banned from keeping vehicles within NCA, connecting to a power grid, settling outside of designated areas, direct contact with tourists, and using modern building materials.

As compensation for these restrictions, the NCAA helps to meet the needs of local people by working through the Pastoralist Council (PC), which was established to represent the interests of the Maasai. The NCAA only provides funds to the PC for grain subsidies and public goods projects that improve the overall quality of life in the village. Here, we consider five public goods projects that are commonly requested by the PC: scholarships for children, new classrooms, dispensaries, cattle dips, and village offices. The current process for selecting among these projects is that first, the members of each village vote for their preferred project in a village meeting. Upon NCAA and PC approval of projects, the PC allocates funding across wards— groups of up to five villages. The ward leadership (typically village leaders) decides which village will receive funding for their preferred project in that year, based on village needs but with a preference for rotating funding across villages within the ward (Stakeholder interviews, 2018; Albers et al. 2022).

Literature on the Maasai and other pastoralists suggests that the health and quantity of livestock are of ultimate importance, with livestock metrics commonly used as proxies for Maasai well-being (Tache and Sjaastad, 2010; Boone, et al., 2006). This finding suggests that projects to improve herd health would be highly valued by Maasai. However, the NCAA and PC invest far more in education, public health, community offices, and grain subsidies than in cattle herds (e.g., through cattle dips). This distribution of funding may reflect recognition that most Maasai – considering women and children – have more diversified livelihood activities, including milking cows but also collecting natural resources. While there is extensive literature on general Maasai values, there has been far less research focused on Maasai women. Kalavar et al. (2014) find that women are primarily concerned with their livestock and children. However, women's concerns with livestock may differ from men's concerns and may focus on providing

milk to their children (Woodhouse & McCabe, 2018). Women were also more likely than men to care about access to healthcare, education for their children, and having a warm house. Woodhouse & McCabe (2018) also find that women emphasized access to natural resources as important to their well-being, likely because they spend many hours per day gathering firewood and water. Our own survey data reveal that women's life satisfaction is not significantly correlated with livestock metrics (Albers et al. 2022).

NCA's discounted price grain distribution program is intended to partially compensate for restrictions on farming and support the well-being and food security of the Maasai. Each village receives sacks of grain every 3 months to distribute at subsidized prices. Each village leader has a list of all women heads of households, and each household is given the opportunity to buy that grain. Because they cannot grow crops, other non-livestock foods are purchased in markets within and outside of the NCA. Our stakeholder interviews and related data analysis find that women's life satisfaction is positively correlated with food security measures (Albers et al. 2022).

Within Maasai society, women play a unique role as the head of their sub-household. One man often has several wives who each have their own dwelling and take care of their own children. Women are primarily responsible for cooking and related tasks such as collecting water and firewood. Adult male household members are often away from the household for long periods of time as they graze cattle. Due to restrictions on grazing areas and changing climatic conditions, Maasai men have increasingly spent long periods of time away from their villages, leaving women with more independence and more responsibility (Homewood, et al., 2012; Woodhouse & McCabe, 2018). This may give women a unique and critically important perspective on the value of alternative projects for their families and their villages.

Methods

In 2018, Environment for Development,Tanzania and the University of Wyoming partnered on a survey of female heads of household in the Ngorongoro Conservation Area. Approximately 20 households per village were randomly sampled in each of the 23 Maasai villages within the NCA (Figure 1, 2). Following stakeholder interviews and semi-structured interviews to develop the survey instrument, interviewer were conducted using a questionnaire that included questions about household possessions, income, daily activities, preferences, and thoughts about the NCAA. The resulting dataset consists of responses to these questions from 459 women heads of sub-households (see Albers et al. 2021 for further detail about the data collection methods).
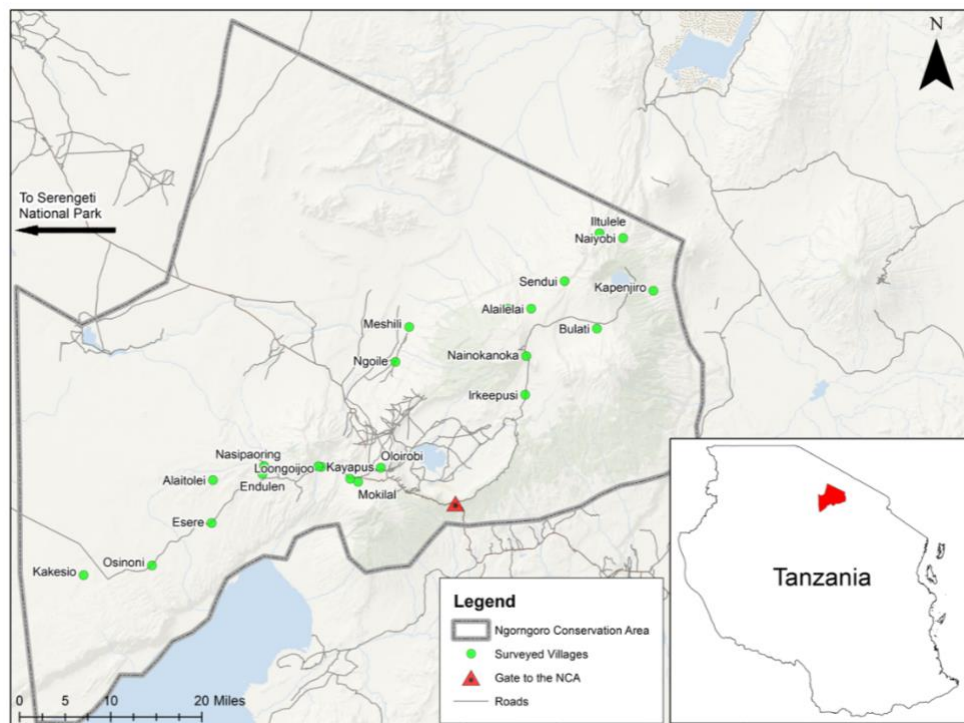

Figure 1. Map of Ngorongoro Conservation Area, villages, main gate, and the location within Tanzania.
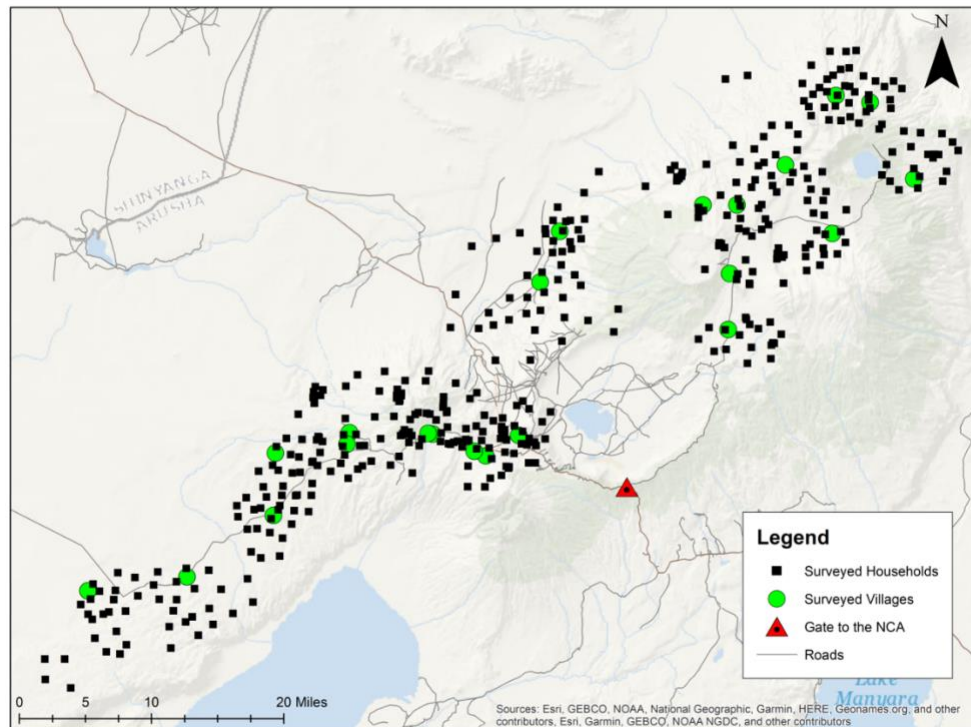
Figure 2. Map of the 23 surveyed villages, respondent locations with random variation from actual to protect anonymity, the NCA gate, and NCA roads.

Survey Instrument

The survey instrument contained ten sections with different foci: basic information about the respondent and other members of the respondent's household; primary sources of income and livestock ownership; time use in a typical day; fuelwood and water collection; livelihood activities of family members; food security, health service access, and school programs; market access, availability, and interaction; community involvement and perspectives; experiences relating to natural disasters such as drought; and a series of dichotomous choice questions about project valuation.

Discrete choice questions to elicit project ranking and willingness to pay

For the project valuation at the center of this paper, the survey collected information about village projects through a series of discrete choice questions designed to assess the

perceived value of different projects funded by the NCA relative to grain. This dichotomous choice experiment identifies bounds on Maasai women's willingness to pay (WTP) for different village projects. Because Maasai women were not often knowledgeable about their household's finances or wealth but were knowledgeable about feeding their families and the availability of grain through the grain distribution program and market purchases, we use grain instead of currency as the numeraire. We use measures of grain that correspond to the grain distribution program's typical quantities, specifically debes per month. Each respondent was asked about five possible village projects—scholarships for children, one new classroom, a dispensary (health care center), a cattle dip, and a village office. Respondents finished the choice questions related to one project before moving onto the next project.

For each project, the survey asked if the respondent would prefer the village project or 2 debes of grain per month over one year, totaling 24 debes of grain over the course of the year (1 debe is approximately 20kg). If the individual said that they would prefer the project, the next question was whether they would prefer the project or 4 debes per month (48 debes of grain total) in the next year. If, instead, the respondent said that they would prefer the grain, they were then asked if they would prefer the project or 1/2 debe of grain per month (6 debes in total). If the individual changed their answer from grain (project) to project (grain) in the second round, that level marked the end of the data collection for the choices for that project. If the respondent continued to answer the same way, whether project or grain, they were asked a final round of dichotomous choice questions: whether they prefer the project or 16 debes/month (192 debes total) of grain, for the respondents preferring the project in the earlier 2 rounds; and whether they prefer the project or 1/6 debe of grain per month (2 annual total), for the respondents preferring

the grain in the earlier 2 rounds. With this process, each respondent answered between 10 and 15

dichotomous choice questions (Figure 3).
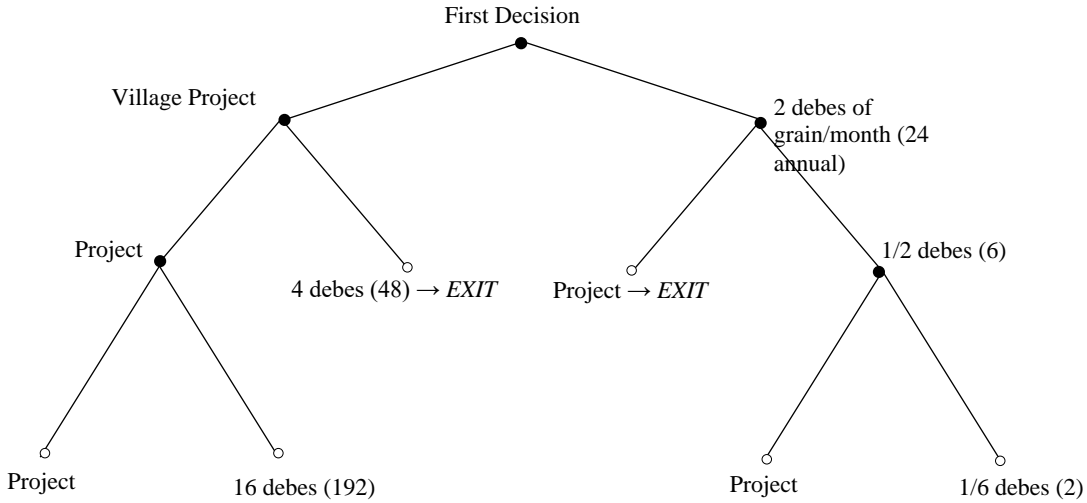
Figure 3. Dichotomous choice diagram of grain debes per month (annually)

Repeated logit model

To these data, we apply a repeated logit model to estimate the respondents' willingness to

trade additional grain for implementation of each project in their village:

(1) $\Pr[A_{ij}] = \frac{e^{\theta_v}}{e^{\theta_v} + e^{\theta_G}}$

(2) $\Pr[B_{ij}] = 1 - \Pr[A_{ij}]$

where equation (1) is the probability of choosing Option A (a village project) over Option B

(grain, where θ_G is set equal to the nominal market value of grain in local currency, debes per

yr), and Equation (2) is the probability of choosing grain over the project. We use a random

utility maximization (RUM) framework for econometric analysis. Specifically, we assume that

for each question respondents selected the highest utility option among those available, and we assume additive independent and identically distributed Type 1 extreme value errors, which yields the standard conditional logit specification in equation (1) above (McFadden 1974). Also, assuming independence among sequential choices, the probability that a respondent chooses, for example, the village project (v) over 2 units of grain in the first question and then chooses 4 units of grain over v in the second question is:

(3) $\Pr[y_{i1} = v, y_{i2} = G] = \dfrac{e^{\theta v}}{e^{\theta v} + e^{2\theta G}} \times \dfrac{e^{4\theta G}}{e^{\theta v} + e^{4\theta G}}$.

where equation (3) represents the probability that a respondent chooses the village project (Choice A) in the first round and then grain (Choice B) in the second round.

Model specification

We hypothesize that preferences depend on household characteristics that influence the demand for and ability to access different public goods. These are incorporated as follows:

(4) $V_{ki} = \theta_k + X_i \beta_k$

where X_i is a vector of household and village characteristics to derive the new probability functions:

(5) $\Pr[A_{ij}] = \dfrac{e^{V_{ki}}}{e^{V_{ki}} + e^{V_{Gi}}}$

(6) $\Pr[B_{ij}] = 1 - \Pr[A_{ij}]$.

The log likelihood function is

(7) $\ln \mathcal{L} = \sum_{i=1}^{N} \sum_{j=1}^{J_i} \sum_{k=1}^{K} \sum_{g=1}^{G} 1[y_{ij} = k] * 1[n_{ij} = g] \ln \left(\dfrac{e^{V_{ki}}}{e^{V_{ki}} + e^{V_{Gi}}} \right)$.

Equation (7) sums across N respondents, J questions per respondent, K number of projects, and G number of grain levels. The y_{ij} term is an index of 'yes' responses or options chosen, and n_{ij} is an index of 'no' responses or options not chosen.

We hypothesize that the socioeconomic status of the household will play a key role in shaping preferences for grain (subsistence) vs. public goods related to education, health, and community governance. This required that we develop several wealth metrics for Maasai households, as described in more detail in Albers et al. (2022). First, Tanzania's Poverty Probability Index (or PPI) was modified to address the lack of crop production in the NCA and related issues with valuing livestock in the absence of crops, in addition to minor changes concerning ages. The PPI value attained from this formula is identified in a PPI "look up" table to determine the probability that the household falls below a poverty line. For example, a PPI of less than 9 falls below the international poverty line of $1.90/day 100% of the time while a PPI of 25 or 50 falls below that poverty line approximately 71% or 20% of the time, respectively (IPA, 2011). Second, we calculate Tropical Livestock Units, or TLUs, as a wealth measure based on the number of animals owned by the respondent's household, although some respondents have limited information about these holdings. Using the FAO's conversion factors, the numbers of various animals that people owned were converted into corresponding TLU scores (FAO, 2010). Given our focus on Maasai pastoralist women in the NCA, the PPI is not entirely appropriate due to the exclusion of cattle, while the TLU may be inappropriate or subject to measurement error due to women's lack of involvement in and awareness of household livestock holdings. Third, we asked women directly about their life satisfaction on a scale of 0 to 10 to create a measure of subjective well-being.[3] Using these 3 metrics, we are able to get a picture of the overall well-being of Maasai women living within the NCA (Albers et al. 2022).

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[3] The specific question asked was: How satisfied are you with your life, all things considered? 0 – 10 scale.

Our setting and questions do not permit the use of an established model that describes Maasai women's preferences. We have no strong priors about explanatory variables in this setting. First, there is limited literature on how pastoralist women generate life satisfaction or make decisions, and no literature addresses their decisions in a context with restrictions such as imposed by the NCA. Second, we have limited data on income and expenditures that might provide stronger guidance on how households make tradeoffs. Third, some of the economics literature demonstrates little correspondence between income metrics and life satisfaction, which further complicates the definition of a specific model of women's household decisions (e.g. Mikucka et al. 2017; Acosta-Gonzalez and Marcenaro-Gutierrez, 2020). Relevant to this particular setting, Sujarwoto et al. (2017) find that life satisfaction correlates positively with district governments' delivery of public services. These characteristics identified in the literature and our setting imply that there is no single accepted model to underpin regression analysis. Given our weak priors, we examine a variety of utility specifications and use model averaging procedures to identify which specifications provide a better fit to the data while including a penalty for additional variables.

Model averaging refers to a class of formal statistical methods that combine results from multiple competing or alternative models when no single model is clearly preferred ex ante over all others (Steel, 2020). A weighted average of results is used to synthesize the models, where the weights are based on a measure of the relative performance of each model in the set. Roughly speaking, better fitting models get correspondingly more weight and models with more variables receive a penalty. Here, we used model weights based on the Akaike Information Criterion (AIC), which gives more weight to models with higher log likelihood values and a fixed penalty per parameters, all else being equal. Specifically, $AIC = -2(\ln L - K)$, where $\ln L$

is the maximized log likelihood for the model and K is the number of estimated parameters in the

model. AIC is a measure of the loss of predictive accuracy of a model relative to a theoretically

best predictive model (Anderson 2008), so models with lower AIC values are preferred. We

define a set of models that reflect hypothesized relationships in the broader literature and in our

stakeholder discussions. Then, we use model averaging across that set of models to define the

grain-value of each project and ranking across projects (Auffhamer and Carson, 2008).

We selected 11 models that consider different possible aspects of Maasai women's

decisions and preferences (Table 1). Models 1-3 are general and include household

characteristics that are likely drivers of decisions across all projects. The first model focuses on

household size and the respondent's education level; the second on metrics of assets or wealth;

and the third on perceptions rather than direct metrics. Although models 4-11 are part of the

overall model, averaging, each of these models addresses a specific project. These models are

meant to capture both "demand" factors – such as characteristics of the household that might

create high demand for that particular project – and "access" factors – such as characteristics of

the household that affect their ability to access the project, perhaps as compared to current access

to those services. Models 4-6 reflect demand and access factors related to education in order to

specifically address NCAA/PC projects for scholarships and for classroom construction. Model

4 contains variables that increase demand such as school age children and food in schools; model

5 adds access characteristics; and model 6 includes demand through respondent education level

and school electricity and access related to distance. For dispensary projects, model 7 considers

healthcare demand factors such as food insecurity, illness, and water access while model 8

considers access to healthcare. Although village offices are largely used by male village leaders,

models 9 and 10 include variables that might influence a woman's view of that investment such

as her perceptions of the NCA Authority, participation in women's groups, and respondent's education level. Last, model 11 reflects characteristics that might drive demand for projects to build a cattle dip to improve cattle health such as TLU (Table 3).

	Model	Variables
General	1	Household size, Education, Total children
	2	PPI, TLU, Women's Kitchen Assets
	3	Life Satisfaction, Main Challenge: Food, Main Challenge: Water, belongs to a women group, Income is sufficient
Classroom/ Scholarship	4	Skipped Meals, Food program in the school, School age children, Total children
	5	Skipped Meals, Educational Infrastructure, Distance to School, School age children, Time to school
	6	Skipped Meals, Educational Infrastructure, Distance to School, Electricity in the school, Education
Dispensary	7	Skipped Meals, Sick days, Main Challenge: Food, Main Challenge: Water, time to water source
	8	Skipped Meals, Dispensary distance, Dispensary existence
Village office	9	Trust in NCAA, Belongs to a women group, Market Access, Dispensary existence
	10	Distance to school, Education level, Belongs to a women group
Cattle Dip	11	TLU, Cattle Dip existence, Market Access

Table 1. Summary of models for averaging process.

We used the likelihood (measure of fit) of these models to create an Akaike Information Criteria (AIC) value. Using the AIC, we derived weights for the models using the following formula:

$$w_n = \frac{e^{-\frac{AIC_n}{2}}}{\sum_{n=1}^{13} e^{-\frac{AIC_n}{2}}}$$

Weighting the outcome of each model creates a weighted average willingness to pay across the models based on each individual model's explanatory power.

Results

Raw Results.

The raw response data to the series of valuation questions falls into six possible ranges: less than 2 debes per year, 2-6 debes per year, 6-24 debes per year, 24-48 debes per year, 48-192 debes per year and more than 192 debes per year (Figure 4). Between 46% and 68% of the responses fall in the last bin of over 192 debes per year, depending on the project. Therefore, the responses are skewed towards high willingness to pay for all projects. The large number of responses in the highest possible category represents a survey design flaw because more information could have been obtained from offering choices with higher numbers of debes of grain. Still, the grain levels used were determined by stakeholder discussions, NCA consumption data, our Village Assessment, and pre-testing of the survey instrument. These high values for projects could also represent low marginal values for grain once basic needs are met, given that 192 debes of grain is much more grain than needed to support an average household of 5 people. Similarly, the high project values could reflect that residents of NCA have no mechanisms to generate the kinds of benefits that these projects create, while they can buy grain, which makes the tradeoff between projects and grain less direct. Overall, the raw data shows that the dispensary project has the most responses in the category of willingness to pay over 192 debes of grain per year, followed by scholarships, classroom construction, cattle dips, and village office construction.
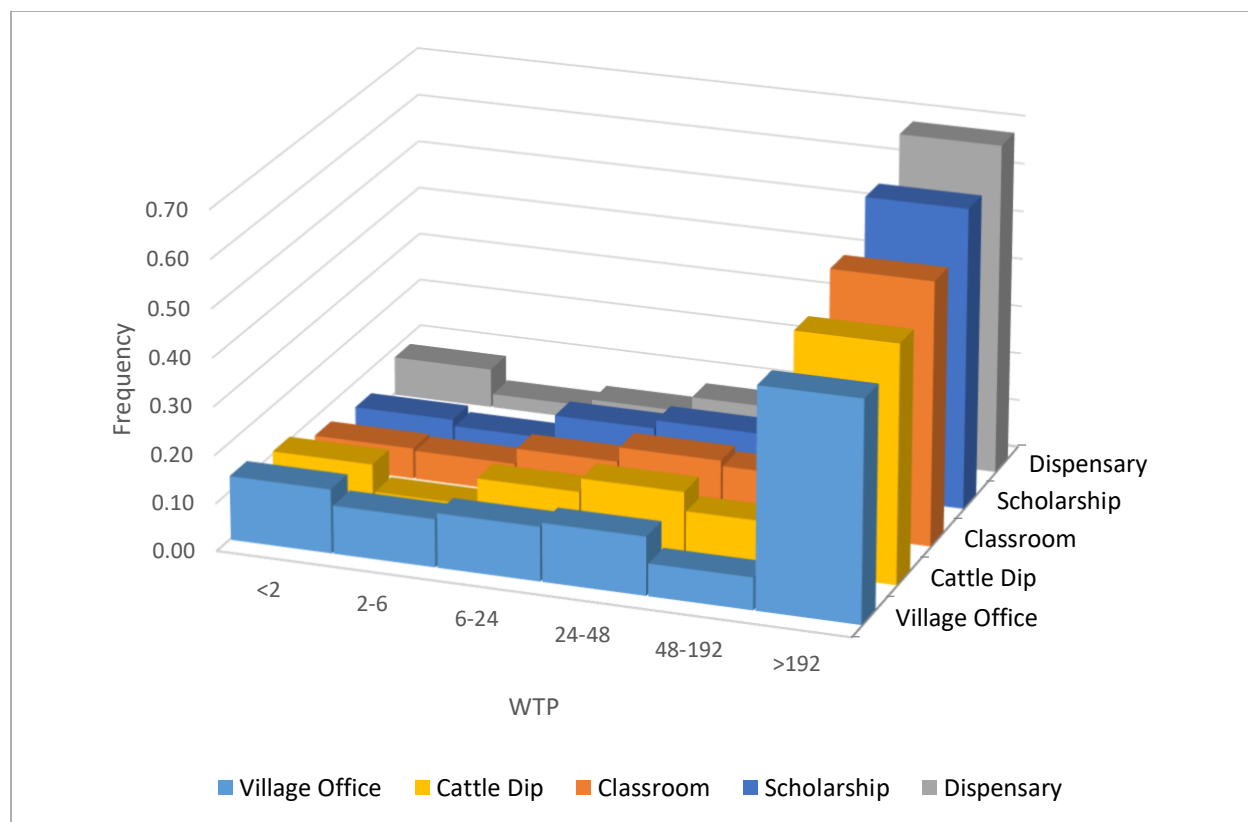
Figure 4. Willingness to pay (WTP) responses by project.

Individual regression models.

Although we use a model averaging approach to attain our willingness to pay project values, the individual models contain information about how different characteristics of the respondents drive specific project values (Table 2).

The first two general models, 1 and 2, have less explanatory power than model 3. Model 1 finds a positive relationship between education levels and the value of scholarships and a negative relationship between total children and village office values. Model 2's focus on different wealth metrics finds a stronger positive relationship between all project values and women's kitchen assets than between project values and more typical metrics of PPI and TLU. In contrast to the lack of significance on many variables in models 1 and 2, Model 3 has more significant variables and higher explanatory power. In particular, life satisfaction correlates

positively with all project values while the main challenge of a lack of food correlates negatively with all project values. In addition, belonging to a women's group correlates positively to all project values, with the largest coefficients for scholarships and dispensaries and the lowest coefficients for village offices.

Models 4-6 focus on aspects of schools to address projects for scholarships and classrooms. Model 4's emphasis on the school-food security link reveals a consistently negative relationship between the number of meals skipped and all project values and a strong positive relationship between school food programs and all project values. More focused on school access, Model 5 finds positive correlations between project values and the number of school age children and level of educational infrastructure. That model also finds that distance to school is positively correlated with project values but that time to school is insignificant. Similarly, model 6 finds a significant negative relationship between meals skipped and project values other than scholarships and a positive relationship between electricity in schools and projects for scholarships, classrooms, and cattle dips.

The health-focused models 7 and 8 reveal the importance of food security. Model 7 finds a positive correlation between project value and the main challenge of lacking food, which may be complicated by the regression also including skipped meals, which typically correlates negatively with project values. Water trip time correlates positively and most strongly with the project value for the dispensary. Model 8 finds negative correlations between meals skipped and all projects, as with model 4. Model 8's variable "dispensary in village" varies in its significance and sign across projects but, in contrast to expectation, is positively correlated with the value of a dispensary project.

The two models that focus on governance to provide more information about village office values, models 9 and 10, both find large positive correlations between women belonging to a women's group and all project values, but with cattle dip and village offices having lower coefficients than scholarships and dispensaries. In contrast, women who state that they "completely trust" the NCA generate a strong positive correlation with village office and cattle dip projects. Model 11's emphasis on cattle-related variables generates a positive correlation between TLU and all project values, in contrast to Model 2's lack of significance on that relationship, yet whether the village already has a cattle dip is not correlated with any project.

	Variable	Scholarship	Classroom	Dispensary	Cattle Dip	Village office
Model 1	Constant	2.014***	2.162***	2.311***	2.046***	1.401***
	Household size	0.07	0.036	-0.002	-0.027	0.165**
	Education (Base: No education)					
	Primary	0.538**	0.099	-0.321	-0.127	0.008
	Secondary	1.608**	-0.078	1.106*	-0.351	-0.372
	Technical/University	0.272	0.532	1.32	-0.588	-0.497
	Total children	0.009	-0.122	0.057	-0.067	-0.252***
Model 2	Constant	1.853***	1.808***	2.279***	1.552***	1.831***
	PPI	0.023*	0.01	-0.003	0.005	-0.015
	TLU	0.044*	0.025	0.033	0.019	0.031*
	Women's kitchen assets	0.223**	0.285***	0.148*	0.208***	0.35***
Model 3	Constant	2.217***	1.897***	1.704***	1.133***	0.778**
	Life satisfaction (0 to 10)	0.096*	0.171***	0.085*	0.143***	0.333***
	Main challenge: Lack of food	-0.613**	-0.971***	-0.435*	-0.307	-1.08***
	Main challenge: Water access	-0.015	-0.587*	1.339***	0.162	-0.548*
	Belongs to a women's group	1.133***	0.601**	1.073***	0.511**	0.41*
	Insufficient income	0.537	0.337	1.371***	-0.19	0.481
Model 4	Constant	1.585***	1.633***	1.718***	1.52***	1.497***
	Total children	0.036	-0.097	0.356***	-0.061	-0.107
	Meals skipped per year	-0.002*	-0.005***	-0.005***	-0.006***	-0.006***
	School food program (Base: No)					
	Yes	0.924***	1.075***	0.807***	0.688***	0.804***
	Don't know	0.041	-0.032	0.243	-0.109	-0.016
	School age children	0.09	0.085	-0.174*	0.093	0.092

Model 5	Constant	0.82***	0.726***	0.735**	0.724***	0.693***
	Meals skipped per year	-0.002	-0.002*	-0.003**	-0.003***	-0.003***
	School age children	0.503***	0.272***	0.312***	0.158**	0.173***
	Educational infrastructure	0.344**	0.251*	0.538***	0.617***	0.186
	Distance to school	0.363***	0.463***	0.641***	0.262***	0.24***
	Time to school	0.034	0.013	0.041	0.024	0.088***
Model 6	Constant	2.03***	1.771***	1.733***	1.686***	1.874***
	Education (Base: No education)					
	Primary	0.628**	0.355	-0.004	0.162	0.313
	Secondary	0.365	0.112	0.334	-0.016	0.015
	Technical/University	0.024	0.032	0.061	-0.014	-0.016
	Meals skipped per year	-0.001	-0.004***	-0.002*	-0.008***	-0.007***
	Educational infrastructure	0.256	0.028	0.509***	0.673***	0.058
	Distance to school	-0.101	0.083	0.192**	0.072	0.071
	Electricity in school	0.65***	0.645***	0.309	0.477**	0.114
Model 7	Constant	1.554***	1.35***	1.235***	1.133***	1.244***
	Main challenge: Lack of food	0.719***	0.576***	0.446*	0.564***	0.423**
	Main challenge: Water access	0.18	0.035	0.304	0.078	0.047
	Meals skipped per year	-0.001	-0.003**	-0.004***	-0.005***	-0.005***
	Unable to work due to sickness (Base: No)					
	Less than 1 week	0.363	0.225	0.038	0.2	0.212
	1 to 2 weeks	0.269	0.354	0.224	0.335	0.324
	2 weeks to 1 month	0.154	0.116	0.298	0.175	0.2
	More than 1 month	0.206	0.199	0.269	0.103	0.366
	Water trip time	0.067	0.105**	0.396***	0.125***	0.049
Model 8	Constant	2.857***	2.431***	3.403***	2.002***	1.81***
	Meals skipped per year	-0.006***	-0.006***	-0.005***	-0.005***	-0.004***
	Dispensary present in the village	0.426**	0.173	-0.991***	-0.39**	-0.154
	Distance to dispensary	0.001	0.002	-0.001	0.011***	0.007**
Model 9	Constant	2.536***	2.061***	3.402***	1.814***	1.3***
	Belongs to a women's group	1.271***	0.898***	1.053***	0.758***	0.797***
	Dispensary present in the village	-0.277	-0.133	-1.91***	-0.398**	-0.076
	Trust in NCA (Base: Completely distrust)					
	Somewhat distrust	-0.338	-0.236	-0.077	0.519	0.11
	Neither trust nor distrust	0.442	0.727**	-0.182	0.452	1.261***
	Somewhat trust	0.51	-0.035	0.113	-0.421*	-0.013
	Completely trust	0.364	0.513*	0.774**	0.706***	1.066***
	Market access (Base: No)					
	Don't know	-1.0583**	-1.0067**	-1.3434***	-1.4797***	-0.7755*

	Yes	-0.4008*	-0.3585*	0.4109*	-0.1872	-0.0987
Model 10	Constant	2.2139***	1.7681***	1.9247***	1.6199***	1.5163***
	Education (Base: No education)					
	Primary	0.5312**	0.1566	-0.345	-0.1125	0.0198
	Secondary	1.3173**	0.065	1.0741**	-0.3097	-0.3446
	Technical/University	-0.8743	-0.0219	3.8433	-0.9841	-1.036
	Belongs to a women's group	1.2156***	0.7684***	0.9377***	0.6613***	0.6759***
	Distance to school	-0.0321	0.1048	0.2272***	0.0225	0.0033
Model 11	Constant	2.4412***	1.9892***	1.9803***	1.7776***	1.4902***
	TLU	0.0636***	0.0506**	0.0419**	0.0372**	0.0591***
	Cattle dip in the village	-0.1202	0.0186	0.0936	-0.2652	-0.1689
	Market access (Base: No)					
	Don't know	-0.7365	-0.942**	-1.0064**	-1.5333***	-0.7795*
	Yes	-0.3102	-0.2887	0.6571***	-0.0823	-0.061

*Table 2. Individual regression models. ***statistical significance at the 99% level, **95% level, *90% level*

Model Averaging.

The results of model averaging produce a WTP estimate for each project for each individual model and then weights those outcomes by the AIC to determine an average WTP for each project across all models (Table 3). As identified by the "weight" column, the model averaging process weights model 3 very heavily, with its focus on life satisfaction perceptions and challenges faced. The second most highly weighted model, model 9, focuses on access to medical services, markets, and support groups. The model averaging determines the sampled Maasai women's value and rank for the 5 projects as: first, scholarships (264 debes per year); second, dispensaries (259 debes per year); third, classroom construction (219 debes per year); and cattle dip and village office construction as the lowest valued projects with a similar willingness to pay (174 debes of grain per year) (Table 4). Further, these average WTP estimates show that women value scholarships 51% more than they value the project of a village office or a cattle dip. This ranking holds across all individual models except models 4, 7, and 9. In those models, the ranking changes to reverse the order of the two highest valued projects to value the

dispensary more highly than the scholarships. The model that controls for variables related to health and missed days of work due to sickness (model 7) produces the lowest estimates for WTP for cattle dip and village office construction.

Model	Scholarship WTP	Classroom WTP	Dispensary WTP	Cattle Dip WTP	Office WTP	Likelihood	AIC	Weight (%)
1	256.8	210.5	242.6	172.6	165.4	-2445	4950	<0.001%
2	257.3	214.9	238.5	175.2	168.1	-2402.8	4845.6	<0.001%
3	263.6	218.8	259.3	174.4	174.7	-2330.3	4720.6	99.419%
4	233.9	201.3	234.4	162.6	160.5	-2447.6	4955.2	<0.001%
5	249.1	194.1	245.9	154.5	150.6	-2497.2	5054.3	<0.001%
6	241.3	205.1	227.3	184.4	162.5	-2439.4	4958.8	<0.001%
7	226.4	188.1	234.8	155.8	148.2	-2459.3	5008.6	<0.001%
8	272.2	215	241.3	161.8	153.7	-2382.5	4805	0.021%
9	262.7	215.9	269.2	178.2	168.6	-2341.2	4772.4	0.559%
10	259.9	211.9	247.6	174.5	164.1	-2415.8	4891.7	<0.001%
11	257.2	213.4	243	174.2	165	-2417.8	4885.7	<0.001%

Table 3. Summary of models WTP, AIC, maximum likelihood estimate, and averaging results (obs. = 3942)

	Weighted Average
Scholarship WTP	263.61
Classroom WTP	218.78
Dispensary WTP	259.40
Cattle Dip WTP	174.45
Office WTP	174.65

Table 4. Weighted average WTP in debes/year

To further explore the stability of the women's project value rankings, we also performed the model averaging over just the first three general models (1-3) to estimate the average WTP. With just those general characteristics and no project-specific characteristics, the order of the

ranking does not change and, in fact, the WTP estimates remain very close to the fuller set of models' results. This stability comes from the prevalence of responses in each valuation level. Model 3 out-performs the other models enough that it dominates the model averaged WTP estimates and rank with a weight of 99% in the model averaging.

Discussion and Conclusion

Although most research on pastoralist communities, and the Maasai in particular, consider livestock holdings (TLU) and number of children as the central wealth and well-being metric, most such studies focus on men's perspectives. In related work with these survey data, Maasai women's life satisfaction correlates with food security, some household assets, and healthcare, but does not correlate with TLU (Albers, et al., 2022). Other literature finds that women place a high value on their children and on their health (Kalavar, et al., 2014; Woodhouse & McCabe, 2018). This project valuation study provides further evidence of women pastoralists' values. In this analysis, women value scholarships, dispensaries, and classrooms, in that order, with cattle dips and village offices completing the ranking at much lower values than the scholarships and dispensary projects.

Because we have used tradeoffs between grain and projects, the interpretation of the results requires consideration of the food security issues confronting NCA Maasai women. When asked, "What is the primary challenge facing your community?", over 75% of women stated that food and water access were the primary challenge, with the next highest categories being access to healthcare (6%) and access to education or scholarships (3%). Yet, beyond the subsidized grain program, NCAA/PC offers no projects aimed at food security. The ranking results are consistent with the related research's findings of the importance of healthcare by providing the second highest value to the dispensary project. In addition, the priority ranking and value for scholarships may reflect an important interaction between education and food security that increases the value of scholarships, and to some extent, the value of classrooms. Albers et al. (2022) find a strong positive correlation for these sampled women between "children are fed at school" and women's life satisfaction, and stakeholder interviews also reflected the importance

of the meals served in school. In addition, women report that adults skip meals more often than children skip meals, which indicates that scarce food is allocated to children within the household. In considering their WTP for scholarships and classrooms, then, women's values may include both the education outcomes and the value in terms of food security that schooling provides. Given that scholarships and classrooms provide both education and food for children, these results should be interpreted as women valuing school and food in combination, as well as valuing local access to healthcare through the dispensary project. NCAA/PC allocations of 38% of village project spending to education appears to address the Maasai women's priority and value for education in the rankings here.

This project ranking and valuation analysis contributes insight about which projects are less valuable to Maasai women in the NCA: village offices and cattle dips. Between 2016 and 2018, NCAA/PC allocated 31% of village project funds to construction of village offices. Although village offices are a common project requested by villages in the NCA, our respondents do not prioritize them in terms of value, which raises questions about whether women's voices and votes on village project priorities come to the fore. Village offices are used to hold meetings, but only 20% of women participate in women's group meetings and few women participate in other types of village meetings. In addition, village offices are primarily used by the village leaders and councilors, who are men. Unlike homes, these offices are constructed with more modern methods and materials, but our analysis demonstrates that women prioritize food (grain) and all other projects considered over such offices.

Perhaps more surprising for a culture that centers on cattle, women place a low value on cattle dips that improve the health of cattle. Albers et al. (2022) finds that these women respondents do not know details of their own household's cattle holdings and that their life

satisfaction does not correlate to TLU. The low ranking and value for cattle dips could reflect a lack of knowledge of the importance or impact of cattle dips on cattle and income due to household division of labor. The low ranking could also depict that women value projects that more directly affect aspects within their purview, such as food, children, and education, rather than aspects over which they exert little control, such as cattle and village governance. The low value of the cattle dip relative to other projects could also correspond to increased income diversification driven by NCAA restrictions on grazing areas leading to some Maasai earning income from other activities (Galvin, et al., 2015), although our survey reflects few other opportunities. Overall, this low ranking for cattle dips underscores that policies to improve Maasai women's well-being might be misplaced if they focus on cattle because women's life satisfaction and project values appear only secondarily related to cattle despite cattle's importance in male-focused analyses of Maasai well-being.

As the amount of land in protected areas increases worldwide, protected area establishment and management continues to shift towards supporting multiple uses and meeting goals around tourism, wildlife conservation, and local livelihoods. Still, local community's needs, and the concerns of particularly indigenous people and women are often overlooked. Few analyses emphasize the specific priorities of women in pastoralist societies such as the Maasai. Using the Ngorongoro Conservation Area (NCA) setting, we assess the value Maasai women place on the common projects that the PA's managing organizations fund with small portions of the NCA tourist gate receipts. Given that the residents in the NCA face high probabilities of falling below international and national poverty lines, determining the value of the limited number of NCAA/PC projects could prove critical to increasing Maasai well-being in the NCA, especially with so few women contributing to the votes that determine village project priorities.

Here, the value that Maasai women place on children's education and healthcare far exceeds how they value the more male-focused projects of cattle dips and village offices. Such findings imply that the emphasis on men and cattle in the policy literature related to the Maasai and other semi-nomadic groups can lead to policies that fail to address large segments of those populations. The NCAA/PC allocate the most funding to education projects, in keeping with how women rank and value such projects. However, women play a central role in the activities and well-being of the Maasai in the NCA through their own actions and their care for children and elderly, and thus women's lack of active participation in determining the most advantageous projects for their villages poses challenges to project selection that benefits women and children. This project value and ranking analysis provides guidance for the NCA Authority and the PC to improve the selection and implementation of projects to promote the well-being of the Maasai within the NCAA.

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