Ecological Economics 220 (2024) 108155

Contents lists available at ScienceDirect

Ecological Economics

journal homepage: www.elsevier.com/locate/ecolecon

Analysis

The value of failure: The effect of an expired REDD+ conservation program on residents' willingness for future participation

Jeffrey Andrews [a,*], Monique Borgerhoff Mulder [a,b,c,d]

[a] Department Human Behaviour and Culture, Max Planck Institute for Evolutionary Anthropology, Leipzig, Deutscher Pl. 6, 04103, Germany
[b] Department of Anthropology, University of California, Davis, Davis, CA 95616, United States
[c] Santa Fe Institute, 1399 Hyde Park, Rd, Santa Fe, NM 87501, United States
[d] Department of Anthropology and Archaeology, University of Bristol, 43 Woodland Rd, Bristol, BS8 1TH, United Kingdom

ARTICLE INFO

Dataset link: www.github.com/abjeffre/wta_public

Keywords:
Conservation
Project legacy
Project failure
PES
REDD+
Pemba
WTA

ABSTRACT

Conservation projects have a lifecycle; they are born, they grow, and they can die. However, researchers know little about how the legacy of a project that failed to deliver upon its promised goals affects former participants' willingness to participate in future conservation programming. We utilize a natural experiment—an expiration of a Reduced Emissions from Deforestation and Land Degradation (REDD+) readiness project that failed to yield payments in Pemba Zanzibar – to explore whether and how exposure to REDD+ has influenced residents' willingness to participate in a proposed future payment for ecosystem initiative (PES). We develop a simple causal model and analyse willingness to accept data from treated and non-treated *shehia* (ward), showing how exposure to REDD+ affected former participants' willingness to engage with future PES projects and how this is moderated by factors shown in previous studies to be key indicators of uptake. Contrary to our expectations, we find that exposure to REDD+ is associated with fewer protest bids and higher levels of expected future participation. We find strong evidence that use values, wealth, loss aversion, environmental attitudes, and social desirability mediate this effect. We discuss these findings concerning Pemba and end with suggestions for conservationists establishing programs with uncertain futures.

1. Introduction

How do communities targeted for conservation interventions view routine project failure and closure? Over the past 35 years, multiple waves of enthusiastic hype for various approaches have spread across the conservation world (Redford et al., 2013; Massarella et al., 2018; Lund et al., 2017; Skutsch and McCall, 2010). These include Integrated Conservation and Development Projects (ICDP), Community Based Conservation (CBC), and Payments for Ecosystem Services (PES), including market-based instruments such as those associated with carbon trading (Borgerhoff Mulder and Coppolillo, 2005). Inevitably, many such projects fail. And while there is a growing literature that evaluates the causes of project failure (Catalano et al., 2019; Etchart et al., 2020), we know little about how project failure affects peoples' willingness to participate in future programming. Given the importance of community/individual-level buy-in to the success of conservation projects (Bennett, 2018; Bottazzi et al., 2018), it is crucial to determine whether exposure to project failure can affect future participation and, if so, how.

Part of the concern comes from the fact that conservationists are increasingly aware of an 'economy of expectations' created through the routine promulgation of new initiatives (Fletcher et al., 2016; Lund et al., 2017; Massarella et al., 2018). When such expectations have been triggered but the project fails, should we expect more disillusionment and lower levels of participation in future programming? Or can successive waves of conservation projects build on past successes despite programmatic failure (Borgerhoff Mulder et al., 2021)? More generally, how does institutional history, and specifically institutional failure, affect the emergence or establishment of future institutions (Currie et al., 2016)?

While the answer depends on the specific program, its reasons for failure and what it left behind, the exact mechanisms through which failure could affect future participation are under-theorized. Accordingly, we propose that programmatic failure may affect future participation by amplifying or diminishing the effects of some well-studied determinants of participation in conservation programming. Here, we consider four specific mechanisms. First, failure and proposed revival can affect residents' valuation of the targeted resource (Fisher, 2012; Waruingi et al., 2021). Second, failure may adjust risk assessments of future projects (Greiner et al., 2009; Lacroix and Gifford,

* Corresponding author.
E-mail address: jeffrey_andrews@eva.mpg.de (J. Andrews).

https://doi.org/10.1016/j.ecolecon.2024.108155
Received 28 January 2023; Received in revised form 20 January 2024; Accepted 20 February 2024
Available online 6 March 2024

2018). Third, failure may amplify the crowding out/in of intrinsic motivations for conservation (Gómez-Baggethun and Ruiz-Pérez, 2011; Wong, 2014; Reutemann et al., 2016; Ezzine-de Blas et al., 2019; Kaczan et al., 2019). Finally, by adjusting community-level discourses about conservation projects, project failure may change the social desirability of rejecting or accepting future initiatives (Andersson et al., 2018; Benjaminsen and Kaarhus, 2018).

Here we provide evidence from a case study in Tanzania that explores how exposure to a Reducing Emissions from Deforestation and forest Degradation (REDD+) intervention that failed to produce any carbon payments has affected residents' willingness to participate in future PES conservation. Using data gathered two years after the formal conclusion of the REDD+ readiness project and by all outwards signs had failed to meet its stated long-term goals, we test how exposure to an incomplete REDD+ intervention affected willingness to engage with future PES initiatives and how use values, social desirability, environmental attitudes and risk may mediate future participation.

The paper proceeds as follows. First, we review the related literature on the enduring effects of failed conservation projects and hypothesize how failure may affect participation through four well-studied determinants of participation. We then introduce our study site and the REDD+ project. The methods section begins with a simple causal model detailing how project failure affects future motivations and outlines our statistical models. Finally, we present our results and discuss them and their limitations.

2. Background

2.1. Participation in PES programs

Despite the frequency with which conservation interventions, including those offering payments for ecosystem services, are delayed, suspended, or even cancelled, the consequences thereof have received surprisingly little attention (Etchart et al., 2020). Existing case studies, including those from planned terminations, indicate mixed outcomes. Emerging evidence suggests that programs which build household assets (allowing them to reduce dependence on targeted resources) show greater resilience than those that impose constraints on people's behaviour (Calle, 2020; Rasch et al., 2021). Yet even programmes focused on behavioural constraints can show some permanence after a period of disturbance or uncertainty, as Hayes et al. (2022) discovered in a study of grazing pressures on communal lands. However, the permanence of a conservation project can disappear when pressures to resume harvesting remain high (Etchart et al., 2020); this is because once the money stops, the opportunity costs for continuing to restrict harvests increase (Jayachandran et al., 2018; Fisher, 2012). Additional research has highlighted that permanence depends on how community members view the intervention (Hayes et al., 2019), the salience of non-monetary motivation (Rasch et al., 2021), as well as the extent to which the programme may have crowded out intrinsic motivations for conservation (such as Fisher's (2012) "no pay, no care" characterization of PES in Uganda). Nevertheless, in some cases, programs may spark or revive intrinsic commitments to conservation that are not contingent on compensation as with the engagement of intellectuals in Mexico (Shapiro-Garza, 2020; Kosoy et al., 2008), effectively a "crowding in" of environmental ethics (Calle, 2020). The multiplicity of these motivations (Maca-Millán et al., 2021; Authelet et al., 2021) and their patterning will undoubtedly shape the legacy of a failed intervention.

2.2. Moderating influences on participation

A relatively robust literature exists on the determinants of participation in conservation, particularly PES programs. We propose that one way in which programmatic failure will affect participation is by modulating the relative salience of these determinants.

Opportunity Costs and Use Values: Opportunity costs are the central theoretical pillar of PES programs—according to the rational actor foundations of market-based programs, *ceteris paribus* actors should agree to PES contracts if payments are above the opportunity cost of participation (Engel et al., 2008; Wunder, 2015). It follows that there should be a strong correlation between a household's use value and the amount of monetary compensation required to encourage participation. Yet, studies find that focusing only on payment levels and opportunity costs is insufficient to account for empirical observations about participation (Arriagada et al., 2009; Bremer et al., 2014), as Pagiola et al. (2005) recognized long ago.

Nevertheless, programmatic failure could adjust people's internal valuation of their natural resources (thus their opportunity costs) for at least two reasons. First, having prior exposure to the neo-liberal, market-based structure of PES programs may encourage a 'commodification of nature.' This, in turn, may raise the relative salience of use values and increase the compensation required to induce future participation. Second, repeated attempts to initiate a PES program may be akin to repeated visits from a prospective buyer, thus increasing prospective participants' valuation of the demand for their resources and their estimates of the value of their resources and, thereby, the compensation demanded.

Risk: Conservation projects affect the risk portfolios of participants. PES programs have been shown to help reduce inherent risks in rural livelihoods by (a) assuring a legal basis for secure tenure over resources (Bremer et al., 2014), (b) providing consistent income streams that are not subject to local climatological or market shocks (Etchart et al., 2020; Hayes et al., 2022), and (c) ensuring the stability and existence of ecosystem services that in turn reduce the variance in income from other rural livelihoods (such as farming) (Shinbrot et al., 2019). At the same time, conservation projects themselves are a source of risk requiring the investment of resources for uncertain returns (Adams et al., 2014), particularly when projects require collective action and implementers may breach contracts.

Programmatic failure can affect the perceived risk of new projects. However, the expected direction of this relationship is not immediately apparent. On the one hand, an experience with failure can increase the predicted probability of future failure due to an increase in the salience of risks regarding implementation and contract breaches. On the other hand, implementers and residents may have gained experience during the implementation of the previous project. This experience may translate into higher levels of competence that could inspire confidence, thereby reducing the perceived risk of future projects.

Environmental attitudes: While environmental attitudes can, at least in theory, strongly influence involvement in conservation programs (Jones et al., 2019; Arriagada et al., 2009; Bremer et al., 2014; Obeng and Aguilar, 2018; Shapiro-Garza, 2020), there is an ever-present concern about motivational crowding out (Kaczan et al., 2019; Moros et al., 2023). Notably, a large meta-analysis (Jones et al., 2020) suggests that while pro-environmental motivations generally increase with participation, participation may be the cause rather than the consequence of such environmental attitudes, accordingly cause and effect are not easily distinguished. Indeed, there are cases where no associations are observed (e.g., Grillos, 2017), suggesting that PES programs can just as easily crowd-out as crowd-in positive environmental values.

When conservation projects fail, they may create a sense of disillusionment amongst those concerned with the environment, perhaps promoting otherwise instrumental and extrinsic motivations, thereby decreasing the influence that environmental attitudes would have on participation. Nevertheless, given that environmental education is often a major component of conservation programming (and present in HIMA), the prior normative inculcation may have strengthened environmental convictions and encouraged a deontological commitment to conservation values driving participation despite the project's demise.

Social Desirability: Social motivations for participation are diverse, but a generic concern for others is generally positively associated

with participation in pro-environmental activities (Lacroix and Gifford, 2018; Hayes et al., 2019), with multiple possible pathways indicated. For example, such motivations may arise as individuals seek social approval and reputation through participating in or rejecting a program, through conformist pressure of peers (Pfaff et al., 2019; Bremer et al., 2014; Kaczan et al., 2017; Jones et al., 2020), through an altruistic concern with preserving resources for future generations (Rogers, 1994), or as a consequence of concern for coordination over collective action (Hayes et al., 2019; Pfaff et al., 2019). Thus , social motivations (conformity, reputation and altruism) can be frequency dependent and depend on what an individual knows (or believes) about the beliefs or actions of others. Again however, causality is difficult to ascertain (contrast Authelet et al., 2021 with Bottazzi et al. (2018)), and it is also quite likely that the importance of social approval and social networks, more generally, are influenced over the course of an intervention.

While we doubt that program failure would affect more general altruistic tendencies, failure will indeed affect people's willingness to participate by adjusting the social desirability of accepting or rejecting future projects. Specifically, project failure may affect community-level discourse concerning future projects (Benjaminsen, 2014); this discourse may directly affect people's willingness to participate by adjusting what course of action is seen as socially desirable. However, the direction of this pressure will again depend on how the community views the project's collapse.

3. Site and project background

The Indian Ocean archipelago of Zanzibar is a semi-autonomous jurisdiction lying off the coast of Tanzania. Its forests have changed dramatically over the last millennium in ecology and management due to maritime trade with Oman and beyond and in the last two centuries to commercial clove production. In the early 20th century, forests were further impacted by selective sawmill logging, British colonial afforestation programs, the gazetting of Forest Reserves under both the colonial and post Revolutionary governments, and Finnish aid for plantation development between 1980–1997 (Chachage, 2000). The more recent global shift from a focus on commercial wood production to conservation, together with internal political liberalization, opened up space for multilateral and nongovernmental support for community forestry and a new Forest Management and Conservation Act. Novel community-based initiatives drew support from a variety of international donors. Then in 2009, Tanzania was identified as an appropriate country for piloting REDD+. With the principal support of the Norwegian government, eight site-specific REDD+ projects were initiated (Burgess et al., 2010), including one on Zanzibar (Caplow et al., 2014). Here the Hifadhi ya Misitu ya Asili (HIMA) program was designed to slow deforestation through the establishment of Community Forest Management Agreements (CoFMA) in 45 shehia (wards, 18 of which are on Pemba, see Fig. 1), to sell carbon credits on the voluntary market. Shehia for participation were selected on the criteria of having high forest cover and high rates of deforestation.

These agreements (formalized in 2015 Andrews et al., 2020) assured shehias collective land tenure over the shehia's community forests, which previously were de facto open access. Their use rights allow them to zone areas of forest for higher protection. In addition, their Shehia Conservation Committees (SCC) became eligible for support through training, planting, restoration, patrols and the fining of illegal forest harvesting. Crucially, as part of the HIMA's institutional capacity building, 'mock carbon payments' were issued to all participating shehia to incentivize participation and simulate the potential effects of a PES scheme. Each ward independently determined how to use the payments. Some built mosques and schools and repaired roads. Others distributed direct cash payments to all residents or vulnerable segments of their shehia. In contrast, others reinvested the money directly into conservation by building nurseries, purchasing additional equipment and paying for patrols.

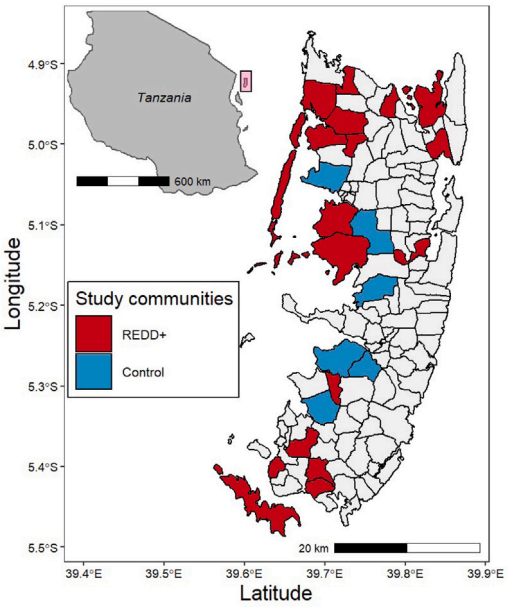

Fig. 1. Shehia in study.

After 2015 all formal funding to the project ended, and the international partners withdrew according to the original plans in the project document. HIMA was then effectively put into a state of stasis while the final validation and verification were being completed. As of 2017, the offices of the coordinating local NGO JUMIJAZA were forced to close, and by 2019, the Department of Forestry, an original HIMA partner, was seeking new sources of locally generated revenue outside of carbon markets to fund CoFMA related activities. Despite efforts by concerned residents and internationals to finalize the auditing process by 2022, it has still not been completed, and no carbon payments have ever been issued to Pemba. Nevertheless, there were some successes during the projects life-span . In particular, the legal frame-work established during REDD+ still exists and to varying degrees, the local conservation committees persist and function today despite the lack of funds. More so, to some extent these institutions are proliferating across communities that were not in the original HIMA programme (Borgerhoff Mulder et al., 2021). Furthermore, we have evidence of wealthy landowners seeking to engage with the failing HIMA programme between 2017 and 2019, indicative of their genuine interest in the PES scheme. The continued viability of CoFMAs, and interests therein, suggest that the longer-term effects of HIMA on conservation willingness merit attention.

Economically, Pemba is primarily a rural society whose inhabitants depend on small-scale farming, clove production, and fishing and have a long history of forest dependence (for a general economic overview, see Andrews and Borgerhoff Mulder, 2022). Except for three government forest reserves and a few government/privately-owned plantations, most forested land is under private or common-pool resource management, even though technically, all land is owned by the state. Nevertheless, in many areas, usage is mainly open access because of poorly articulated usufruct rights, community boundary disputes, increasing land pressure, and ambiguities between central government, district and community rights and responsibilities (Borgerhoff Mulder et al., 2021; Andrews and Borgerhoff Mulder, 2022). In recent years population pressure and economic growth have contributed to a deforestation rate of 3.4% per year (2010–2018 Collins et al., 2022). The primary drivers of deforestation are the subsistence needs of rural households and demands for converting land to agriculture (Caplow et al., 2014; Andrews and Borgerhoff Mulder, 2022). Although no hard statistics are available, local users, including town

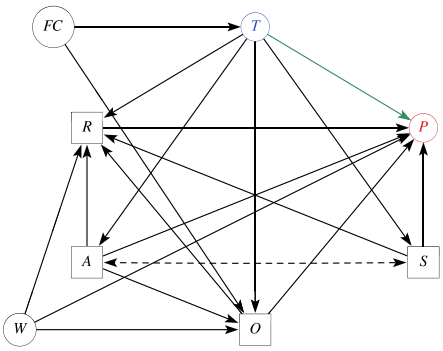

Fig. 2. Directed acyclic graph.

residents, are primarily responsible for deforestation (for agricultural expansion, building materials, firewood and charcoal); there are no large-scale commercial extraction industries. Demand for timber from tourist developers (mainly from the neighbouring island of Unguja) and the government is growing.

4. Methods

4.1. Causal inference

We construct a directed acyclic graph (DAG) (Pearl, 2009) to formalize the arguments above and determine necessary adjustment sets for causal identification, thereby allowing us to isolate the effect of REDD+ on future participation and understand how this is mediated by the mechanisms proposed above.

Fig. 2 shows the DAG that maps out the effect of the REDD+ treatment (T) on Participation (P). In the top-left, the primary exogenous variable was the amount of forest cover (FC) in the shehia in 2010. This was the primary reason a ward was selected to participate in REDD+ (Collins et al., 2022). Therefore, forest cover directly affects the treatment as well as opportunity costs (O), as people living next to well-maintained forests generally have higher use values (Andrews and Borgerhoff Mulder, 2022). Note that we also assume that the treatment affects opportunity costs for the reasons specified in Section 2.2 and because REDD+ programming may have directly affected harvesting behaviour through the creation of new property rights and rules. Following Section 2.2, the treatment is also assumed to affect the risk (R) of future projects, social desirability (S) and environmental attitudes (E) as well as having a direct effect on participation. The risk of future projects is also partially determined by social desirability, which modulates risk perceptions (Carter et al., 2020), opportunity costs as required compensation should track use values, and wealth (W) as the effect of opportunity costs is modulated by baseline wealth. We also assume that environmental attitudes directly affect opportunity costs values adjusting use values (harvesting) and vise versa that harvesting affects environmental attitudes as people rationalize their own actions. Finally we assume that environmental attitudes affect and are affected by social desirability in a community, and that they affect the perceived risks associated with environmental degradation and conservation projects.

Using the backdoor criterion and the DAG, we need only include forest cover to estimate the direct effect of receiving the REDD+ intervention on future participation in our models. Additionally, we can investigate the moderating effects of opportunity costs, risk, and environmental attitudes, by condition on these same variables and wealth.

4.2. Site and sampling procedure

The data comes from 829 households across. Eighteen of these shehia consist of those that had been granted CoFMAs in 2015, which, as noted above, were not randomly selected but were targeted because they were known to contain forests with high rates of deforestation and enough woody biomass to be under threat (Collins et al., 2022). Six matched controls were selected on the basis of two primary criteria—a high percent of forest cover and rapid perceived rates of forest loss, the former confirmed with satellite imagery. Additionally, while there is a history of development projects across the island (marine conservation, health, social welfare etc.), the distribution of these projects is, in effect, 'random' in relation to the assignment of shehia to control or treatment conditions because the selection criteria for these prior projects have nothing to do with forest cover.

Within these 24 shehia, we selected two contrasting villages, one close to the forest and one further away. For each village, we randomly sampled between 15 and 20 households from village registers (20% of all households). Household heads were interviewed and, when absent, substituted by the most senior household member available. The data were collected between June and December 2017.

4.3. Survey design

The data were collected as part of a broader study of forest dependency on Pemba. The survey was modelled on the CIFOR-PEN instrument (for additional details, see CIFOR, 2007; Andrews and Borgerhoff Mulder, 2022), with other modules that measured environmental attitudes, WTA, and economic preferences. To measure the participant's willingness to participate in future PES schemes, we asked a Willingness to accept (WTA) question that measured how much money the person would have to be paid to participate in a future PES program that would include a year-long moratorium on all forest harvests and farm expansion in all forested areas on Pemba. The exact question reads as follows:

> We would like you to imagine that JUMIJAZA (a local NGO) is interested in signing contracts with some households to restrict forested land use in exchange for direct cash payments. Under the contract, your household would stop harvesting any forest products from any forest (in your shehia and all others). In addition, you would not be allowed to expand your farmland into any forested area. You would sign a legally binding contract with JUMIJAZA, and in return, you would be paid half the value at the beginning of the contract and half at the end. The contracts are signed for one year with the possibility of renewal. If you violated the contract and collected forest products or expanded your farm, the contract would be terminated immediately. Please note that JUMIJAZA can only issue these contracts to a small number of households because of limited funds and will only offer contracts to households that have issued the lowest bids. What is the likelihood you would participate in one of the contracts if the payment amount is X?

To account for poorly defined preferences towards such questions, the payment card allowed for the measurement of uncertainty. Participants could indicate the probability that they would accept each bid (100%, 75%, 50%, 25% and 0%). The value of the bids spans from $20 USD to $8000 USD increasing with each bid in a roughly exponential fashion (note participants did not know the maximum, and it was chosen during extensive pretesting to ensure that a minimum of 90% of respondents accepted the maximum offer).

To improve the quality of research, we followed the principles in Johnston et al. (2017) for survey design and administration. This included choosing an elicitation technique matched to the conservation challenges; rooting the questions in the immediate economic realities of the island; ensuring incentive compatibility by using an

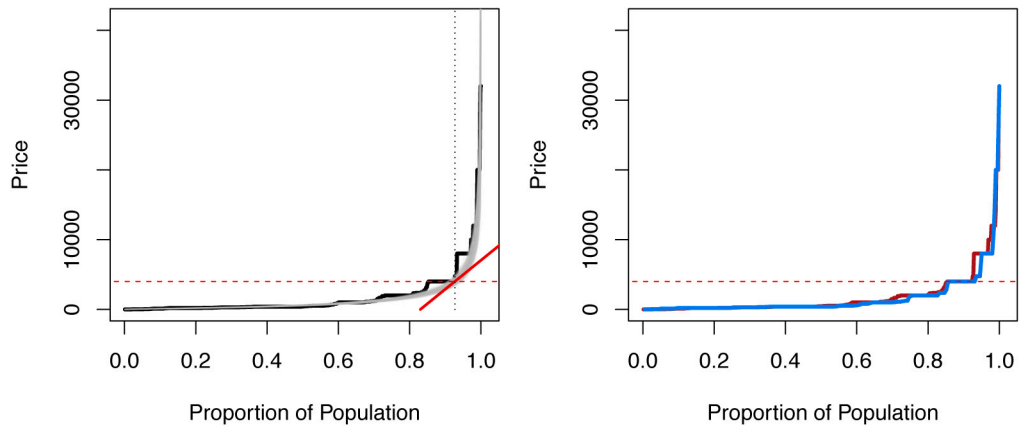

Fig. 3. Identification of Protest Bids. First panel—The thick black line shows the empirical supply curve drawn directly from the data. The grey lines show the estimated supply curve drawn from the posterior of a calibration model. The dashed red line shows the price at the inflection point. The dotted grey line shows the percentage of the sample at the inflection point. The second panel—shows the respective supply curves for the empirical distributions for those in REDD+ shehia and those in controls (blue).

"auction framing" based on Becker et al. (1964); using a proven (hypothetical) payment delivery mechanism; and including no-answer options, together with follow-up questions to determine the reasons for (non)-participation, which allow us to determine if non-response were motivated by protest (as defined below) or altruistic considerations.

The contract we offer differs from HIMA's, as we specifically invite *private households* to participate in a program aimed at forest conservation. In contrast, HIMA relied on a process where *communities* chose to participate or not through rudimentary FPIC. We dropped the collective framing to help our measurement process focus on measuring individuals' willingness to engage with future PES programs without the obfuscation induced by the myriad of collective action dilemmas necessary for the successful functioning of a collective PES program.

4.4. Variable definition

Here we define our primary independent and dependent variables.

4.4.1. WTA

We use the acceptance probabilities in the payment card to calculate WTA point estimates. These allow us to estimate both expected WTA values and variances/standard deviations that characterize the degree of uncertainty for each WTA point estimate. To derive both measures, we use the probability mass function, which is the probability that a bid is accepted and that all previous bids have been rejected. Thus, we can define the expectation as:

$$E(wta) = \sum_{K=1}^{K} [x_k(p_{k_{k}\prod(_{i=0}^{k}{}^{(1-p_{i\ldots k-1})})})] \tag{1}$$

where X is the set of offered bids and x_k indexes the kth bid defined on the payment card. p_k is the probability that the person accepts the kth bid. Thus: $\prod(_{i=0}^{k}(1-p_{i\ldots k-1}))$ is the probability that all previous bids have been rejected (Note: $p_0 = 0$). Using LOTUS and the probability mass function, we can calculate the variance/standard deviation over the set of bids presented to each individual.

$$\sigma(wta) = \sqrt{\sum_{K=1}^{K} [x_k^2(p_{k_{k}\prod(_{i=0}^{k}{}^{(1-p_{i\ldots k-1})})})] - (\sum_{K=1}^{K} [x_k^2(p_{k_{k}\prod(_{i=0}^{k}{}^{(1-p_{i\ldots k-1})})})])^2} \tag{2}$$

Simplified

$$\sigma(wta) = \sqrt{E(wta^2) - E(wta)^2} \tag{3}$$

We define uncertainty in each individual's WTA as equal to the standard deviation derived above. The uncertainty is used in the second stage of the hurdle model (see below) as measurement error on the outcome variable (WTA).

4.4.2. Protest bids

Protest bids raise analytical problems for contingent valuation studies (Halstead et al., 1992). A protest bid is a response to a WTA question where the individuals nominate a monetary value that would appear to represent an outright rejection of the question's premise either on ethical, emotional or other grounds (Meyerhoff and Liebe, 2006). Typically, researchers delineate a threshold (Ferreira and Gallagher, 2010) above which bids are considered "protests" and are either discarded or analysed separately. Unlike other studies, we do not exclude protest bids from our analysis but analyse whether participation in REDD+ has changed their prevalence.

Protest bids are, unfortunately, difficult to demarcate. More specifically, identifying a cutoff point between a genuine "very large bid" from a protest bid is arbitrary if one assumes strategic motivations amongst bidders. Thus we adopt the point of view of a policy planner looking to maximize participation and minimize costs. Accordingly, using the existing bids, we plot out the supply curve as seen in Fig. 3 and calculate the inflection point where the slope equals one. This inflection point is crucial because it represents where marginal costs (payments per person) equal marginal gains (additional participation). To the right of the point, the cost per additional participant begins scaling supra-linearly, and net costs expand exponentially for each additional participant. The inflection point is at approximately a payment value of $4000 per year. Note that this value is more than 87% of the sampled households' yearly income. Using the $4000 cutoff designates 8% of the sample as having issued protest bids. The remainder we call 'in-market' (see Table 2).

4.4.3. Exposure to REDD+

Our primary independent variable is exposure to the REDD+ project, which we consider as a treatment. We utilize the six matched control shehia that did not receive the REDD+ intervention (untreated) as a quasi-experiment that allows us to measure the individual's exposure to the failed REDD+ program, which accounts for endogenous and hard-to-measure covariates that may have been overlooked (Stuart, 2010).

Given the small size of the island and the extent of inter-community ties (Pisor et al., 2024), we cannot assume control shehia are ignorant of the REDD+ intervention. However, despite this potential knowledge, it is key to remember that households in such shehia have not faced the specific tradeoffs entailed in implementing or following regulations.

4.4.4. Moderating variables

The proposed moderating factors identified in Section 2.2 are included as interactions/moderators in our regressions and are defined in Table 1. Further definitions can be found in SI 1.

Table 1
Variable definitions.

Concept	Definition	Operationalization	Summary
Opportunity costs	Forest income	The total market value of all primary (harvested) and secondary (produced) goods are dependent on the forest for their existence. (see Andrews and Borgerhoff Mulder (2022) for a full definition)	Median = $214 SD = $539
Wealth	Total wealth	Summed market value of all items, including land, luxuries, and other productive assets owned by the household.	Median = $6089 SD = $7815
Social pressure	Neighbour's expected WTA	"How much money do you think your closest neighbour requires to sign the above contract?"	Median = $1000 SD = $4385
Environmental attitudes	Concern for deforestation	Summed Likert Scales: "How concerned are you with deforestation in your shehia", "How concerned are you with deforestation in Pemba".	Mean = 7.5 SD = 1.5
Risk	Loss aversion	100% chance of losing 5 USD vs. 50% chance of losing 10 USD	Mean = 0.28

Table 2
General definitions.

Variable	Definition	Operationalization
Protest	Individuals who are not willing to participate. The participant issued a bid demonstrating an attempt to seek rent, manipulate future programs, and/or indicate an ethical rejection of the foundations of PES schemes.	$WTA > 4000USD$ or $WTA = \infty$ (see main text)
Deontological conservationists	Individuals who require no compensation to participate	$wta = 0$
In-market	All people who issued non-protest bids.	$WTA \neq Protest$
Supply	The number of residents who are willing to participate in a PES scheme at a given price/payment(p). The supply curve determines the full set of price/supply combinations. The slope is proportional to the elasticity such that steeper slopes are less elastic (indicating less price sensitivity) and flatter slopes are more elastic (indicating greater price sensitivity).	$s_p = \sum_{i=1}^{n}(wta \leq p)$

4.5. Statistical approach

We use a triple hurdle model (see Burke et al., 2015) to account for the multiple nested nature of our data, as seen in Fig. 4. First, we estimate a logistic model to determine the effect of REDD+ on the probability of issuing a protest bid vs. being 'in-market'. Second, we estimate another logistic model only on those 'in-market' to estimate the effect of the treatment on the probability of being a deontological cooperator. Finally, for all non-deontologist in the market, we use a log-normal likelihood that estimates the numerical WTA value. As our elicitation technique measured individual-specific uncertainty in WTA bids, this uncertainty (see Eq. (3)) is used in the log-normal portion of the hurdle model regressions as measurement error on the outcome (following McElreath, 2020). All models have the same parameters, and thus we can write the binomial model as:

$$\begin{aligned} Y &\sim Bernoulli(p) \\ logit(p) &= a + b_1 FC + b_2 T + b_3 O + b_4 R + b_5 E + b_6\ W \\ &+ b_7 S + b_8 TO + b_9 TR + b_{10} TE + b_{11} TS + b_{12} EN + b_{13} V \end{aligned} \tag{4}$$

where Y is either protests or deontological depending on the stage. The log-normal model incorporates the measurement error as follows

$$\begin{aligned} wta &\sim N(wta_{true}, \sigma) \\ wta_{true} &\sim N(\mu, \sigma(wta)) \\ \mu &= a + b_1 FC + b_2 T + b_3 O + b_4 R + b_5 E + b_6\ W \\ &+ b_7 S + b_8 TO + b_9 TR + b_{10} TE + b_{11} TS + b_{12} EN + b_{13} V \end{aligned} \tag{5}$$

For both equations, variables follow the naming conventions set forth in Fig. 2. We log and standardize all continuous variables (FC, W, and O). After the primary effects ($b_1..b_7$), The subsequent four terms in the model are the interaction terms that provide random slopes conditional on treatment. The final two terms are random intercepts to account for interviewer effects and shehia level effects.

All models are fit in Stan (Carpenter et al., 2017), we imputed missing values for all independent variables using categorical and regression random forests using the MICE package in R. All code and exact prior specification can be found at https://www.github.com/abjeffre/cpr_public.

5. Results

5.1. Effect of REDD+ on WTA and protests

The left-hand side of Fig. 5 presents the marginalized effects of the REDD+ project on WTA values. Each line is a simulated out-of-sample prediction for 'in-market' individuals based on the posterior estimates. The red dotted line shows the median price point necessary to induce 50% of the population to participate in the proposed PES scheme, which is $516 for those exposed to REDD+ and $698 for those not—a difference of $182. The proportion of individuals issuing protest bids can be seen where each separate curve hits the top of the graph (further to the left means more protests). The slope of the curve provides information about price elasticity on the supply of conservation. Finally, where the curve intersects with the x-axis reveals the number of deontological conservationists (further to the right means more deontologists).

The middle panel of Fig. 5 shows the marginal effect of REDD+ on protest bids. Having experienced REDD+ is associated with about a 10% decrease in the likelihood of protest bids. Using the results from both in-market and protest bids, we can estimate the total impact of REDD+ on the supply of conservation across the participating shehia. Across all REDD+ 18 shehia, there are an estimated 13 461 households. In a counterfactual scenario where REDD+ never existed, it is estimated that a PES program using our proposed bidding system would need to spend 1,781,126 USD per year to induce 50% of the population to participate. However, given that REDD+ took place, the point estimate falls to $1,387,113, thus a net reduction in costs of 344,013 USD

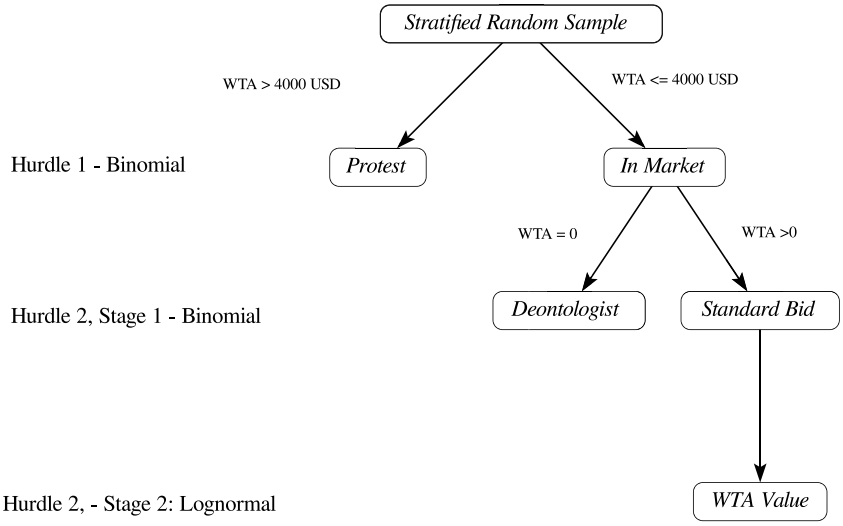

Fig. 4. Triple hurdle model.

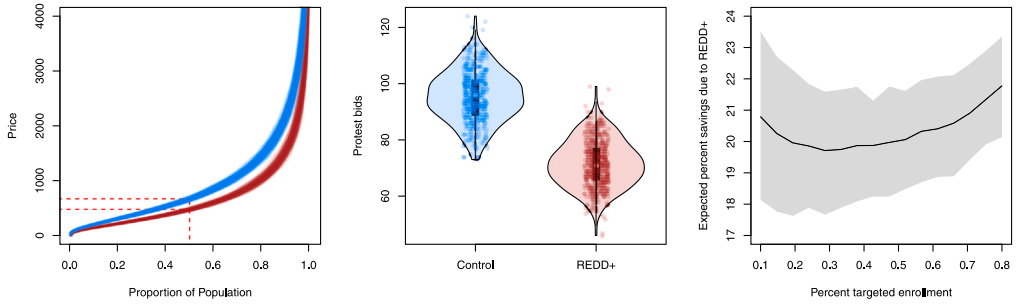

Fig. 5. The effect of REDD+ on Future Participation: Left—the effect of REDD+ on the supply of conservation for in-market individuals. Each line shows a supply curve drawn from the posterior distribution. Red lines show the supply for REDD+ shehia, and blue lines show the supply for control shehia. Middle—the effect of REDD+ on Protest bids. Each point represents the predicted number of protest bids out of 1000 draws from the posterior. Right—The savings from REDD+ combine both models to estimate the percent reduction in costs for a future PES program (y-axis) with a target X (x-axis) enrolment.

per year or a reduction of ~20%. Note that the actual scale of WTA estimates is likely inflated due to artificially high reserve prices in WTA measures compared to willingness to pay (Brown and Gregory, 1999). Nevertheless, by dividing the two costs, we can get the percent change in the expected supply as a function of REDD+, which, like all ratios, is scale-free, and thus unaffected due to inflation in the absolute scale caused by WTA methods.

The right-hand plot of Fig. 5 shows the expected net reduction in costs for future PES programs caused by the changes in supply as a result of REDD+. The net expected savings are stratified on the x-axis by the targeted desired enrolment (what proportion of households a hypothetical future program would wish to comply with the contracts). The savings are the largest when the program only targets those with the lowest WTA values—because REDD+ is associated with a higher frequency of deontological conservationists (see below). The savings shrink in the middle but increase again as the desired enrolment rate passes 60% because exposure to REDD+ also causes a net reduction in the frequency of protest bids.

5.2. Moderating effects

5.2.1. Use value

Fig. 6 shows the results from our analysis of the effect of moderating variables on the supply of conservation in REDD+ (top) and control shehia (bottom). The supply curves are out-of-sample posterior predictions with all variables except for the focal variable held at median values. Different colour supply curves demarcate different levels of the moderating variable (e.g. high-use value (gold - 1.41 USD) vs. low-use value (black- 223 USD)).

Use values affect the amount of compensation demanded, but the relationship is not one of strict equivalence. Indeed, across both treated and non-treated shehia, households with higher use values have demanded higher levels of compensation and issued more protest bids, and the amount of compensation required for in-market individuals increased with use value. In the REDD+ shehia, moving from a z-score of −2 (1.41 USD) to a score of +2 (223 USD) caused an increase in the reserve price for 50% participation to rise from ~497 USD to ~685. Note that the increase in use value across the conditions is ~ 221 USD, which increases the bid price by only 188 USD. . However, the impact of use values on WTA is even stronger in control Shehia, where low-use value households have a 50% reserve price of 467 USD and high-use value households have an astounding 1299 USD. As per the treatment effect, households in control shehia issued more protest bids (21%—nearly twice as large as the unmoderated effect) than those in REDD+ shehia (9%) and had significantly higher reserve bids (to reach 50% compliance, the average payment would have to be ~ 1299 USD in controls and was only ~ 685 USD in the REDD+ shehia).

The difference in the marginal impact of use values across treatment groups surprised us and prompted us to see how wealth might pattern this relationship. The results of this model are presented in SI 2. They show that poorer households in both REDD+ and control shehia have significantly higher reserve prices, that use values have a much stronger

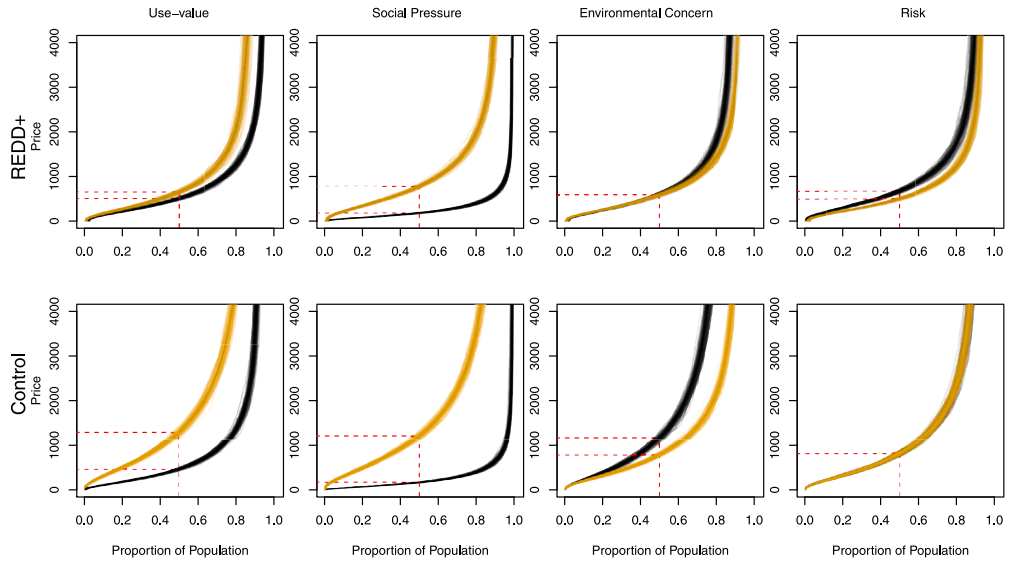

Fig. 6. Moderators of the effect of REDD+ on participation: The top row shows the interaction effects for the REDD+ shehia. Each black line shows a single draw from the posterior. In column one, the black line is the predicted supply curve when use values are low (z score = −2, 1.41 USD), and gold shows when the use value is high (z score = 2, 223 USD). For social desirability, the black line shows an expected WTA for neighbours of 10 USD, and the gold line shows 1000 USD. For environmental concern, the black lines show low Concern (E = 2), and the gold line shows high concern (E = 10). Finally, for loss aversion, the black line shows the supply for those who are not loss averse, and the gold line shows the supply for those who are loss averse. All other variables are held at their median values.

positive effect on bid size, and that they issue significantly more protest bids than their wealthier counterparts. However, the effect of use values on bid size and the issuance of protest bids was still considerably lower in REDD+ shehia for all wealth levels. Interestingly, for those with low-use values, as wealth increased, so too did the probability of issuing a protest bid (from 7% amongst the poor to 21% among the wealthy).

5.2.2. Social desirability

The second column in Fig. 6 shows the results regarding social similarity. Generally, we find a positive relationship between a respondent's expectation of their neighbours' WTA bid and the size of their own bid, and the probability that they issue a protest bid. In other words, the more compensation participants thought their neighbours would demand, the more they demand for themselves. Comparing the top and bottom panels, we can see that people in the treated shehia report WTA bids that are generally lower than what they expect their neighbours to report. In contrast, the opposite is true in the control shehia, where participants typically demand more than they expect their neighbours to. This means that if respondents believe their neighbour's WTA to be 1000 USD per year, to achieve 50% compliance in REDD+ shehia, a new program would have to offer a minimum of 874 USD to each household, while in the control shehia, they must offer 1210 USD. Additionally, the number of protest bids also increases from an estimated 11% in REDD+ shehia to 32% in the control shehia. Overall, these results imply that while agents generally think that their bids are very close to their neighbours, individuals in REDD+ shehia consistently report that their WTA bids are lower than their neighbours, while those in the controls report that their own bids are higher.

5.2.3. Environmental attitudes

The panels in the third column of Fig. 6 show the effect of the perceived threat of deforestation on willingness to participate. In the REDD+ shehia (top panel), the results show that environmental concern has no effect on the size of bids issued by those 'in-market' (for example, values needed for 50% compliance is $611 for high concern (gold) and 621 USD for those with low concern (black)). However, note that we find a more certain reduction in the number of protest bids from ~ 17% for those with low concern to ~ 10% for those with serious concern.

In the control shehia, environmental attitudes substantially affect the bids of those 'in-market.' Here, to reach 50% compliance, payments must be 852 USD for those who are highly concerned with deforestation, while the value increases to 1183 USD per year for those not worried at all. Here we also find a substantial decrease in the expected number of protest bids from 23% of all bids amongst the least concerned to only 12% amongst the most concerned.

5.2.4. Risk

The panels in the final column show the results for loss aversion. In the REDD+ shehia, those who are not loss averse (black) require 742 USD per year to achieve 50% compliance, while those who are loss adverse only need 589 USD (gold) – a difference of approximately 150 USD – additionally, those who are loss adverse issued approximately 8% fewer protest bids than those who are not. In the control shehia, we can see that the curves are layered directly on each other, indicating no difference between those who are and are not loss averse.

6. Discussion

6.1. Was REDD+ worth it?

Despite its ultimate failure to produce carbon credits and deliver upon its original goals, the REDD+ intervention in Pemba was not a complete failure. Compared to those in non-targeted matched shehia, individuals exposed to REDD+ gave a considerably lower price point for entering into a hypothetical future PES programme. A particularly encouraging aspect of the analyses is that there is no evidence that exposure increases protest toward PES programs, as might be expected from many commentaries on the failures of REDD+ (e.g., Lund et al., 2017; Fletcher et al., 2016). This challenges the idea that a series of (even failed) conservation interventions are unable to build on each others' gains, at least in cases such as this. This is likely because REDD+ intervention helped to establish collective property rights over forests, provided mock carbon payments, and contributed to some local enterprise initiatives and environmental training. However, given that the REDD+ project on Pemba cost approximately 9 million euros (TCG, 2017) and had no measurable impact on forest cover loss (Collins et al., 2022), could the effect on future participation alone justify the costs? Taken into consideration with the net reduction in costs shown in the third panel of Fig. 5, a new PES scheme targeted at the same set of shehia would have to operate for 26 years at 50% participation or

ten years at 80% participation for the project's costs to be offset by additional buy-in caused by the HIMA project.

As such, one must ask whether such participation rates are viable, given the stock of carbon in Pemba and the current carbon price on the voluntary carbon market. The original project document predicts that the project would save 110,644 tCO2e annually from the two islands (TCG, 2017). Assuming Pemba contributes half, the carbon price would have to be approximately $26 per tonne to encourage a 50% enrolment rate and $92 to obtain an 80% enrolment rate. More so, the rate of carbon stored is most certainly endogenously determined by the participation rate. Thus, the expectation that the island could achieve the maximum potential carbon capture with only a 50% buy-in rate is unlikely, given that those who are most likely to protest and thus not participate are those with high forest usage—the ones most responsible for deforestation.

6.2. How do opportunity costs affect participation?

Here, we have two main results. First, for households with high-use values, exposure to the failed REDD+ project is not associated with lower levels of participation. Quiet the opposite, those with high forest dependence are more likely to participate if they received the REDD+ treatment than if they did not. Second, this effect is mediated by wealth (see SI 2), such that it is the poor, forest-dependent households who demand the highest compensation and who issue the most protest bids but again, but their overall apprehension is reduced if they experienced REDD+.

The finding that forest-dependent households are more likely to participate after experiencing REDD+ is striking—particularly if it is taken in conjunction with the observation that in the REDD+ shehia, there is relatively little difference in the amount of compensation demanded between those with high and low-use values. This implies that these highly dependent households *are not* simply estimating the market value of the forest and then demanding compensation based on such equivalences. Indeed, judging by the elasticity of the supply curves for highly dependent households (gold) in Fig. 6, we can infer that exposure to REDD+ has *not* increased the commodification of forests. How can we know this? If REDD+ had increased the commodification of nature, we would expect to see the market value of forest goods playing a more central role in determining the amount of compensation people demanded from PES schemes if they had been exposed to the treatment. However, this is not the case. This implies that factors other than strict market values drive decisions to participate in 'treated' households. Indeed, one possible mechanism driving this may be the environmental education that people in these shehia have received, which may have led to a valuation of nature based on its multidimensional benefits to humans and the broader ecosystem.

Second, one of the central theoretical foundations of contingent valuation and the WTA method is that the loss in utility from agreeing to a contract should equal the utility gained from the compensation provided (Engel et al., 2008). It follows directly from this that there should be no wealth/income effect that adjusts the total amount of payment required to offset the loss. For example, two agents, one rich and one poor, who use $100 of forest goods per year, should require the same monetary compensation to result in a net zero change to their utility. Thus, why poorer households report requiring more compensation at a fixed use value requires additional theoretical assumptions.

This result can be partially explained by reflecting on risk. Suppose we consider the change to a household's utility from project-associated risk (e.g. a contract breach by implementers failing to pay). In that case, with any concave utility function that holds opportunity costs fixed, the relative loss in utility to a poor household from a contract breach is greater than the relative loss of utility to a wealthy household because of the non-linear transformation of monetary losses into utility. Therefore, *ceteris paribus*, given any non-zero risk associated with a conservation program, poor households should require higher compensation levels than wealthier households to offset any possible losses.

In figure SI 1.1 we can see that the poor who depend on forest resources demand vastly higher levels of compensation. If compared across treatments, this effect is larger in the control than in the REDD+ shehia. This result is consistent with the idea that poor forest-dependent households with no experience with PES are the ones who perceive the highest amount of risk associated with such programs. When this result is taken in conjunction with the fact that only in REDD+ shehia are more loss-averse households more willing to participate, then it seems likely that the experience with REDD+ has actually reduced the perceived risk of PES schemes despite having failed. This could be because of the indirect benefits of the HIMA project outlined above.

6.3. Is participation more socially desirable after REDD+?

Our results confirm the general trend in the literature that social forces, in the form of conformity, norm compliance and/or fear of punishment/social exclusion by others in the community, may be a major motivating force that can drive participation in conservation programming. Specifically, we find strong evidence that agents tend to calibrate their compliance based on the expected behaviour of their fellow community members.

What is peculiar about our results is the difference across the treatment conditions—where those in REDD+ shehia report WTA bids less than their expectation of the community average, while those in control shehia report WTA bids higher. Consider those who expect their neighbours to issue WTA bids of $1000. To achieve 50% compliance in the REDD+ shehia, the average offer must then be $874 versus $1210 in the control shehia. Those in REDD+ shehia are offering bids lower than what they expect their neighbours to do.

One possible interpretation of this finding is that the REDD+ project has increased community awareness of environmental challenges, creating a new social ethic where participation in environmental conservation is seen as socially worthy. Thus, participants present themselves as being more willing to contribute than their fellow community members. However, if we compare the expectations of neighbours' WTA bids across REDD+ and control shehia, we find that the median expectation is 800 USD and 400 USD, respectively. This suggests that exposure to REDD+ dramatically altered people's reporting of their perceptions of their neighbours' willingness to participate. Therefore, an equally plausible explanation is that exposure to the failed REDD+ project inculcated the belief that other community members are now less willing to participate in PES programs. Of course, this belief is unfounded, as participation is higher in the REDD+ shehia. Thus, the project's failure may have distorted people's perception of their community's support for PES programs.

6.4. Did REDD+ crowd-out intrinsic motivations?

Our results on the effect of environmental attitudes directly pertain to motivational crowding-out. In the REDD+ shehia, we find that environmental concern has no impact on WTA values and only slightly affects the frequency of protest bids. In contrast, in the control shehia, we find that across all measures (WTA values and protest bids), those who are more concerned with the environment are dramatically more likely to participate in future PES programs. In unpublished analyses, we have checked other operationalizations of environmental attitudes, such as the number of ecosystem services participants can correctly identify, but all yield similar results.

One possible interpretation of this finding is that REDD+ crowded out otherwise intrinsic environmental motivations. Such an interpretation might be warranted given that the marginal increase in supply due to environmental concern is more substantive in shehia that did not receive the REDD+ treatment—indicating that value-based motivations are less impactful after REDD+'s implementation. At the same

time, this seems unlikely, given that those who report being entirely unconcerned with the environment in the REDD+ shehia still have lower predicted WTA values than those maximally concerned and in the control shehia. This difference means that even if REDD+ crowed out pro-environmental values, the project's net gains on the conservation supply are still enough to compensate for that loss.

7. Limitations

This study has several limitations. Firstly, during data collection, optimism surrounded REDD+'s potential, and resentment may have increased since. Despite this, CoFMAs have spread (Borgerhoff Mulder et al., 2021), suggesting ongoing positive evaluations within certain segments of society. Thus, conclusions about complete programmatic failure are somewhat premature. More recent data would help illuminate the overall trend.

Secondly, our study relies on a single time point, lacking pre-treatment Pemba data and using matched shehia for quasi-experimentation. This limits intra-individual or intra-shehia assessments over time, and thus all existing estimates assuming our conditioning blocks unobserved endogenous variables (Pearl, 2009). Thirdly, exploring factors affecting PES participation faces causality challenges. REDD+ bundled benefits, making causal identification of sub-component contributions impossible. Difficulties in operationalizing concepts like opportunity costs and social desirability, especially in domain-specific contexts, underscore the need for a genuine within-individual longitudinal study.

Finally, readers should note that WTA values may be grossly inflated without effective upper bounds, impacting intercept estimates but not coefficients on other predictors.

8. Conclusion and policy recommendations

The REDD+ failure on Pemba produced fewer adverse side effects than would be expected from arguments presented in the literature concerning conservation fads and fashions. Our data suggest that there remain significant pockets within the communities exposed to REDD+ where an appetite for forest protection under some kind of PES scheme persists. Yet, despite this finding, we emphasize that this does not absolve implementers of the ethical responsibility to provide high-quality projects and follow through with commitments. Given that not all projects can or should succeed, it is encouraging to note that project failure does not necessarily wholly erode former participants' willingness to engage with future conservation. In this particular case, the failure of the HIMA program can be placed firmly in the court of the foreign implementing partners, in line with critical analyses of REDD+ as a primarily extractive institution; see, for example, the analysis of Frewer (2021) on the collapse of a similar REDD+ project in Cambodia under the same carbon agent (Terra Global Capital). Somewhat remarkably, both projects still appear on the agent's website (as of early 2024), despite zero payments.

More specifically, concerning policy recommendations, we have several points. First, given our finding that use values dramatically affect rates of participation and protest amongst the poor, future programs would benefit from engaging more directly with poor forest-dependent individuals and dedicating resources to increasing their participation rates. More generally, as a result of the importance of opportunity costs, future programs can expect higher participation rates and less protest if they invest in economic development programs that lower dependence on forest goods, particularly amongst the poor, such as through policies that reduce the cost of substitutes or boost other non-farming sectors of the economy. Second, it is likely that by building a legal basis for secure property rights over community forests, the legacy of the REDD+ pilot project will be felt years in the future. Therefore we believe that in addition to building household assets, programs that build legal frameworks, particularly property rights, that persist beyond the program's death will be able to have lasting positive effects.

CRediT authorship contribution statement

Jeffrey Andrews: Conceptualization, Data curation, Formal analysis, Investigation, Methodology, Validation, Visualization, Writing – original draft, Writing – review & editing. **Monique Borgerhoff Mulder:** Conceptualization, Funding acquisition, Methodology, Project administration, Resources, Supervision, Writing – original draft, Writing – review & editing.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Data availability

Data will be available at www.github.com/abjeffre/wta_public.

Acknowledgements

This research was supported with funds from the Max Plank Institute of Evolutionary Anthropology, Germany. We thank Assa Sharif Ngwali, Asha Yussuf Nour, Bidawa, Bidawa Bakari Khamis, Fatima Mbarouk Saleh, Hamad Khamis Mbarouk, Omar Mtarik Msellem, in addition to and two anonymous referees for comments on an earlier manuscript. All remaining errors are our own.

During the preparation of this work the author used CHATGPT in order to increase the clarify of the text. After using this tool/service, the author reviewed and edited the content as needed and take full responsibility for the content of the publication.

Funding source declaration

This work was supported by the Max-Planck-Institut für Evolutionäre Anthropologie, Germany and a Seed Grant for International Activities, Grant/Award from UC Davis Global Affairs; UC Davis' College of Letters and Sciences, United States.

Author agreement

All authors have read and certified the final version of the manuscript before submission. The article is our original work and has not been received for prior publication, nor is it under review elsewhere.

Appendix A. Supplementary data

Supplementary material related to this article can be found online at https://doi.org/10.1016/j.ecolecon.2024.108155.

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