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# Motivational drivers and the effectiveness of conservation incentives

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The debate about how external incentives (e.g., payments for ecosystem services) and internal motivations (e.g., intrinsic values) interact in producing conservation outcomes is still unresolved. This paper examines the role of personal values (biospheric and egoistic) as intrinsic motivational drivers for conservation and their potential to affect conditional payments to enhance conservation behavior. We used a lab-in-the-field experiment with rural farmers in two ecological corridors of Tanzania to assess their conservation behavior under two payment modalities, namely a fixed individual payment and a fixed individual payment with an agglomeration bonus. In addition, a post-experiment survey was conducted to determine the levels of personal value endorsement for each individual participant. We consistently found that biospheric values increased conservation behavior, while egoistic values decreased it. The positive effect of biospheric values was higher than the negative effect of egoistic values. Both payments do not seem to affect the conservation behavior of farmers with high biospheric value endorsement. Heterogeneity in personal values thus likely has economic implications for the design of real-world PES schemes. Our results suggest that educational investments in training future generations of farmers with strong pro-environmental values can reduce future pressure on the environment and the costs of associated policy action. Areas for further research are discussed.

KEYWORDS

**ecological corridors, payment for ecosystem services, biospheric, egoistic, lab-in-the-field experiment**

## 1 Introduction

Human-induced activities, including unregulated farming practices and deforestation, are the primary cause of the alarming biodiversity decline (Convention on Biological Diversity, 2022), particularly in areas with high levels of biodiversity and ecological corridors where they disrupt ecological connectivity (Gregory et al., 2021). Ecological corridors are landscapes that structurally and functionally link protected areas, making them fundamental hotspots for targeted interventions, such as restoration activities to maintain ecosystem service flows (Beita et al., 2021). To promote restoration of corridors, many countries have launched policies to encourage conservation behavior of farmers, including monetary and non-monetary incentives. Non-monetary incentives are important for the argument that behavioral shifts of farmers are not only driven by rationality but also by intrinsic motivation[1], among other factors (Bopp et al., 2019). Farmers' conservation decisions are further entangled with social dilemmas, where individual interests might conflict with societal goals (Dawes and Messick, 2000), making it challenging to predict farmers' behavior under a given policy option without understanding individual motivations.

Numerous attempts to explain intrinsic determinants of conservation behavior have been made in the last decades using different proxies of intrinsic motivational drivers of decision makers (Cetas and Yasué, 2017). For example, Bopp et al. (2019) and Sommerville et al. (2010) concluded that farmers' attitudes toward conservation constitute an important intrinsic motivational driver for conservation behavior. Luu et al. (2024) also underscore the role of farmers' attitudes in spreading and delivery of agro-climate services, which are necessary for development of conservation agriculture. Similarly, De Blas (2021) highlights the importance of self-determination drivers, such as individuals' autonomy (the power to make their own decisions), sense of competence (confidence in achieving goals), and relatedness (feeling of social and environmental connectedness), in promoting conservation behavior. Accounting for such intrinsic motivational drivers in conservation strategies and programs has shown to be successful in supporting both social and ecological goals (Moros et al., 2019; Cetas and Yasué, 2017).

A further proxy of intrinsic motivational drivers are the personal values, as suggested by Schwartz (1992). Both biospheric (valuing the environment) and egoistic (valuing personal resources) value orientations are among the personal values of relevance in environmental domains (Davis et al., 2023; Russo et al., 2022). These values have been studied by Lange et al. (2022), Suama et al. (2019), and Contzen et al. (2021), among other scholars, to understand pro-conservation behavior. Unlike other intrinsic motivational drivers, personal values are theoretically considered stable over time, prompting scholars (e.g., Ignell et al., 2019; Russo et al., 2022) to argue that personal values are key for long-lasting efforts to conserve biodiversity. Furthermore, there is evidence showing value orientations explain more variance in pro-environmental behavior than self-determined motivational drivers (De Groot and Steg, 2010). We thus focus on personal values in this study.

Research on the conservation roles of personal values, largely presented in the psychological literature, shows that individuals with strong biospheric value are more likely to be intrinsically motivated to engage in pro-environmental behavior (Fornara et al., 2020; Kim et al., 2023; Matzek and Wilson, 2021). The opposite is true for individuals with strong egoistic values, who are often unlikely to engage in pro-environmental behavior (Marshall et al., 2019) unless with support for extrinsic factors (De Groot and Steg, 2010). However, some studies also found biospheric values to be unrelated to conservation behavior (Kollmuss and Agyeman, 2002; Rhead et al., 2018), for example, when the conservation action is too effortful, costly, or culturally incompatible (Steg et al., 2014a). In the same vein, some literature (e.g., Kollmuss and Agyeman, 2002; De Dominicis et al., 2017) has shown that strong egoistic farmers may act pro-environmentally, even without external motivation. This may occur, for example, when environmental problems affect farmers personally, such as through their health or financial wellbeing (Matzek and Wilson, 2021). Different results have also been observed across socio-demographic characteristics, such as age, income, and gender (see Sargisson et al., 2020), the level of farmers' reliance on environmental assets (Steg et al., 2014b), and in diverse cultural settings (Ignell et al., 2019; Milfont et al., 2006). These differences underscore the importance of acknowledging variations in personal values across regional and cultural contexts as a key to leveraging pro-conservation behavior in the design of environmental policies.

Despite the relevance of intrinsic motivation for farmers' behavior, policymakers still seem to favor conditional economic incentives, such as payments for ecosystem services (PES), as a tool for biodiversity conservation (Powlen and Jones, 2019). Most of these incentive schemes rely on an individual fixed payment per area (PY) design (Ngoma et al., 2020). This design has faced numerous criticisms. One concern is that it can result poorly unconnected conservation areas that provide limited overall conservation benefits due to the fragmentation it can cause (Parkhurst et al., 2002). Parkhurst et al. (2002) proposed an agglomeration bonus (AB) to promote connectivity, which requires coordinated decisions among farmers. This payment would supplement the fixed payment (i.e., PY + AB) and encourage farmers to systematically retire or conserve connected fragments of land (Parkhurst and Shogren, 2008; Parkhurst and Shogren, 2007; Parkhurst et al., 2002). Recently, Nyanghura et al. (2024) examined the effectiveness of PY and PY + AB on conservation of two ecological corridors of Tanzania using a lab-in-the-field experiment. Both payment modalities appeared to motivate conservation behavior substantially.

Incentive design is closely linked to cost-efficiency, i.e., the relationship between conservation outcomes and the total costs of implementing a conservation scheme (Martin et al., 2014). One way that inefficiency can occur is when the pre-existing intrinsic motivations of farmers favor conservation, which can lead to overpayment (Greiner and Gregg, 2011). For example, if a farmer already has a strong internal motivation to conserve land (e.g., due to higher biospheric values), the additional benefits of payments may be limited, making the scheme less efficient. Thus, external motivations (such as PES) and intrinsic motivation variables (here, personal values) may not only have a significant influence on farmers' decisions, but may also mutually influence each other, resulting in a complex interplay between these variables that shapes conservation behavior. Bopp et al. (2019) found limited evidence for the need of subsidies when the conservation attitude of farmers to adopt sustainable conservation agriculture is relatively high. Further interactions have been discussed in the view of the crowding effect of PES, which can either undermine or reinforce intrinsic conservation motivation (Rode et al., 2015). However, the crowding effect on personal values may be limited due to their inherent resistance to change. Instead, pre-existing personal values could affect the effectiveness of introduced PES. Here, our proposition is closely related to Polomé (2016), who showed limited effects of economic incentives to motivate private forest owners to adopt biodiversity-related protection programs when intrinsic conservation motives (attachment to the

1 A general definition of motivation is "to be moved to do something" (Ryan and Deci, 2000). Thus, borrowing from the environmental psychology literature, motivation is defined as a reason to engage in behavior that benefits the environment. This behavior is often manifested through decisions and/or actions (Steg et al., 2014a).

forest and mastery of forest practices) are constant. Polomé's study, however, did not focus on the underlying personal values.

Here we thus systematically assessed the role of intrinsic motivational factors, expressed through personal values, for conservation behavior and on how they shape PES effectiveness, using a case study of two ecological corridors in Tanzania. Understanding the interplay between PES and personal values is relevant because international and national funds are increasingly used to pay farmers and communities to support pro-environmental behaviors, of which the question of efficiency is critical (Chu et al., 2019). In the following section, we formulate a set of hypotheses to be tested through an on-site behavioral experiment with farmers. Section 2 outlines the context of the study area, the data collection procedure, and the analytical approach. Our findings are presented in Section 3, followed by a discussion in Section 4. Section 5 concludes with policy recommendations.

## 1.1 Formulation of hypotheses

The effect of personal values on conservation behavior is described by the theory of basic human values proposed by Schwartz (1992). The theory postulates that individuals' decisions are motivated by the values they hold, but also emphasizes the complementary and conflicting nature of these values. Of the 10 values proposed by Schwartz (1992), biospheric values are the most associated with conservation behavior, as they explain one's concern for the environment or nature. Several scholars have demonstrated a strong correlation between biospheric value orientation and pro-conservation behavior (Bouman et al., 2018; Marshall et al., 2019; Shi et al., 2019; Wang et al., 2021). This motivates our first hypothesis as follows:

> *H1*: Biospheric values enhance conservation decisions and related environmental benefits.

Engaging in pro-environmental actions often has negative consequences for individuals (e.g., increased financial costs and reduced personal comfort) (Sargisson et al., 2020). Consequently, egoistically motivated individuals would be less likely to participate in conservation efforts, given their preference for prioritizing personal income. According to Schwartz (1992) and other recent research (e.g., Marshall et al., 2019; Nkaizirwa et al., 2022), egoistic values are associated with anti-conservation behavior. Therefore, our second hypothesis is framed as follows:

> *H2*: Egoistic values discourage conservation decisions and related environmental benefits.

Furthermore, the existing literature on incentive systems and behavior suggests that conditional monetary incentives can motivate farmers to adopt pro-conservation behavior when intrinsic motivation is low (Bopp et al., 2019; D'Adda, 2010). However, this effect is most likely to manifest when the intrinsic motivational factor is already positively aligned with pro-conservation behavior. However, when farmers are strongly motivated by stable conservation commitments, such as constant intrinsic motivation or social norms, external influences like financial incentives tend to result in limited conservation success (Greiner and Gregg, 2011; Polomé, 2016). This is similar to biospheric values which positively correlate with pro-conservation behavior but often remain stable over time. With a strong biospheric value orientation, the effectiveness of PES is likely to be undermined. Consequently, intervention with an incentive scheme may not be justifiable for farmers, who already have a high level of biospheric values. Against this background, the following third hypothesis emerges:

> *H3*: Conditional incentive schemes are less likely to produce additional environmental benefits when the biospheric values are high.

Self-interest motives can be effectively reinforced by conditional payments (Bopp et al., 2019; Steg et al., 2014a). This is due to the benefits that farmers receive from compensation. Subsequently, individuals are inclined to prioritize self-centered actions with higher personal gains rather than uncompensated conservation behavior. Thus, individuals who are more egoistic should be more likely to conserve to augment their financial savings and circumvent the inconveniences and potential risks associated with farming. This background results in our fourth hypothesis as follows:

> *H4*: Conditional incentive schemes are more likely to enhance environmental benefits when the egoistic values are high.

# 2 Methods, study area and data

## 2.1 Study area

The study was conducted in two ecological corridors of Igando-Igawa wildlife corridor (IIWC) and Bagakisimagonja (BKG) in Tanzania (Figure 1). The IIWC is located in the southern highlands of the country and has a total land area of about 90,400 ha, largely used by rural farmers for crop production. The corridor connects Mpanga Kipengele Game Reserve with Ruaha National Park and is managed by village governments under the supervision of Mbarali and Wang'ingombe Districts. The BKG is a small corridor of 2,300 ha located in Bumbuli District Council. The corridor is important for the connectivity of forest goods and services (e.g., water and small mammals) between the Baga and Kisima Gonja Forest Reserves.

The two corridors rank at the top of the list of corridors highly threatened by agricultural expansion (Ministry of Natural Resources and Tourism, 2022). As of 2022, cropland accounted for approximately 75% of the total landscape in IIWC and 56% in BKG (Ministry of Natural Resources and Tourism, 2022). The remaining forests are highly vulnerable to deforestation because they can be easily reached by road, which facilitates the advancement of the agricultural frontier and the development of charcoal-making activities. It is then not surprising that the public and several conservation organizations have decided to operate in these landscapes to preserve the connectivity of the corridor. The Wildlife Conservation Society (WCS) and Tanzania Forest Conservation Group (TFCG) are among the conservation NGOs that have attempted to support conservation of these landscapes in various ways, such as the establishment of a community conservation area in IIWC and the planting of trees in BKG. These measures seem to have helped to conserve a fragment of the landscapes but have done little to restore connectivity. This is because

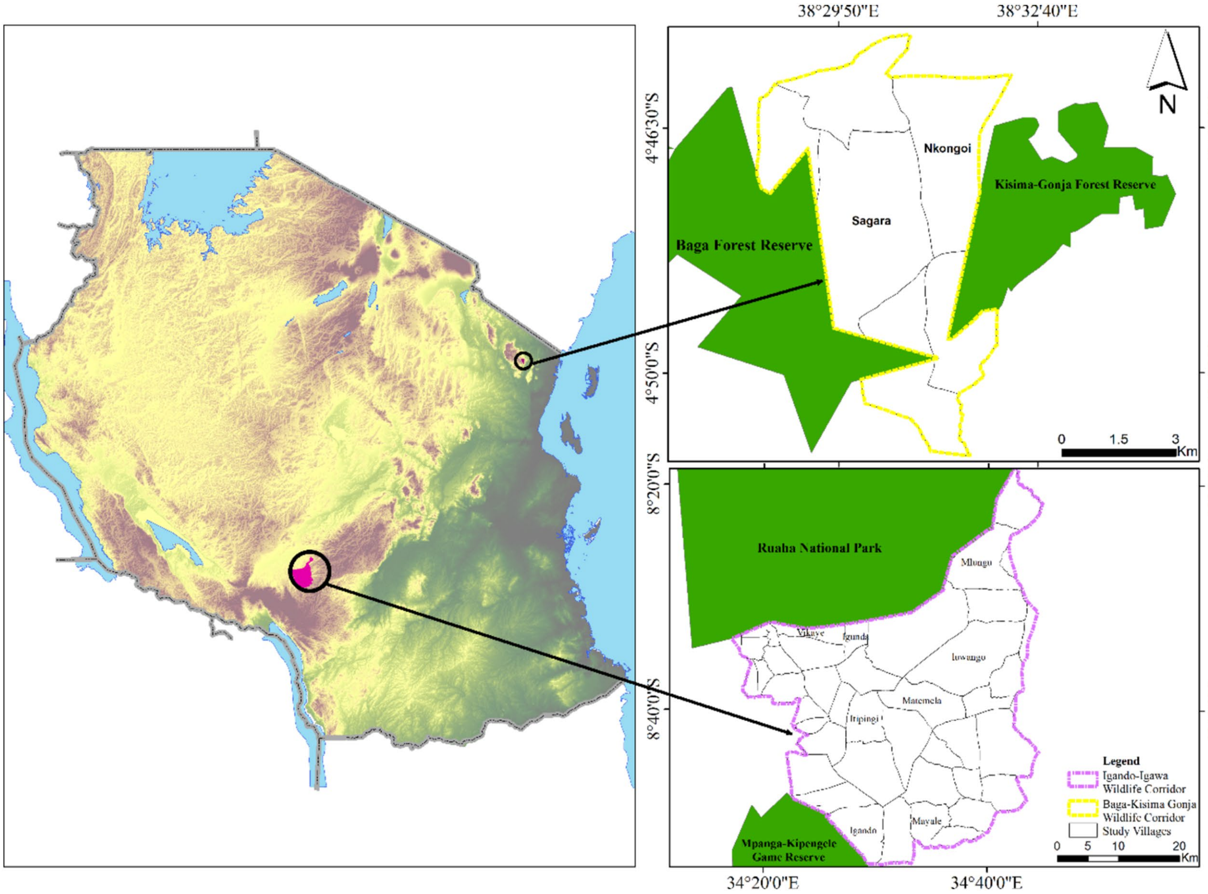


FIGURE 1
Map of the study area showing the two ecological corridors (IIWC and BKG) and the 10 villages within those corridors, participated in the experiment and survey. The map is adopted from Nyanghura et al. (2024).

the areas targeted by the projects were often scattered communal lands rather than privately owned properties, which are agroecologically relatively productive (Southern Tanzania Elephant Program and Wildlife Connection, 2016).

The importance of conserving privately owned farmland, among other reasons, prompted the government of Tanzania in 2018 to introduce a wildlife conservation regulation (United Republic of Tanzania, 2018) to persuade farmers to voluntarily retire their farmland for conservation, but without financial compensation. To date, no ecological corridor has been established under this regulation. We argue, based on rationality assumptions, that farmers are unlikely to follow such regulations. However, financial incentives could be a viable option to compensate for the losses associated with farmers' conservation decisions and to address the growing demand for implementing instrumental conservation policies in countries of the Global South (Moros et al., 2023). Already there is evidence from Nyanghura et al. (2024) which shows that PES can support conservation in these two corridors, but it is currently unknown how the intrinsic motivations, particularly personal values, shape such effects. This gap was the motivation for our study.

Our study was conducted in 8 out of 22 villages in IIWC and in 2 out of 4 villages in BKG. These villages were selected to represent the spatial distribution and population density within their respective corridors. In each village, farmers were represented by the heads of households or their spouses, and were randomly selected from village registers. The total sample size was 384 farmers, determined by power analysis. Land tenure was mostly informal: over 80% of participants in both landscapes did not hold legal land titles but claimed legitimate ownership of their farmlands. The average landholding size was 2.8 acres per household in BKG and 11.5 acres in IIWC. Land ownership was unequally distributed among households, with greater inequality in IIWC (Gini = 0.635) compared to BKG (Gini = 0.455). Crop farming was the dominant livelihood activity in both corridors, with over 87% of farmers practicing crop farming, both for subsistence and as a primary source of income. Common crops include rice, maize, beans, and various horticultural crops, especially in BKG.

## 2.2 Data collection

We collected our data from a conservation game (i.e., lab-in-the-field experiment) that was conducted with farmers in the two corridors. The game was followed by a questionnaire that we filled out together with the farmers. In the game, farmers were randomly assigned to a team of four players. Each team was then randomly assigned to subgroups with either equal or unequal land size distribution and to either a treatment (TG) or a control group (CG). In the equal subgroups, each farmer received two hypothetical land parcels. In the unequal subgroups, two participants received two pieces of hypothetical land while the other two received four parcels. Participants who received two parcels were defined as small farmers, and those who received four parcels were defined as large farmers.

During the game, we introduced three treatments at the group level (i.e., groups of four players) for three consecutive rounds. The first treatment (baseline) was a cheap talk about the importance of conservation to maintain ecosystems. The second treatment was a conditional payment (a fixed payment (T1)), and the third treatment was a fixed payment plus an agglomeration bonus (T2) – the latter two treatments (T1 and T2) were assigned only to treatment groups. Control groups repeated the baseline treatment for the next two rounds.

In each round, each participant voluntarily and independently decided for each parcel whether to conserve or continue farming. The decisions had real-world implications in terms of private financial rewards and environmental payoffs, which were reflected in a donation to a local environmental NGO. The total environmental benefit contributed by each individual decision corresponded to the payoff value, ranging from TZS 0 to TZS 8000 (USD 3.44) for a small farmer and up to TZS 17,000 (USD 7.31) for a large farmer. A detailed procedure for the game is presented in the Supplementary material to this article (see Section 1.1 of the Appendix).

We conducted a survey with each player after the game (see Section 1.2 of the Appendix) to elicit information about the endorsement of personal values to farmers and other potentially confounding factors (Table 1). We measured personal values using the universal values scale as proposed by Schwartz (1992) and as applied in several psychological studies (e.g., Ignell et al., 2019; Wang et al., 2021; Yasir et al., 2021). Since these values are latent variables, it was necessary to assess them based on indicators following a theoretical construct item. We assessed the biospheric values based on four questions related to each respondent's affinity with nature, commitment to environmental protection, respect for the earth, and efforts to prevent pollution. The egoistic values were assessed based on the extent to which the farmers assessed their own social power, authority, wealth, ambition, and influence. Each participant was presented with a list of statements related to these values and was asked to use a 9-point Likert scale (from −1 *opposed to my values* to 0 *not important* to 7 *of supreme importance*) to express the importance of each statement as a guiding principle in their lives. Collected control variables included socio-economic characteristics of the respondents, such as age, gender, household income, family size, marital status, and farmland size ownership, which might also have had an impact on the personal values of respondents and their conservation behavior.

It is important to note that the game was designed to induce coordinated decisions among players to achieve higher environmental benefits, e.g., in the form of the agglomeration bonus. Nevertheless, each player decided to conserve or to continue farming privately. Therefore, it is reasonable to assume that a respondent's decision may have been influenced by the level of trust in the co-players (Liu et al., 2019). Furthermore, social relatedness might also have played a role in the decision outcomes, as exemplified by the reputation effect (Handberg and Angelsen, 2019). This effect comes into play when a player is aware of a peer's values and motivations regarding conservation and farming. Therefore, we included a variable reflecting trust within each group of players using a 10-point Likert scale and a dummy variable indicating the presence of relatives or friends within a group. As emphasized by Hayo and Vollan (2012), farmers are likely to bring real-world experiences to decision games like ours. We therefore also included questions about the participants' authority and decision-making power regarding the land use and at the household level (such as selling to, purchasing from, or gifting to others).

After dropping outliers, our dataset included responses from 381 out of 384 farmers. Of the 381 farmers, 191 were assigned to the equal subgroup and 190 to the unequal subgroup. A total of 192 farmers participated in the treatment group and 189 in the control group. Since each player participated in three rounds, the full sample contains 1,143 observations.

## 2.3 Empirical approach

We began by examining whether self-reported values identified after the experiment were affected by the experiment. To do this, we regressed self-reported personal values on dichotomous dummy variables (treated vs. control, equal vs. unequal, and whether a participant was a small or large farmer in a game) and control variables (Table 1) using linear regression as modeled in Equation 1.

$$PV_i = \alpha + \varphi Treat_i + \partial LD_i + \theta Farm_i + \vartheta X_i + \sigma ENUM_i + \rho COR_i + \varepsilon_i \quad (1)$$

where $PV_i$ represents personal values (i.e., biospheric and egoistic) endorsed by individual $i$, and $Treat_i$ ($T1$ = Payment and $T2$ = Payment + Agglomeration bonus) was included as a dummy variable, with "$T0$ = no incentive" in the control group as a reference. $LD_i$ represents a dummy variable for whether the participant was assigned to an equal or unequal subgroup. $Farm_i$ indicates whether a farmer was assigned as a small or large farmer in the game. $X_i$ is a vector of subject specific covariates (socio-demographic characteristics) and other control variables as listed in Table 1. $ENUM_i$ is a set of $j-1$ dummy variables controlling for enumerator effects, and $COR_i$ is a dummy variable controlling for the corridor effect.

We proceeded by estimating the effect of personal values on environmental benefits (i.e., testing H1 and H2) using Equation 2.

$$\pi_{i,t}^{PCB} = \alpha + \gamma PV_i + \varphi Treat_{i,t} + \partial LD_i + \vartheta X_i + \sigma ENUM_i + \rho COR_i + \mu Round_t + \varepsilon_i \quad (2)$$

where $\pi_{i,t}^{PCB}$ refers to the proportion of total environmental benefits contributed by individual $i$'s decision in round $t$. This was our dependent variable. The variable "$Round_t$" controls for round effects ($t$ = 1, 2, and 3). The rest of the variables are defined as in Equation 1. We used a Tobit regression model for our estimation because the dependent variable was zero truncated.

Finally, we tested H3 and H4 using Equation 3.

$$\pi_{i,t}^{PCB} = \alpha + \gamma PV_i + \varphi Treat_{i,t} + \partial LD_i + \theta Treat_{i,t} * PV_i + \vartheta X_i + \sigma ENUM_i + \rho COR_i + \varepsilon_i \quad (3)$$

TABLE 1 Descriptive statistics of the main variables used in the model estimation.

| Variables | Description | Mean | SD |
|---|---|---|---|
| A. Environmental benefits | Proportion of the total environmental benefits (in TZS) contributed by each individual for all rounds of the game. | 0.28 | 0.34 |
| B. Personal values | | | |
| Biospheric [−1:7] | Care for the environment: measured as the average from the Likert scale score of four items: unity with nature, environmental protection, respect for the earth, and pollution prevention. | 4.98 | 1.54 |
| Egoistic [−1:7] | Care for self-interest: measured as the average from the Likert scale score of four items: social power, authority, wealth, and influence. | 4.28 | 1.78 |
| C. Socio-economic and demographic characteristics | | | |
| Age | Age of respondents in years | 43.4 | 13.24 |
| Educ | Years of schooling | 6.80 | 2.46 |
| HHI | Household income of the last year in TZS presented in 1,000,000 s | 2.59 | 3.05 |
| Gender | Sex of the respondents (Dummy: 1 = Male, 0 = Female) | 0.61 | 0.49 |
| Famil_size | Number of people who sleep in the same household on a regular basis | 6.00 | 2.95 |
| Marital_status | Whether respondent is married or not (Dummy: 1 = Married, 0 = Not married) | 0.89 | 0.31 |
| Farm_own | Farm size owned by household in acres | 8.78 | 14.73 |
| D. Other control variables | | | |
| Trust [0;10] | Respondents had to answer this question: Generally speaking, most people in the community are trusted (Likert scale: 0 = fully disagree, 10 = fully agree). | 6.95 | 2.14 |
| Decision_land | The authority of the subject with regards to decisions related to land (use, purchase, selling, reallocation, etc.) at household level (Dummy: 1 = subject is the main decision maker or has shared power in land decisions, 0 = subject has no power in decisions) | 0.89 | 0.31 |
| Relat_friend | Whether a farmer had a relative or friend in the same experiment group (Dummy: 1 = Yes, 0 = No) | 0.23 | 0.42 |

1TZS is equivalent to approximately 0.00043 USD (https://rb.gy/p6dr3s).

Here, we extended Equation 2 to allow interaction between the respective treatments and personal values (i.e., $Treat_{i,t} * PV_i$). The coefficient on this interaction term represents the effect of the incentive (here: treatments) under different intrinsic motivational factors (here: personal values). Our estimation was done with a sample of 1,143 observations.

# 3 Results

## 3.1 Descriptive statistics

On average, the participants were 43 years old and had attended school for 7 years. The majority were men (61%), and the average household family size was 6, with an average farm size of 8.78 acres. The average proportion of environmental benefits contributed by the farmer was equivalent to TZS 0.28 (USD 0.00012) (Table 1). On average, the biospheric values were endorsed at a level of 4.98 out of 7 and the egoistic values at 4.28 out of 7 (Table 1). A specific variation of personal values endorsed by different categories of socio-economic characteristics is presented in Appendix Table A1.

The variation of personal values endorsed by participants across the different experimental groups (treatment vs. control group, equal vs. unequal, and small vs. large farmers in the game) is presented in Figure 2. We found that the level of personal values endorsed by treatment and control participants was comparable: the score was around 5 (biospheric) and 4 (egoistic), as shown in Figure 2A.

On average, participants in the equal subgroup endorsed biospheric values at 5.15 and egoistic values at 4.81 (Figure 2B). In comparison, those in the unequal subgroup had average scores of 4.77 for biospheric values and 3.78 for egoistic values (Figure 2B). The differences between the subgroups for each value were not statistically significant. However, the difference between egoistic values endorsed by the equal and unequal subgroups was statistically significant (Mann–Whitney U test: $p < 0.01$). Both small and large farmers in the game reported relatively higher biospheric than egoistic values (Figure 2C).

## 3.2 Reliability, validity, and consistency of the measurement items used to measure personal values

Before the empirical model estimation, we assessed the reliability, validity, and consistency of the personal values indicators. We determined the reliability by estimating factor loadings (Table 2) and found that most indicators surpassed the recommended threshold of a 0.7 factor loading, as suggested by Fornell and Larcker (1981). This indicates that the respective indicator constructs account for more than 50% of the variance, thus showing acceptable indicator reliability.

To validate the accuracy of construct measurement, we computed convergent validity using the average variance extracted (AVE) method, similar to Sánchez-García et al. (2021). The AVE estimates reflect the degree to which the construct converges to explain the variance of its indicators. Our AVE estimates exceeded 0.5 for each

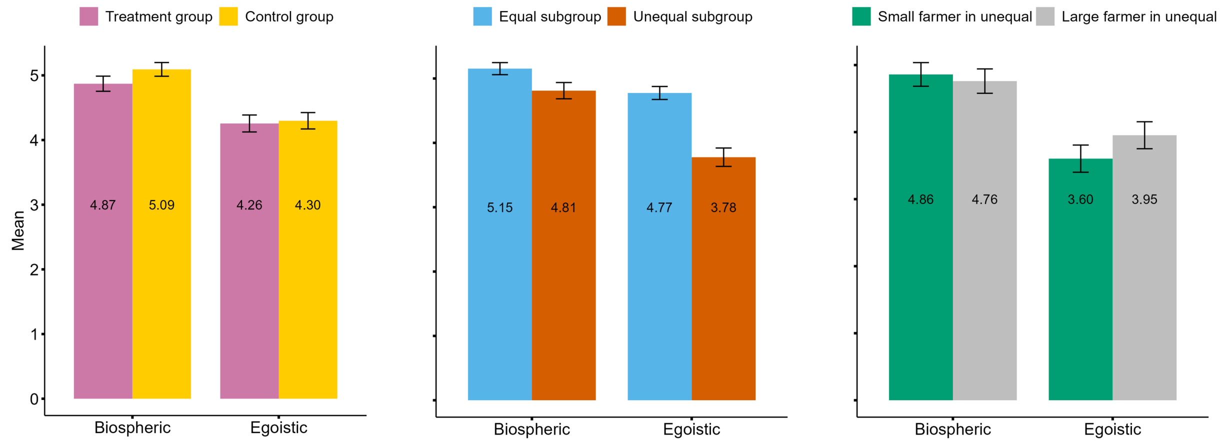


FIGURE 2
Average personal values endorsed by farmers across different experimental groups.

TABLE 2 Test for reliability, convergent validity, and consistency of personal values' measurement items.

| Measurement item | Mean | SD | FL | AVE | alpha |
|---|---|---|---|---|---|
| Biospheric values | | | | 0.744 | 0.88 |
| Unity with nature | 4.889 | 1.825 | 0.848 | | |
| Environmental protection | 5.314 | 1.628 | 0.900 | | |
| Respect for the earth | 4.374 | 2.050 | 0.841 | | |
| Prevent pollution | 5.343 | 1.667 | 0.860 | | |
| Egoistic values | | | | 0.588 | 0.815 |
| Social power | 3.151 | 2.726 | 0.778 | | |
| Authority | 2.997 | 2.579 | 0.783 | | |
| Wealth | 5.275 | 2.253 | 0.771 | | |
| Ambition | 5.916 | 1.528 | 0.759 | | |
| Influence | 4.047 | 2.443 | 0.743 | | |

SD, standard deviation; FL, factor loading; AVE, average variance extracted.

indicator, affirming that all indicators adequately explain the variance (Zahedi et al., 2019). To assess the internal consistency of each indicator construct, we used Cronbach's alpha ($\alpha$) (Table 2). All alpha estimates exceeded the recommended threshold of 0.6 as proposed by Martinez-Conesa et al. (2017), indicating a high level of internal consistency in measuring the constructs of the model.

## 3.3 The effect of experimental elements on personal values

Our results from Equation 1 show that none of the experimental elements significantly affected the personal values elicited during the post-experiment survey (Table 3).

## 3.4 The effect of personal values on environmental benefits

The results of Equation 2 indicate that personal values had a significant effect on environmental benefits, supporting H1 and H2 (Table 4). We found that biospheric values enhanced environmental benefits by 11%, while egoistic values lowered environmental benefits by around 4% (Model 1). This effect remained consistent when we controlled for socio-economic variables specified in Table 1 (Model 2) and when experimental elements were added (Model 3).

## 3.5 How do personal values shape the treatments effect toward environmental benefits?

We tested H3 and H4, assessing how personal values shape the performance of conditional incentives, by estimating interaction effects of treatments and personal values. We present our results from the sample analysis (1,143 observations) in Table 5. The results show that none of the interaction terms were significant. A similar pattern of results was observed when we re-estimated the interaction term using the second and third round dataset (the rounds that received treatments with 762 observations)—see the results in Appendix Table A5. Our results suggest that higher biospheric and egoistic scores weaken the effect of treatments in inducing

TABLE 3 The effect of experimental variables on personal values.

| Variables | Dependent variables are personal values | |
|---|---|---|
| | Biospheric | Egoistic |
| Treatment/Control: (Treatment = 1) | 0.161 | 0.067 |
| | (0.151) | (0.170) |
| Equal/Unequal: (Equal = 1) | 0.304 | 0.102 |
| | (0.257) | (0.290) |
| Small/Large farmer: (Small = 1) | −0.185 | 0.300 |
| | (0.209) | (0.235) |
| Socio-economic and demographic characteristics (Table 1) | Yes | Yes |
| Other control variables (Table 1) | Yes | Yes |
| Corridor-fixed effect | Yes | Yes |
| Enumerator-fixed effect | Yes | Yes |
| *N* | 381 | 381 |
| $R^2$ | 0.206 | 0.240 |

Standard errors (in parentheses) are clustered at the individual level. *$p < 0.1$; **$p < 0.05$; ***$p < 0.01$. See the detailed table in the Appendix Table A2.

TABLE 4 The effect of personal values on environmental benefits.

| Variables | (1) | (2) | (3) |
|---|---|---|---|
| Biospheric | 0.109*** | 0.104*** | 0.087*** |
| | (0.013) | (0.013) | (0.013) |
| Egoistic | −0.043*** | −0.046*** | −0.063*** |
| | (0.010) | (0.010) | (0.010) |
| Socio-economic and demographic characteristics (Table 1) | | Yes | Yes |
| Other control variables (Table 1) | | Yes | Yes |
| Treatment/Control: (Treatment = 1) | | | Yes |
| Equal/Unequal: (Equal = 1) | | | Yes |
| Small/Large farmer: (Small = 1) | | | Yes |
| Rounds of the game (Ref = round 1) | | | Yes |
| Corridor-fixed effect | | | Yes |
| Enumerator-fixed effect | | | Yes |
| *N* | 1,143 | 1,143 | 1,143 |
| Pseudo $R^2$ | 0.043 | 0.071 | 0.142 |

Standard errors (in parentheses) are clustered at the individual level. *$p < 0.1$; **$p < 0.05$; ***$p < 0.01$. See the detailed table in the Appendix Table A3.

conservation decisions. Thus, our findings confirm H3 while providing limited evidence in support of H4.

We extend our analysis to the subsample level by estimating the interaction (treatments and personal values) in equal and unequal subgroups separately, although we had no specific hypothesis for this. Our decision to perform this analysis was motivated by prior expectations regarding the treatment effect under different distributions of land ownership as an important local contextual factor (see Nyanghura et al., 2024). In summary, Nyanghura et al. used a lab-in-the-field experiment to estimate the average treatment effect (T1 and T2) on conservation under two subgroups of participants: equal (symmetric landowners in the experiment) and unequal (asymmetric landowners in the experiment). The study found no strong evidence of a difference in treatment effect between the two subgroups. Here, we extended the analysis to examine the interaction of treatments and personal values among subsamples of the same two subgroups. Our subsample analysis revealed a significant interaction effect, where both treatments (T1 and T2) reduce environmental benefits significantly ($p < 0.05$) by 12 and 22%, respectively, when the biospheric values were high (see Table 6, Model 2, Part I and II, respectively). However, this effect was observed in the equal subgroup and not in the unequal subgroup (see Model 5). Surprisingly, T1 and T2 also reduce environmental benefits significantly ($p < 0.01$) by 13 and 21%, respectively, when the egoistic values were high in the equal subgroup (Table 6, Model 3), similar to what we observed for the high biospheric values. More surprisingly, this effect was inconsistent compared to the unequal subgroup, where both treatments increase environmental benefits substantially ($p < 0.05$) by about 7% when the egoistic value was high (Model 6). A further subsample analysis between small and large farmers in the unequal subgroup shows that

TABLE 5 The interaction effect of incentives and personal values (full sample of 1,143 observations).

| Variables | Full sample | | | |
|---|---|---|---|---|
| | (1) | (2) | (3) | (4) |
| Treatment/Control: (Treatment = 1) | 0.239*** | 0.305** | 0.204** | 0.279** |
| | (0.033) | (0.125) | (0.085) | (0.130) |
| Biospheric | 0.087*** | 0.094*** | 0.087*** | 0.097*** |
| | (0.013) | (0.018) | (0.013) | (0.019) |
| Egoistic | −0.063*** | −0.063*** | −0.067*** | −0.071*** |
| | (0.010) | (0.010) | (0.014) | (0.015) |
| Treatment × Biospheric | | −0.013 | | −0.020 |
| | | (0.023) | | (0.025) |
| Treatment × Egoistic | | | 0.008 | 0.015 |
| | | | (0.018) | (0.020) |
| Socio-economic and demographic characteristics (Table 1) | Yes | Yes | Yes | Yes |
| Other control variables (Table 1) | Yes | Yes | Yes | Yes |
| Equal/Unequal: (Equal = 1) | Yes | Yes | Yes | Yes |
| Small/Large farmer: (Small = 1) | Yes | Yes | Yes | Yes |
| Rounds of the game (Ref = round 1) | Yes | Yes | Yes | Yes |
| Corridor-fixed effect | Yes | Yes | Yes | Yes |
| Enumerator-fixed effect | Yes | Yes | Yes | Yes |
| *N* | 1,143 | 1,143 | 1,143 | 1,143 |
| Pseudo $R^2$ | 0.142 | 0.143 | 0.143 | 0.143 |

Standard errors (in parentheses) are clustered at the individual level. *$p < 0.1$; **$p < 0.05$; ***$p < 0.01$. See the detailed results in the Appendix Table A4.

the positive effect was indeed driven by the small farmers (Appendix Table A8) and not by the large farmers (Appendix Table A9). This suggests heterogeneity between different categories of landowners, even if they endorse the same egoistic motive.

## 4 Discussion

The objective of this study was to ascertain the influence of personal values on conservation behavior and to examine how these values influence the effect of conditional payments on conservation behavior. By incorporating psychological factors (in this case, personal values) into the analysis, we broadened the scope of the neoclassical approach to explaining farmers' behavior.

Our findings indicate a consistent positive effect of biospheric values on conservation behavior. This suggests that individuals with strong biospheric values are willing to forego some private returns to the benefit of nature. Our findings align with those of other studies that have evaluated the impact of personal values on conservation behavior and in diverse environmental contexts. For example, research has demonstrated a positive correlation between biospheric values and individuals' actions toward the conservation of biodiversity, even in the absence of direct benefits from ecosystem services in return (Fornara et al., 2020; Matzek and Wilson, 2021). Furthermore, Soyez (2012) demonstrated that individuals with elevated biospheric values are more likely to consume organic food products. Additionally, Perlaviciute and Steg (2015) posited that consumers with robust biospheric value orientations are more likely to purchase renewable energy equipment. In Tanzania, secondary students who endorsed biospheric values demonstrated a substantial level of conservation behavior (Nkaizirwa et al., 2022).

As anticipated, our results demonstrate a negative and significant impact of egoistic values on conservation behavior. This is because egoistic values often lead to the pursuit of personal gains rather than public benefits, which often entail ecological costs. Our findings are consistent with those of previous studies that examined the relationship between egoistic values and pro-conservation behavior (e.g., Perlaviciute and Steg, 2015; Bouman et al., 2018; Oh et al., 2021). Notwithstanding, our findings indicate a below-average conservation response among egoistic farmers, irrespective of the intervention (here: compensation through T1 and T2). One reason may lie in the stability of personal values. This stability is more pronounced in adulthood (as is the case for all our participants) than in childhood, when values are considered to be in their nascent stages of formation (Ignell et al., 2019). This is supported by the study of Sargisson et al. (2020), who showed that adults are more likely to express stable egoistic behavior than children.

The effect size of the two personal values is also worth noting. Although all observed values showed a statistically significant conservation benefit, the large positive effect size of the biospheric values relative to the negative effect caused by the egoistic values suggests that biospheric values trump egoistic values. This observation somewhat explains the recent findings of Nyanghura et al. (2024), in the same study areas, which showed a sizable willingness of farmers to retire their personal farmland for conservation, even without compensatory payments. Greiner and Gregg (2011) also found

TABLE 6 The interaction effect of incentives and personal values for equal and unequal subgroups.

| Part I: Effect of T1 | Equal subgroup | | | Unequal subgroup | | |
|---|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) | (6) |
| T1: PY | 0.333*** | 0.966** | 0.967*** | 0.246*** | 0.045 | −0.026 |
| | (0.072) | (0.334) | (0.281) | (0.074) | (0.241) | (0.143) |
| Biospheric | 0.099** | 0.159*** | 0.091** | 0.070** | 0.048 | 0.071** |
| | (0.031) | (0.046) | (0.029) | (0.026) | (0.038) | (0.025) |
| Egoistic | −0.046 | −0.054* | 0.016 | −0.066** | −0.066** | −0.108*** |
| | (0.029) | (0.029) | (0.038) | (0.021) | (0.021) | (0.029) |
| T1 × Biospheric | | −0.119** | | | 0.040 | |
| | | (0.060) | | | (0.044) | |
| T1 × Egoistic | | | −0.129** | | | 0.074** |
| | | | (0.056) | | | (0.031) |
| Small/Large farmer: (small = 1) | No | No | No | Yes | Yes | Yes |
| Socio-economic and demographic characteristics (Table 1) | Yes | Yes | Yes | Yes | Yes | Yes |
| Other control variables (Table 1) | Yes | Yes | Yes | Yes | Yes | Yes |
| Corridor-fixed effect | Yes | Yes | Yes | Yes | Yes | Yes |
| Enumerator-fixed effect | Yes | Yes | Yes | Yes | Yes | Yes |
| *N* | 191 | 191 | 191 | 190 | 190 | 190 |
| Pseudo $R^2$ | 0.234 | 0.252 | 0.257 | 0.217 | 0.221 | 0.235 |

| Part II: Effect of T2 | Equal subgroup | | | Unequal subgroup | | |
|---|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) | (6) |
| T2: PY + AB | 0.449*** | 1.629*** | 1.510*** | 0.542*** | 0.285 | 0.270* |
| | (0.078) | (0.396) | (0.300) | (0.072) | (0.231) | (0.151) |
| Biospheric | 0.105** | 0.218*** | 0.090* | 0.059* | 0.031 | 0.061* |
| | (0.038) | (0.048) | (0.037) | (0.026) | (0.036) | (0.025) |
| Egoistic | −0.033 | −0.050 | 0.068* | −0.070** | −0.069** | −0.112*** |
| | (0.032) | (0.032) | (0.038) | (0.022) | (0.022) | (0.031) |
| T2 × Biospheric | | −0.220** | | | 0.051 | |
| | | (0.070) | | | (0.042) | |
| T2 × Egoistic | | | −0.214** | | | 0.075** |
| | | | (0.060) | | | (0.036) |
| Small/Large farmer: (small = 1) | No | No | No | Yes | Yes | Yes |
| Socio-economic and demographic characteristics (Table 1) | Yes | Yes | Yes | Yes | Yes | Yes |
| Other control variables (Table 1) | Yes | Yes | Yes | Yes | Yes | Yes |
| Corridor-fixed effect | Yes | Yes | Yes | Yes | Yes | Yes |
| Enumerator-fixed effect | Yes | Yes | Yes | Yes | Yes | Yes |
| *N* | 191 | 191 | 191 | 190 | 190 | 190 |
| Pseudo $R^2$ | 0.203 | 0.239 | 0.244 | 0.299 | 0.304 | 0.314 |

Standard errors (in parentheses) are clustered at the individual level. *$p < 0.1$; **$p < 0.05$; ***$p < 0.01$. See the detailed results in the Appendix Tables A6, A7.

Australian farmers to boast higher intrinsic motivational scores in favor of conservation behavior than for self-interest.

Our PES treatments did little to alter conservation behavior for participants with high biospheric values compared to the average treatment effect (Table 5). Still, it may not be necessary to fully compensate farmers with high intrinsic conservation motives for their opportunity costs to achieve the same conservation levels than on farms headed by individuals with average intrinsic motivation levels. This finding offers a complementary explanation for why some studies observe high participation rates in conservation schemes with low actual payments, which has also been attributed to adverse selection (see, Bopp et al., 2019, and Wunder et al., 2020).

However, neither participant with high egoistic values exhibited stronger responses to PES incentives than farmers with average motivation scores (Table 5). On average we thus do not find any evidence for personal motivations to mediate PES impacts. Still, higher payment levels might be needed to induce highly egoistic farmers to conserve the same amount of land than farmers with average motivational scores.

When looking at equal and unequal groups separately, we found small but statistically significant interactions between treatments and motivational scores (Table 6). In the equal subgroup, for example, these interaction effects are of similar size as the average effects of the motivational scores indicating that motivations matter less in the presence of PES than under the control condition without conservation payments. This finding, even if only present in the subgroup analysis, suggests that conservation payments could, under some conditions, offset the effects of intrinsic motivations lending weak support to the idea of motivational crowding (Rode et al., 2015).

Future research may expand on our study to explore the role of other personal values, such as altruism and hedonism. This would require a larger sample size and, crucially, the ability to deconstruct prevailing or centrally endorsed values from the other existing values to see the possible effect of complementarity or conflicting among them. As our study employed self-reported measures for evaluating personal values, it is not possible to completely rule out the possibility of response error due to social desirability bias. Therefore, it may be necessary to use other measures, such as peer reporting, in future studies to offset this bias. Additionally, examining the generational dynamics of personal values, including the transformation across generations (children, young adults, and elders), would be a thought-provoking and innovative extension of the current study.

Finally, it would be beneficial for future studies to test the suitability of treatment effects in a wider range of social and spatial contexts to ensure the robustness of the findings for national-based policy recommendations. Such an extension should also investigate the conditions under which different groups of farmers (e.g., small and large landowners) may be motivated to conserve biodiversity. Since our study derived the outcome variables from a lab-in-the-field experiment, we cannot entirely rule out potential biases related to our experimental design. For instance, farmers who were either not interested in or had negative experiences with conservation NGOs might not have opted to retire their farmland for conservation, as this decision would have resulted in a donation to a conservation NGO. Future research could explore how farmers' decisions to retire farmland for conservation might differ when donations are directed to various organizations (e.g., government vs. non-government conservation organizations).

## 5 Conclusions and policy recommendations

This study offers two conclusions, followed by potential policy suggestions and areas for further studies. First, our findings underscore the relevance of personal values, specifically those related to the environment (biospheric) and those related to the individual (egoistic). The positive effect of the biospheric values on conservation and the negative effect of the egoistic values suggests that policymakers should acknowledge the pre-existence of personal values and their effect on conservation efforts. It is crucial for policymakers to focus their conservation strategies on reinforcing the human-environment relationship supporting biospheric values. To achieve this, interventions might include investing in conservation education for future generations, such as children in schools, who are at the formative stage of value development (Ignell et al., 2019). For current generation, it may be necessary to enhance the dissemination of conservation information, for instance, through advertisements. Formation and strengthening of the biospheric values are vital for enhancing the cost-effectiveness and efficiency of conservation policies, such as PES (Steg et al., 2014a). Investing in the education and training of future farmers with strong pro-environmental values would most likely be a viable option to strengthen pro-environmental behavior and thereby reduce the costs of PES related policy measures.

Second, our findings on interaction effects between conservation incentives and motivational indicators suggest that payments can, under some conditions, offset the effect of intrinsic conservation motives (i.e., motivational crowding out) or boost willingness to conserve for rather self-interested individuals (i.e., motivational crowding in). These motivational PES impact channels must remain on the radar of incentive-based conservation program developers.

## Data availability statement

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

## Ethics statement

Ethical review and approval was not required for the study on human participants in accordance with the local legislation and institutional requirements. Written informed consent from the [patients/participants OR patients/participants legal guardian/next of kin] was not required to participate in this study in accordance with the national legislation and the institutional requirements.

## Author contributions

QN: Conceptualization, Data curation, Formal analysis, Funding acquisition, Investigation, Methodology, Project administration, Writing – original draft, Writing – review & editing. JB: Conceptualization, Funding acquisition, Methodology, Supervision, Writing – review & editing. LB-F: Conceptualization, Funding acquisition, Methodology, Supervision, Writing – review & editing.

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## Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

## Publisher's note



## Supplementary material

The Supplementary material for this article can be found online at: https://www.frontiersin.org/articles/10.3389/fsufs.2024.1493672/full#supplementary-material

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