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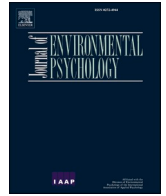
Informing versus generating a discussion: Comparing two approaches to encouraging mitigation of soil erosion among Maasai pastoralists

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ABSTRACT

Soil erosion is a critical problem for pastoralist societies that rely on healthy grazing land for their livelihoods. Previous research suggests that unsustainable land management practice is one of the factors exacerbating soil erosion, and that willingness to adjust this practice is closely linked to community land protection norms. The present research explores approaches to building stronger community norms and intentions linked to mitigating soil erosion among Maasai pastoralists in Northern Tanzania. In particular, we compare two impact approaches based on the information deficit model (exposure to scientific information) and the social identity framework (a group-based discussion). The results demonstrate that the information deficit approach results in stronger perceived land protection norms and, indirectly, stronger intentions, as compared to the discussion-based approach. We discuss contextual features that should be taken into account when interpreting these findings and suggest these may be key for impact approach choices.

Soil erosion is one of the central environmental problems in many areas of the world, leading to a yearly loss of millions of hectares of arable land and resulting in alarming costs to the global GDP (UNCCD, 2017). Decreasing land health and productivity, it has serious economic consequences for many communities that depend on land for their livelihoods (UNCCD, 2019a), reducing their resilience, causing poverty, and undermining health and well-being (Borelli et al., 2017; Pimentel, 2006). These problems are particularly acute in rural areas where people's livelihoods are strongly connected to agriculture and pastoralism, making healthy land a key condition for food security. Addressing causes of soil erosion, preventing further land deterioration, and restoring eroded areas are the key priorities in such areas, directly connecting to the UN Sustainable Development Goal of ending poverty (SDG 1, UNCCD, 2019b).

Natural science has developed an elaborated understanding of the physical processes involved in soil erosion (see Blaikie & Brookfield, 2015; Ionita, Fullen, Zgłobicki, & Poesen, 2015; Valentin, Poesen, & Li,

2005). At the same time, it has been suggested that such an understanding alone may not be sufficient to develop effective pathways to addressing the problem of soil erosion on the ground. In particular, it has been noted that in addition to landscape characteristics, soil properties, and climate change, land management practice (situated within historical, social, and economic context) plays a significant role in exacerbating or alleviating land degradation (e.g., Blake et al., 2018; Wynants et al., 2019). Aligning land management practice with the goals of land preservation and restoration requires working with communities involved to develop effective approaches to adjusting attitudes and behaviours linked to sustainable land use. At the same time, research with a focus on attitude and behaviour component of the soil erosion challenge, and especially approaches to changing these, is limited (see Rabinovich et al., 2019, 2020). The present research aims to address this gap by empirically comparing effectiveness of two possible approaches to encouraging sustainable land management in a pastoralist area of Northern Tanzania strongly affected by soil erosion. Below we briefly

outline the context of the soil erosion challenge in the area of study, before describing the two impact approaches to be compared: The top-down approach based on the information deficit model, and the bottom-up approach rooted in the social identity framework.

1. Soil erosion challenge in the area of study

The present study was conducted in the Moduli district situated in Northern Tanzania (see Fig. 1). This area suffers from increasing rates of soil erosion due to the interlinking of natural environmental factors (distinct topography, semi-arid climate, and vulnerable soils) with a changing climate (heavier rainfall and more severe droughts, IPCC, 2012; Nicholson, 2014), as well as recent social and economic change within pastoralist communities (e.g., a shift to a more settled way of life and an expansion of private land ownership, see Rabinovich et al., 2020). A significant proportion of the district's population consists of Maasai pastoralists whose livelihood is closely linked to cattle keeping and is dependent on availability of healthy grazing land. Although pastoralism has remained relatively sustainable for centuries in Maasai land, recently the pressure on the land has increased due to restrictions on pastoralists' mobility (brought about by the conversion of grazing lands to commercial farms or wildlife reserves) and population growth (e.g., Wynants, Solomon, Ndakidemi, & Blake, 2018). This has led to increased soil disturbance in the communal areas still available for grazing, making the soil more vulnerable to erosion. Existing research demonstrates a significant scale of the soil erosion problem in the area (Blake et al., 2018), including its effects on pastoralist livelihoods and well-being (Rabinovich et al., 2019). It has also linked the soil erosion in the area with the destruction of the vegetation cover (partly due to overgrazing) and the intensification of cattle tracking (Blake et al., 2018).

Previous work in the Monduli area, based on a qualitative analysis of interviews with the stakeholders, suggests that while pastoralist communities have a strong awareness of the soil erosion problem and realize the need for action, their ability to respond may be undermined by the cultural importance of cattle keeping, weak governance structures, and a lack of social cohesion that could drive a collective response (Rabinovich et al., 2019). A follow-up survey study applied the social identity framework to explore predictors of willingness to care for the communal pasture land (e.g., to adjust one's land management practice in order to mitigate the erosion), and demonstrated that pastoralists' willingness to care for the land was predicted by social identification with one's community, which motivated the development of land-protective norms (Rabinovich et al., 2020). However, interpretation of these findings is complicated by the study's correlational design which creates uncertainty about the direction of the observed relationships. In the present research, we aim to compensate for this limitation and extend the existing knowledge base further, by experimentally comparing effectiveness of two theory-based approaches to motivating willingness to mitigate soil erosion among pastoralists. We provide an overview of these approaches below.

2. The information deficit approach

The information deficit model suggests that individual attitudes to a scientific topic (such as climate change or new technology) are linked to availability of scientific knowledge on that topic and one's ability to understand it (e.g., Layton, Jenkins, McGill, & Davey, 1993; Schultz, 2002; Ziman, 1991). For example, it would predict that a lack of knowledge about causes and consequences of climate change underlies unwillingness to adopt sustainable behaviour (e.g., Geiger, Geiger, & Wilhelm, 2019; Kaiser & Fuhrer, 2003). As a consequence, clear science communication is suggested to be the key to overcoming public skepticism and motivating action consistent with scientific recommendations (e.g., Díaz-Siefer, Neaman, Salgado, Celis-Diez, & Otto, 2015). According to the information deficit model, awareness-raising and scientific education programmes are central for encouraging attitude and behaviour change consistent with the scientific consensus: When people have sufficient information, they trust the science and act in line with it (e.g., Bauer, Allum, & Miller, 2007; Frick, Kaiser, & Wilson, 2004). For
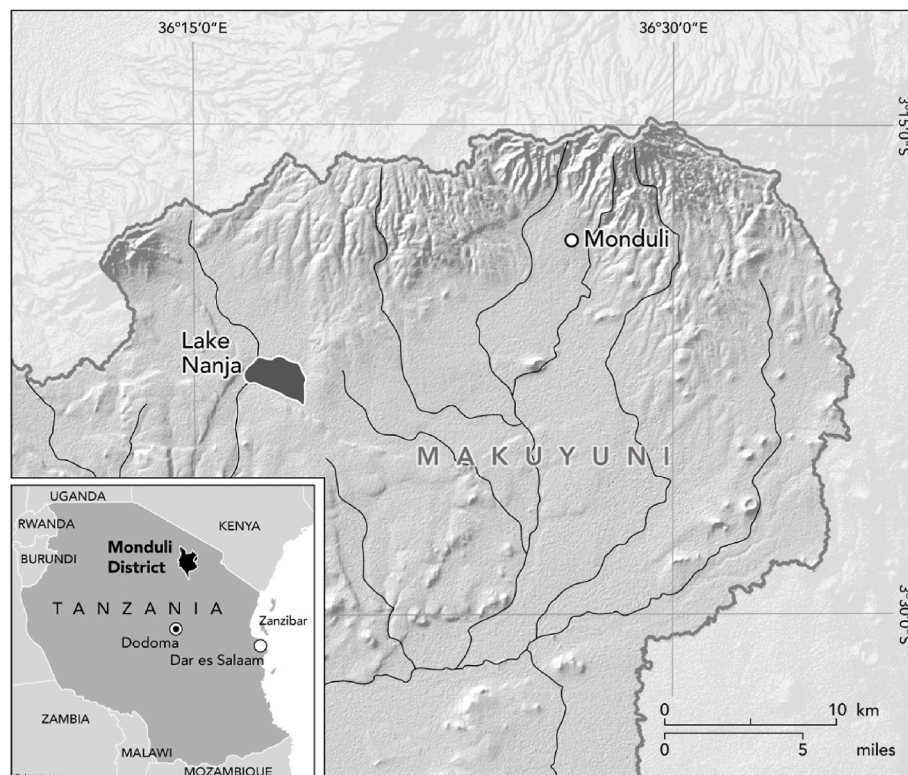

Fig. 1. Monduli district in Northern Tanzania (study site).

example, a person who has a good understanding of the relationship between overgrazing and soil erosion would be motivated to protect the land they depend on from overgrazing.

There is some evidence that can be interpreted as consistent with the information deficit model. In particular, a meta-analysis by Allum, Sturgis, Tabourazi, and Brunton-Smith (2008) demonstrated a small but statistically significant association between scientific knowledge and attitudes to scientific topics that remained robust across cultures and time: For example, more extensive knowledge of biology and genetics was associated with more positive attitudes towards GM food. This evidence, however, does not clarify a direction of the observed relationship (i.e., whether access to scientific information leads one to agree with its conclusions and suggestions, or whether trusting scientific conclusions motivates one to gain more knowledge). More recent work in the domain of urban wildlife ecology supports the former possibility: The results of a cross-lagged analysis suggest that scientific knowledge predicts attitudes to a relevant topic, rather than the other way around (Bruckermann et al., 2021). Similarly, Bidwell (2016) demonstrated experimentally that provision of in-depth information about wind energy led to stronger support for it, and Neaman et al. (2021) showed that soil science education resulted in more positive attitudes towards caring for the soil. At the same time, there is also evidence that for more complicated sets of information (e.g., that include risks and benefits of a new technology), knowledge does not improve relevant attitudes, but rather strengthens initial predispositions based on ideological beliefs (e. g., Kahan et al., 2009). It has also been demonstrated that when a topic is highly polarized, providing new information may only entrench existing views (Drummond & Fischhoff, 2017; Hart & Nisbet, 2012; Kahan et al., 2012). Overall, it seems that access to scientific information could be conducive to attitudes consistent with scientific consensus, but mainly when such information is unambiguous and concerns non-contentious issues.

While there is some evidence for a relationship between having access to scientific information and having positive attitudes to related topics, it does not directly address a relationship between scientific knowledge and relevant action. Support for this particular link is relatively weaker (e.g., Nolan, 2010). For example, a meta-analysis of a relationship between understanding (and accepting) scientific consensus on climate change and taking sustainable action suggests that this association is small to moderate (Hornsey et al., 2016). Extensive work on the motivated rejection of science demonstrates that even when scientific information is available, there is a number of factors that may lead individuals to reject this knowledge (Hornsey, 2020), including existing world-views and ideologies (e.g., Kahan, Jenkins-Smith, & Braman, 2011), vested interests (e.g., Lewandowsky, Oreskes, Risbey, Newell, & Smithson, 2015), and social identity concerns (e.g., Bliuc et al., 2015). Overall, the evidence suggests that although science education may be conducive to adopting relevant attitudes, this relationship may become weaker for actions.

Although the information deficit model has been criticized for failing to take into account wider contexts of attitude formation (e.g., Bauer et al., 2007; Sturgis & Allum, 2004), a significant proportion of research on motivating environmentally sustainable action seems to adopt the principles of this model as its underlying assumptions. In particular, a considerable amount of work is dedicated to exploring effective ways of communicating climate change information to public audiences (for example, through effective framing, Bertolotti & Catellani, 2014; Morton, Rabinovich, Marshall, & Bretschneider, 2011; Nisbet, 2009), with the assumption that effective science communication would motivate relevant action. For example, much attention has been dedicated to exploring various framings of uncertainty statement in IPCC reports with a focus on increasing the correspondence between the intended scientific messages and public understanding (e.g., Budescu, Broomell, & Por, 2009), as well as to using precise language that takes into account lay ways of understanding scientific terms (such as "error" or "bias", Hassol, 2008). Given this emphasis on the importance of effectively

communicating science behind environmental decisions, and, at the same time, the contested nature of the underlying knowledge deficit model, it would be of value to test the effectiveness of scientific knowledge exposure against other possible approaches.

3. The social identity approach

The deficit model described above is based on an assumption that individual attitudes and actions are driven by individual-level processes (such as knowledge or understanding of scientific information). An alternative way of understanding what determines attitudes and behaviour is offered by the social identity framework (Reicher, Spears, & Haslam, 2010; Tajfel & Turner, 1979; Turner, Hogg, Oakes, Reicher, & Wetherell, 1987). According to it, individual behaviour is driven by group-level processes (such as group identification and norms) in contexts that make group memberships salient. The setting of the present study is one of such contexts, since it focuses on the erosion of the communally managed land (thereby making community membership strongly salient), and, therefore, the social identity approach would be relevant to understanding the behaviour of interest (willingness to mitigate the erosion and protect the land).

According to the social identity approach, people develop a strong sense of connection with important groups (i.e., group identification). In contexts, where group identities become salient, attitudes and behaviour of individuals with strong group identification are driven by group norms (i.e., ways of thinking and behaving accepted within and approved of by the group, e.g., Hogg & Turner, 1987). There is extensive evidence demonstrating the link between group identification, norms, and individual choices in environmental sustainability contexts (e.g., Fritsche, Barth, Jugert, Masson, & Reese, 2018; Postmes, Rabinovich, Morton, & Van Zomeren, 2014; Rabinovich, Morton, Postmes, & Verplanken, 2012; Schultz, Nolan, Cialdini, Goldstein, & Griskevicius, 2007), including the impact of norms on sustainable agricultural practice (Fielding, Terry, Masser, & Hogg, 2008; Truelove, Carrico, & Thabrew, 2015). Previous research on communal land management among Maasai pastoralists also demonstrates the key role of community norms in shaping land management intentions (Rabinovich et al., 2020).

One way in which new norms are developed and strengthened is through a collective discussion of challenges faced by a group (e.g., Koudenburg, Greijdanus, & Scheepers, 2019; Smith & Postmes, 2011). A discussion also provides opportunities for strengthening group identification that increases the likelihood of individuals acting in line with group norms (Thomas, McGarty, & Mavor, 2009). In addition, a group discussion in contexts where cooperation is required to protect a shared resource could help develop a sense that the problem is understood in a similar way by other group members (shared cognition), trust that others would act cooperatively (Orbell, van de Kragt, & Dawes, 1988), and confidence that the group is capable of tackling the problem (efficacy, Van Zomeren, Postmes, & Spears, 2008). Previous research suggests that these factors are important drivers of behaviour in contexts that require cooperation around a shared resource (e.g., Kamleitner & Rabinovich, 2010; Kerr, 1996; Orbell et al., 1988), and provides consistent evidence for the positive effect of group discussion on individual decisions about shared resource management (see Meleady, Hopthrow, & Crisp, 2013 for an overview).

Based on the above evidence, it could be suggested that an approach that provides an opportunity for a collective discussion of the soil erosion problem faced by a community could be effective at motivating attitudes and behaviour aimed at mitigating this threat. This effect would be expected due to the discussion creating an environment for developing relevant group norms, as well as strengthening identification with other community members, mutual trust, and sense of efficacy[1]. In the present research we test the effectiveness of this approach against the one based on the information deficit model.

4. Present research

The present research aims to empirically compare effectiveness of the above impact approaches to encouraging mitigation of soil erosion among Maasai pastoralists. The first of these is based on the information deficit model which assumes that informing decision-makers about the science of erosion will be sufficient to encourage sustainable action, while the second is based on the social identity framework and suggests that group norms are the key driver of land-protective action, and that these norms can be developed and strengthened through a group discussion.

To test the effectiveness of these two approaches we conducted an experimental study with Maasai pastoralists who live in an area strongly affected by soil erosion (the Monduli district in Northern Tanzania). We randomly allocated participants to conditions that corresponded to the impact approaches described above. In the condition corresponding to the information deficit approach, participants were provided with accessible information on soil erosion processes and factors that may cause it (referred below as the Science narrative condition). We avoided including specific recommendations, because the purpose of a wider interdisciplinary project (that this study was part of) was to co-develop solutions, taking into account local knowledge and concerns (as opposed to imposing solutions externally). In the condition corresponding to the social identity approach, participants had an opportunity to discuss the same topic with fellow community members, focusing on developing a group understanding of the soil erosion process (referred below as the Group discussion condition). It should be noted that, unlike much previous research on discussion-induced cooperation, we asked participants to discuss the problem of soil erosion and its possible causes (rather than solutions, see Method section for detail). This was done to ensure consistency with the Science narrative condition and to avoid confounding, where solutions would be explicitly considered in one of the conditions, but not the other. Our expectation was that a discussion focused on a shared problem would be sufficient to strengthen shared understanding of the erosion causes. Shared understanding of causes, in turn, could lead to an agreement on what actions are necessary and motivate that action (e.g., if there is a shared understanding that intensive grazing is part of the problem, a perception that reducing grazing is normative and willingness to do so would follow). In other words, a problem-focused discussion could have a positive effect on willingness to protect the shared land, even in the absence of an explicit focus on solutions (indeed, there is evidence that a discussion of a collective problem leads to stronger willingness to act than a discussion of possible solutions to that problem, Smith & Postmes, 2011).

We measured willingness to take action that protects the land from further erosion as the central outcome. Based on the overall stronger support for the social identity approach, it was expected that participants in the Group discussion condition will report stronger community identification and trust, higher shared cognition and efficacy, and stronger perceived community norms and intentions for mitigating erosion than participants in the Science narrative condition (Hypothesis 1). Based on the existing research in the same context (Rabinovich et al., 2020), it was expected that the effect of group discussion on intentions will be mediated by perceived group norms (Hypothesis 2). Finally, we expected that participants in the Science narrative condition will report higher perceived understanding of soil erosion than participants in the Group discussion condition (Hypothesis 3), but that this will not translate into stronger erosion mitigation intentions (Hypothesis 4).

5. Method

5.1. Participants and design

Participants were 285 Maasai pastoralists from thirteen communities of the Monduli district in northern Tanzania (34% female, mean age = 41.03, SD = 11.23). The participating communities were randomly selected from the list of villages meeting the following criteria: location within the Monduli district, Maasai population, use of communally shared land, presence of soil erosion on the community land, and geographical accessibility. Within each community, participants were recruited with the help of the village leaders, who were asked to invite for participation a mix of community members, ensuring representation of both genders, different age groups, and occupations. The target sample size was calculated as $N = 260$ using the G*Power software, estimating small to medium effect size ($d = 0.35$), with alpha = .05, and power = .80 for a two-tailed independent samples t-test. We over-recruited above this number because we did not have direct control over the exact number of participants turning up for each testing session and aimed to adjust for possible missing data.

The study used a between-subjects experimental design with two conditions. The independent variable was the impact approach used, with two levels: Science narrative (the information deficit approach) versus Group discussion (the social identity approach). The dependent variables were perceived understanding of soil erosion processes, community identification and trust, shared cognition about the soil erosion problem, collective efficacy in relation to managing erosion, perceived community norms supporting sustainable land management, and intentions to adopt sustainable land management practice.

5.2. Materials and procedure

Materials were developed in English, translated into Kiswahili, and back-translated into English to ensure a precise retention of meaning. Several adjustments were made to the phrasing of the items after comparing the original and the back-translated versions. An effort was made to minimize the length of the questionnaire. The study was approved by the departmental Ethics Committee.

Within each community, the data were collected in one session in a communal space (a village hall). When participants arrived, they were randomly allocated to one of the two conditions (while maintaining approximately equal group size) and immediately directed to one of two separate rooms. Two researchers were responsible for running each of the groups, and there was no interaction between the groups during the study. The research assistants were trained in the experimental procedure and ethics, and were native Kiswahili speakers.

In both conditions, the session was presented to participants as a workshop about soil erosion. In the Science narrative condition, after welcoming participants, a research assistant explained the process of soil erosion from a soil science point of view, in an accessible form. First, the importance of healthy soils for agriculture and water quality was briefly described. Then it was explained that the process of erosion starts with a loss of vegetation cover, which, among other things, can happen due to overgrazing and forest clearance. This is followed by unprotected soil being washed away by heavy rains, as well as crust formation that prevents water infiltration and increases run-off. Gullies are then formed due to rain waterflow concentrating within natural or man-made depressions in the landscape, and the gully formation itself strengthens the waterflow. Visual aids were used throughout this talk to demonstrate bare soil, crust formation, and gullies photographed in the Monduli district. The talk took about ten -fifteen minutes. After the talk, participants were given an opportunity to ask questions and clarify anything they did not understand, but no group discussion took place.

After all questions were answered, participants were handed out consent forms and those who provided consent completed the outcome measures independently. Participants then received a debriefing sheet with information about the study, and again had an opportunity to ask questions. After a break, participants in this condition engaged in a group discussion exercise equivalent to the experimental procedure in the Group discussion condition (see below). For the Science narrative condition, this discussion was not part of the experimental procedure, and all outcomes were measured before this activity took place.

In the Group discussion condition, after participants were welcomed,

they engaged in a group discussion exercise. Participants were sat together around the same table. Each participant was first given a description of two characters – both Maasai pastoralists from the same region, one female and one male. The descriptions presented the characters, described their livelihoods and occupations briefly, and continued by saying that each character faces a problem of soil erosion on their land (on their farms and on the village land used for grazing). After participants read the information about characters, they were given icon images and a background sheet (see below) and were asked to collectively create a story explaining how and why the soil erosion happens. While doing this, they were asked to think about what might have led to soil erosion on the land of the characters that they had just read about. Participants were given half an hour to complete the task. During the discussion, the research assistant did not interfere, except to encourage everyone in the group to contribute. In the end of the exercise, each group chose one or two members to tell the final story using the images provided.

The materials used in the discussion exercise consisted of 18 round icon images printed on hard paper, in colour, each 100 mm in diameter. Each image schematically depicted a key concept related to soil erosion – for example, a gully, rain, a stream of water, dry crusted soil, cut down trees, grass, animal tracks, etc. Overall, the concepts represented matched the ones that were mentioned in the scientific narrative. In addition, the set included 24 smaller images (60 mm in diameter) depicting three different types of local livestock (eight identical icons for each livestock type). This was done in order to give participants an opportunity to consider livestock numbers and incorporate this into their narratives. Finally, participants received an A0 canvas background with a very minimal representation of local landscape that they could use for positioning the icon images.

After completing the discussion exercise, participants were given the consent forms, and those who gave consent completed the outcome measures independently. Participants then received the debriefing sheet and had an opportunity to ask questions. After a break, participants listened to the scientific explanation of the soil erosion process equivalent to the experimental manipulation in the Science narrative condition, and again had an opportunity to ask questions. For the Group discussion condition, this activity was not part of the experimental procedure. In the end of the day all participants were thanked and compensated for their time.

The questionnaire started with demographic items – these included village name, age, gender, occupation, and dichotomous measures of whether participants or their immediate family members owned any land privately, and whether they used communal village land for any purpose (see SM for a randomization check on these parameters). These items were followed by measures of perceived understanding of soil erosion, community identification, community trust, shared cognition about soil erosion, collective efficacy, perceived community norms related to protecting land from soil erosion, and intentions to take action to protect the land[2]. Participants responded to all items on a five-point Likert scale (1 = "strongly disagree", 5 = "strongly agree"). Items within each scale were averaged to compute a single score. All items were based on the measures used in previous research in the same context (Rabinovich et al., 2020).

Perceived understanding of the soil erosion process was measured using two items: "I understand why soil erosion happens" and "I know what needs to be done to prevent further erosion on our land" ($r = 0.62$, $p < .001$). Community identification was measured with two items: "I have strong relationships with other people in my community" and "I am happy about being a member of my community" ($r = 0.48$, $p < .001$). Two items were used to measure community trust: "People in my community can be trusted" and "Most people within my community can be counted on to do what they say they will do" ($r = 0.69$, $p < .001$).

Shared cognition was measured using three items: "In my community we all agree about what causes soil erosion", "In my community we all agree about what needs to be done to stop soil erosion", and "People

in my community all agree that we need to act to stop soil erosion" (alpha = .62). Collective efficacy in dealing with erosion was measured using two items: "As a community, there are actions we can take to prevent soil erosion" and "I am confident that, as a community, we can manage land well to prevent further soil erosion" ($r = 0.49$, $p < .001$). Seven items were used to measure perceived community norms related to taking action to protect the land from soil erosion (e.g., "Most people in my community think that cattle stock planning and reducing herd size to prevent soil erosion is a good idea", "Most people in my community think that planting grasses and trees to prevent soil erosion is a good idea", alpha = .80). Seven corresponding items were used to measure intentions to mitigate soil erosion (e.g., "I will make changes to how I run my household in order to stop soil erosion", "I am willing to reduce the size of my herd to reduce grazing and help the land restore", "I will take part in planting grasses and trees to fix the gullies", alpha = .82).

6. Results

Means, standard deviations, and bivariate correlations for all variables are shown in Table 1.

To explore the effect of experimental condition on the outcome variables (hypothesis 1), we conducted a MANOVA with experimental condition as a predictor and intentions, community norms, community identification, trust, efficacy, and shared cognition as dependent variables, controlling for gender, age, land ownership, communal land use[3], and dummy variables for village membership as covariates. The analysis demonstrated that the overall effect of the experimental condition was not statistically significant: F (6, 197) = 0.863, $p = .523$, $\eta_p^2 = 0.026$. Univariate analyses showed that the experimental condition had a statistically significant effect on perceived community norms: F (1, 202) = 4.86, $p = .029$, $\eta_p^2 = 0.024$. In particular, participants perceived stronger community norms supporting land protection in the Science narrative condition ($M = 4.35$, $SD = 0.58$) than in the Group discussion condition ($M = 4.21$, $SD = 0.58$). No other univariate effects were statistically significant ($ps > .197$), although the means for all outcomes were higher in the Science Narrative condition (see Table 2). We also conducted a separate ANOVA with perceived understanding of soil erosion as an outcome (since for this outcome the opposite direction of effect was predicted, hypothesis 3), controlling for the same demographic parameters as above. There was no statistically significant effect on perceived understanding: $M_{science} = 3.80$, $SD = 1.04$; $M_{discussion} = 3.92$, $SD = 1.04$; F (1, 246) = 0.910, $p = .341$, $\eta_p^2 = 0.004$ (see SM for the relationships between the demographic controls and the outcome variables, and for analyses without controls). Hypothesis 2 and 4 (which proposed to test mediating relationships) could not be tested due to the absence of the predicted effects on the proposed mediators.

Given the significant effect of the experimental condition on perceived community norms (in an unexpected direction), and a high correlation between norms and intentions, we conducted a post-hoc test of an indirect effect of the experimental condition on intentions via perceived norms. The analysis using a PROCESS macro, model 4, with the experimental condition as a predictor (0 = group discussion, 1 = science narrative), community norms as a mediator, and intentions as the outcome, controlling for the same demographic variables as in the above analyses, demonstrated that the indirect effect of the experimental condition on intentions to protect the land via perceived community norms was statistically significant, estimate = 0.078, $SE = 0.035$, 95% CI [0.017; 0.160] ($R^2_{intentions} = 0.44$, for the direct effect, estimate = 0.0002, $SE = 0.056$, $t = 0.003$, $p = .998$; for total effect, estimate = 0.078, $SE = 0.066$, $t = 1.19$, $p = .237$]. In other words, participants in the Science narrative condition perceived stronger community norms supportive of land protection action and, consequently, reported stronger intentions to engage in activities protecting the land form erosion. See SM for tests of additional mediating models.

Table 1

Means, standard deviations, and correlations between all study variables.

	M (SD)	1	2	3	4	5	6
1. Perceived understanding	3.87 (1.04)						
2. Community identification	4.47 (0.50)	.23***					
3. Community trust	4.10 (0.83)	.05	.34***				
4. Shared cognition	4.25 (0.65)	.23***	.35***	.36***			
5. Collective efficacy	4.40 (0.56)	.28***	.48***	.29***	.41***		
6. Perceived group norms	4.28 (0.58)	.31***	.44***	.33***	.42***	.53***	
7. Intentions to take action	4.34 (0.53)	.36***	.43***	.24***	.41***	.51***	.55***

Note. ****p* < .001.

Table 2

Effects of experimental condition on the outcome variables.

Outcomes	Science narrative condition (*M, SD*)	Group discussion condition (*M, SD*)	*F*	*p*	η_p^2
Perceived understanding	3.80 (1.04)	3.92 (1.04)	0.91	.341	.004
Community identification	4.55 (0.47)	4.45 (0.50)	1.50	.223	.007
Community trust	4.20 (0.83)	4.11 (0.81)	1.36	.245	.007
Shared cognition	4.34 (0.65)	4.24 (0.63)	1.16	.283	.006
Collective efficacy	4.45 (0.57)	4.39 (0.57)	0.86	.355	.004
Perceived group norms	4.35 (0.58)	4.21 (0.58)	4.86	.029	.024
Intentions to take action	4.40 (0.54)	4.33 (0.49)	1.67	.197	.008

7. Discussion

The present study aimed to compare effectiveness of the impact approaches based on the information deficit model and the social identity framework on strengthening intentions to mitigate soil erosion on communal land among Maasai pastoralists. It also aimed to compare effects of these two impact approaches on group norms related to land protection, community identification and trust, shared cognition, community efficacy, and perceived understanding of the mechanisms behind soil erosion.

Contrary to the predictions, the results demonstrated that using the information deficit approach (i.e., providing participants with accessible scientific information on soil erosion) resulted in stronger perceived group norms consistent with land protection than using the approach based on the social identity model (i.e., engaging participants in a group discussion). This effect was small, but statistically significant. While no other direct effects of the approach used were statistically significant, the impact approach had a significant indirect effect on intentions to mitigate erosion. In particular, the information deficit approach translated into stronger intentions to mitigate erosion via stronger perceptions of relevant group norms, as compared to the discussion-based approach.

These results are not consistent with the previous research which suggests that discussing shared issues strengthens group identification (e.g., Thomas et al., 2009) and is conducive to development and strengthening of group norms (e.g., Koudenburg et al., 2019; Smith & Postmes, 2011). It is also not consistent with the existing work on the effect of group discussion on trust in contexts that require cooperation around shared resources (e.g., Orbell et al., 1998), and on the link between discussion and cooperative choices (see Meleady et al., 2013). It should be noted, however, that while in this previous research the focus of the discussion was explicitly on the social dilemma, in the present study participants were asked to focus on the causes of the soil erosion problem. This instruction was included to maintain consistency between the two experimental conditions. It is possible that a discussion focused on possible solutions would provide more opportunities for developing land-protective norms and intentions.

At the same time, the results are in line with the central tenet of the social identity approach to attitude and behaviour change by demonstrating the strong link between perceived community norms and individual intentions (e.g., Hogg & Turner, 1987): In line with the previous research they demonstrate that group norms are a key predictor of individual intentions (e.g., Fielding et al., 2008; Fritsche et al., 2018; Schultz et al., 2007). This finding is also consistent with the previous work conducted in the context of pastoralist land management that emphasizes the central role of community norms in predicting willingness to protect the land (Rabinovich et al., 2020).

It should also be noted that while providing scientific information had a positive indirect effect on intentions to protect the land (as compared to the discussion-based approach), this finding is not fully consistent with the classic information deficit approach, since the effect was mediated by perceived community norms, rather than increased understanding. Contrary to what could be expected on the basis of the information deficit logic, exposing participants to the scientific narrative did not produce significant changes in perceived understanding (in fact, the latter was non-significantly higher in the discussion condition), but instead strengthened perceived group norms. This may call for extending the theory behind the information deficit approach – for example, it is possible that exposure to science may, in some contexts, be effective due to an expectation that others will be affected by this information in a particular way, rather than due to increased individual-level familiarity with the issue. In this respect, it is important to note that participants were exposed to the scientific narrative in groups, and hence could become aware about potential impact of this exposure on other community members.

One possible explanation for the counter-intuitive finding that the information deficit approach resulted in stronger perceived group norms than the discussion-based approach is that the group discussion could bring out differences (rather than similarities) in opinion about possible causes of soil erosion and ways of managing it. Some causes and corresponding mitigation actions may clash with Maasai cultural values (for example, acknowledging that overgrazing plays a role in soil vulnerability and that controlling cattle numbers or restricting grazing access to some areas may be a necessary measure, see Rabinovich et al., 2019). It is possible that in the Group discussion condition participants experienced some level of disagreement about these. In contrast, in the Science narrative condition such differences would remain unseen, and after receiving the information from an authoritative source, participants might have assumed that other group members adopted attitudes and intentions consistent with this information. This could lead to a stronger perception of land protective community norms after the exposure to the scientific information, as compared to the discussion condition.

Another possibility is that the discussion was insufficiently long to take the groups to an agreement stage. According to Meleady et al. (2013), group discussions in contexts requiring cooperation proceed through a number of stages, from problem orientation, to conflict, to consensus development and norm interiorization. It is possible that in the present study most groups did not have enough time to reach the consensus stage. If this was the case, a lack of consensus would also

undermine trust, a sense of shared understanding, group identification, and collective efficacy. Future research could test this possibility by recording discussion content to trace group progression through the above stages and exploring whether extending the discussion time strengthens perceived collective norms.

Overall, however, the results suggest that, in the present context, an exposure to scientific information is at least as effective as a relatively short group discussion focused on the same topic, and that the former approach may be motivating by creating a perception of group norms supportive of sustainable action. To interpret these findings, it is important to take into account two contextual features. First, Maasai communities have a very good understanding of the seriousness of the soil erosion problem and generally welcome external expert opinion and advice. There is also a lot of respect for education and expertise in general (Rabinovich et al., 2019). This could play a role in the positive response to the science narrative and provide a ground for participants' assumption that other group members took the information on board (resulting in stronger perception of group norms). Second, as described above, erosion of the pasture land is a relatively contentious topic in the present context, and some level of disagreement could be expected. This could have undermined positive effects of the group discussion. Such contextual features could be an important consideration when making decisions about an impact approach in applied settings.

7.1. Strengths, limitations, and directions for future research

A crucial strength of the present study is using an experimental method (which allows to compare the selected impact approaches), while maintaining high external validity. The latter is achieved by conducting the research in an applied setting, where the target issue is of high importance to the participating communities. The study responds to the calls to take experimental research on cooperation outside of the lab and to explore predictors of cooperation in applied settings (e.g., Van Lange, Joireman, Parks, & van Dijk, 2013). Perhaps most importantly, we rise to this challenge by working with a population of the type that is strongly under-represented in the research on the topic (a marginalized population within a non-Western low-income country). By working with pastoralist communities in Tanzania, we are giving voice to an under-represented population, as well as extending our knowledge about encouraging cooperation by testing it in a fundamentally new context.

Despite the above strengths, the present research has a number of limitations. First, it could be suggested that there was some degree of discrepancy between the science narrative used and the outcome measures: The narrative focused on describing the causes and processes of soil erosion, while the outcome measures were concerned with actions aimed at mitigating it. We aimed to avoid a directive approach that imposes specific solutions on participating communities without sufficient inclusion of local expertise and concerns – for this reason, direct action recommendations were not included in the science narrative. However, it is possible that the effectiveness of the information deficit approach could have been higher if it included direct references to recommended actions. A similar consideration applies to the discussion-based approach: In the present study, participants were asked to discuss how soil erosion comes about rather than focus on possible solutions. It is possible that an explicit emphasis on action could have streamlined the discussion and led to stronger perceived unity and efficacy. Future research could test these possibilities by comparing impact of science narratives with and without suggestions for action against impact of a group discussion with a focus on either causes of soil erosion or mitigation measures.

Another limitation is that the discussion-based approach may not have provided participants with a sufficient knowledge base for discussing the topic most productively. Although the emphasis in the social identity approach to behaviour change is on norms development through intra-group interaction, it would be important that participants come into these interactions equipped with sufficient knowledge of the problem, that would enable them to develop consensus around effective solutions. It could be suggested then that the most productive avenue for future research is combining the two approaches tested here. Future studies could test the effectiveness of an impact approach where exposure to scientific information is followed by a group discussion focused on solutions.

Finally, it would be useful to disentangle effects of group interaction in general from effects of discussing a specific topic. If we had observed the expected effects of the discussion condition in the present study, these could have been explained either by participants discussing the soil erosion issues, or by participants engaging in a group discussion in general, irrespective of its topic. It would also be useful to assess effects of the selected impact approaches against a baseline, in addition to each other. Future studies should include relevant control conditions to address these limitations.

8. Conclusion

The present research is the first attempt, to our knowledge, to empirically compare effectiveness of the two impact approaches based on different theoretical models in an applied context of pastoralist land management. The findings suggest that the approach focused on providing participants with clear scientific information may result in stronger perceptions of land protective community norms and, indirectly, stronger intentions to mitigate soil erosion, than the group discussion approach based on the social identity framework. In line with the previous research in the pastoralist land management context, the analysis also supports the central role of community norms in mediating the observed effects on intentions to protect the land. These results, however, have to be interpreted with caution, bearing in mind the limitation of a restricted discussion length and its focus on causes of erosion, as opposed to solutions. Future research could test effectiveness of a combined approach to encouraging mitigating action on soil erosion that would integrate exposure to scientific information with a group discussion of possible solutions.

Author statement

Anna Rabinovich: Conceptualization, Methodology, Investigation, Formal analysis, Writing – Original Draft, Writing – Review and Editing, Supervision, Funding acquisition. **Vladimir Zhischenko**: Investigation, Data Curation, Project administration, Supervision. **Mona Nasseri**: Methodology, Visualization, Investigation. **Stacey Heath**: Methodology. **Alpha Laizer**: Investigation, Data Curation. **Francis Mkilema**: Investigation. **Aloyce Patrick**: Investigation. **Maarten Wynants**: Resources. **William H. Blake**: Resources, Funding acquisition. **Kelvin Mtei**: Supervision, Project administration. **Patrick Ndakidemi**: Funding acquisition, Supervision.

Notes

1. A possibility should be acknowledged that when a discussion concerns a contentious issue (where opinions about causes of a problem and preferred solutions are heterogenous), it may bring differences of opinion into light, leading to reduced perceived agreement.
2. Participants also completed a number of measures that are not analysed in the present paper: Perceived threat, perceived causes of soil erosion, perceived effectiveness of various measures to reduce erosion, trust in experts, and perceived need for change.
3. The four control variables (age, gender, land ownership, communal land use) were chosen ad-hoc because they are likely to affect motivation to protect shared land. In the Maasai communities, there are considerable gender and age differences in land use. In particular, women are normally not involved in cattle grazing, and hence make limited use of communal pasture land. Similarly, the youth are

less likely to have their own cattle and to use communal land for grazing it. Consequently, the importance of communal land and its health may have different value for different age and gender groups. Similarly, land ownership and communal land use have direct implications for motivation to protect shared land (i.e., land ownership may reduce reliance on shared land, while communal land use enhances its importance).

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Appendix A. Supplementary data

Supplementary data related to this article can be found at https://doi.org/10.1016/j.jenvp.2022.101885.

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