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March 2019

Governance

International Initiative for Impact Evaluation

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Suggested citation: Armand, A, Costa, AI, Coutts, A, Vicente, P and Vilela, I, 2019. *Using information to break the political resource curse in natural gas management in Mozambique,* 3ie Impact Evaluation Report 93. New Delhi: International Initiative for Impact Evaluation (3ie). Available at: https://doi.org/10.23846/TW8IE93

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Acknowledgements

Many have contributed to the success of this report. In particular, we would like to acknowledge the inspiring leadership of Imamo Mussa throughout different stages of the project, as well as the overall support of the Ministry of Science and Education of Cabo Delgado, without which this report would not have been possible.

In addition, we are grateful for the support of:
- all the enumerators and supervisors who have spent countless hours working in the field;
- all the administrators and local leaders of the areas where we worked, without whose permission the project would not have run so smoothly;
- Benedita Carvalho, Ana Costa, Henrique Pita Barros, Matteo Ruzzante and Alexander Wisse for their precious and highly motivated assistance during the fieldwork;
- the Aga Khan Foundation for providing a logistical base of operations for the project; and
- Lúrio University for its partnership and collaboration.

Without the contribution of all of the above, the success of this report would not have been possible.

Summary

Mozambique has discovered substantial natural resources in recent years, drawing a considerable amount of enthusiasm from international players. The US Energy Information Administration had named it 'one of the most promising countries in Africa in terms of natural gas and coal resources'. Yet, as a recent democracy with relatively weak institutions and limited media independence, Mozambique faces a considerable risk of mismanagement of resources and revenue.

In this context, it is crucial to understand the roots of the 'resource curse' – the frequently observed decrease in income following a resource boom. The resource curse is often linked to political economy mechanisms. Two prominent channels are generalised movements towards rent-seeking (decentralised) and the deterioration of public policies by corrupt politicians (centralised). In this report, we study the near-immediate and short-term impacts of a large-scale information campaign on the relative importance of these theories in explaining local communities' behaviour following a newly discovered natural resource extraction site.

We focus on the case of Mozambique, where a substantial discovery of natural gas recently occurred in the Rovuma Basin. The area is off the country's northern coast, in the northern province of Cabo Delgado. The province is characterised by a significant number of natural resources and shares a number of demographic and political features not only with the rest of Mozambique, but also with other countries that remain primarily rural and stand to change dramatically with newly exploited natural resources. In this sense, research in this context is extremely valuable for providing policy lessons that can be applied to many other countries.

We employ a large-scale randomised field experiment, conducted in 206 communities of northern Mozambique after the natural gas discovery in the Rovuma Basin, which has been labelled as the world's largest in many years. We follow the dissemination of information about the management of natural resources at the community level. We designed three community-level interventions: in the first, an information module was delivered only to local leaders; in the second, it was delivered to local leaders and citizens; and in the third, the information module targeting leaders and citizens was accompanied by the organisation of deliberation meetings by citizens, where public policy priorities for the community were discussed in relation to the future windfall from natural gas.

Communities were randomly chosen to receive one of these interventions or no intervention at all. Random allocation of communities to different groups guarantees that each group is statistically identical ex ante. We performed extensive analysis to check that the randomisation procedure achieved a good balance on a wide series of household and village characteristics.

Using a baseline survey collected in 2016, we observed that despite the availability of different media (radio, and family and friends) for learning about the news of the province, villagers in Cabo Delgado lacked information about natural resources and about the discovery of natural gas. Knowledge about the discovery was found to be closely related to demographic characteristics: women, younger individuals, less

educated household heads, individuals living in smaller households and lower-income individuals had a lower probability of being aware of the discovery.

Following the baseline survey and for the purpose of establishing the impact of the different interventions, the project introduced an innovative set of measurements of outcomes related to community members' and local elites' behaviour, by measuring a variety of outcomes through surveys, behavioural activities or structured community activities, following Casey and colleagues (2012), and lab-in-the-field experiments. Behaviour measurements are central outcomes in the study, since observed behaviour can provide fundamental improvements compared to stated preference-type results from survey data.

We group our outcome measures in four sets: information/awareness outcomes on natural resources; elite capture (by local leaders); rent-seeking by leaders and citizens; and mobilisation, trust and demand for political accountability by citizens. We find evidence that the community-targeted information campaign was effective in raising citizens' awareness and knowledge about the natural gas discovery. Citizens become optimistic regarding the future benefits of the discovery for their communities and households.

Importantly, we identify impacts on increasing elite capture when information is given only to local leaders. This appears in terms of leaders' attitudes in favour of corruption, misuse of funds for public purposes and less meritocratic appointments of community members for public service. We also observe increases in rent-seeking activities by citizens when information is given only to leaders. This emerges for reported contacts with influential people, and in bidding for meetings with district administrators. These may denote movements by those close to leaders, consistent with the effects on elite capture.

Finally, we report that community-level treatments increased citizen mobilisation, trust at different levels, voice and accountability at different levels, and decreased the likelihood of violence. We conclude that our patterns of effects are more consistent with a 'curse' mechanism centred on politicians' misbehaviour, possibly countered by improvements in accountability, than one based on generalised movements towards rent-seeking.

These results are relevant for policymakers dealing with the management of newly discovered natural resources for two main reasons. First, we show that a large-scale information campaign can be effective at raising awareness in the population about a resource discovery and its related management debates. Second, we report clear effects on trust in government at different levels, as well as on decreasing violence.

These findings are of crucial importance in the face of the known association of the resource curse with localised conflict in resource-producing areas. The appropriate management of expectations of the local population and the implementation of inclusive deliberation processes as resource exploration unfolds may be a key to escaping the emergence of localised conflict. Information campaigns like the one we study here can be seen as a central piece of those efforts.

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Abbreviations and acronyms

GDP Gross domestic product

ICC   Intra-cluster correlation

MDE Minimum detectable effect

NGO Non-governmental organisation

OLS   Ordinary least squares

SCA   Structured community activity

1. Introduction

Since Adam Smith's *Wealth of Nations*, which contains a number of unfavourable references to mining activities, economists have been wary of potential problems arising from the exploration of natural resources. Gelb (1988) and Auty (1993) were the first to propose the term 'resource curse'; both looked at mineral windfalls and presented a series of case studies from a macroeconomic perspective, with a strong emphasis on the contraction of traded sectors, i.e. Dutch disease.

Then, in the 1990s, African countries such as Nigeria, Angola and Sierra Leone, rich in oil and diamonds, became prominent cases. These cases contributed to the argument in the cross-country empirical literature that the resource curse also related to political economy mechanisms involving widespread corruption (Treisman 2000) and civil conflict (Collier and Hoeffler 2004).

In this report, we focus on political economy mechanisms of the resource curse. We consider effects in the face of news regarding the discovery of resources – i.e. the anticipation of a major resource windfall – and distinguish between two prominent mechanisms. One predicts that a generalised movement towards rent-seeking will emerge in the economy, at the expense of more productive activities (Tornell and Lane 1999; Baland and Francois 2000; Torvik 2002). The other anticipates that after news of the resource discovery, politicians will be more interested in securing political power and, as a consequence, will engage in corruption and inefficient policies such as clientelism (Robinson et al. 2006), with negative consequences for the economy.

Although the first mechanism does not explicitly mention politicians, the second puts them at the centre of action. We endeavour to distinguish between these political economy mechanisms of the resource curse by analysing reactions to a resource discovery at the local level. We are particularly interested in observing the behaviour of local politicians.

We employ a large-scale randomised field experiment conducted in 206 communities in northern Mozambique after a massive discovery of natural gas in the region (in the Rovuma Basin, Cabo Delgado province). This discovery was labelled as the largest worldwide in many years. We follow the dissemination of information about the management of natural resources at the community level. These efforts were sponsored by a large coalition of governmental and non-governmental organisations (NGOs) active in the international, national and local arenas.

In this context, we designed three specific interventions at the community level: in the first, the information module was delivered only to local leaders; in the second, it was delivered to both local leaders and citizens; and in the third, the information module targeting leaders and citizens was accompanied by the organisation of deliberation meetings by citizens, where public policy priorities for the community were discussed in relation to the future windfall from natural gas. In this report, we focus on the near-immediate and short-term impacts of these interventions.

In our experiment, we designed a wide range of measurement instruments, including surveys, behavioural activities or structured community activities (SCAs), following Casey and colleagues (2012), and lab-in-the-field experiments. These are central

outcomes in the study, since observed behaviour can provide fundamental improvements compared to stated preference-type results from survey data. We group our outcome measures in four sets:

- The first set relates to information/awareness outcomes on natural resources. These are based on survey questions administered to local leaders and citizens, for which we typically have both baseline and endline information;
- The second set concerns outcomes depicting elite capture (by local leaders). These centre on behavioural measurements, including SCAs on the use of resources meant for the community (zinc sheets for roof construction, funds for meetings), the appointment of a community taskforce and leader behaviour in a trust game;
- The third set connects to rent-seeking by leaders and citizens. This relies primarily on an SCA eliciting willingness to engage in rent-seeking, with a comparison term related to entrepreneurship, and a novel rent-seeking game; and
- The fourth set links to mobilisation, trust and demand for political accountability by citizens. The outcomes on mobilisation are grounded in survey questions related to social capital, a matching grants SCA, behaviour related to community meetings and a public goods game. The outcomes on trust and accountability are based on survey questions and citizens' behaviour in the trust game.

We find clear positive effects of the community-level treatments on awareness and knowledge about the natural gas discovery. Citizens become optimistic regarding the future benefits of the discovery for their communities and households.

Importantly, we identify impacts on increasing elite capture when information is given to local leaders only. This appears in terms of leaders' attitudes in favour of corruption, misuse of funds for public purposes and less meritocratic appointments of community members for public service. For instance, we find 29 percentage points of leakage on leader funds for a community activity. We also observe increases in rent-seeking activities by citizens when information is given only to leaders only. This emerges not only for reported contacts with influential people, but also in the bidding for meetings with district administrators. These may denote movements by those close to leaders, consistently with the effects on elite capture.

Finally, we find that community-level treatments increased citizen mobilisation, trust at different levels, and voice and accountability at different levels, and decreased the likelihood of violence. We conclude that our patterns of effects are more consistent with a curse mechanism centred on politician misbehaviour, possibly countered by improvements in accountability, than one based on generalised movements towards rent-seeking.

Our study relates to the vast literature on the natural resource curse, defined by Caselli and Cunningham (2009) as a decrease in income following a resource boom. The theory of Dutch disease was one of the first put forward to explain the resource curse. It proposed that resource booms shift inputs away from manufacturing (towards non-tradeable goods) and, subsequently, to a curse through negative knowledge externalities in manufacturing. These ideas date to at least Corden and Neary (1982). Our empirical knowledge of the resource curse is more recent. Sachs and Warner (1999) were the first

to identify a negative relationship between gross domestic product (GDP) growth and exports of natural resources in cross-country data.

Several related models of the resource curse have been proposed that identify the resource curse with an increased propensity for rent-seeking. Tornell and Lane (1999) suggest that a windfall can increase interest group capture of fiscal redistribution; lower growth can follow through a move towards the (inefficient) informal sector. Baland and Francois (2000) propose a multiple equilibrium framework, in which a resource boom could lead to more rent-seeking (instead of entrepreneurship), depending on the initial equilibrium. Torvik (2002) introduces a simple model with rent-seeking and entrepreneurship and argues that, with a demand externality, a resource boom leads to lower welfare. This is generally the case for this family of models and for models of Dutch disease; an externality needs to be assumed to explain the resource curse.

More recently, Mehlum and colleagues (2006) showed that the negative relationship encountered by Sachs and Warner (1999) only held for countries with low-quality institutions. Building on this finding, Robinson and colleagues (2006) proposed a new theory of the resource curse based on a political mechanism: in face of a resource discovery and when institutional quality is poor, namely, in terms of political accountability, politicians are likely to enact inefficient policies that increase the likelihood that they remain in power (and benefit from resource rents). Vicente (2010) tests this assertion more specifically than Mehlum and colleagues by analysing patterns of change in perceived corruption after an oil discovery in the island country of São Tomé and Príncipe. He finds that vote buying increased significantly after that discovery, using Cape Verde as a control group.

More recent empirical work has been devoted to understanding specific settings where natural resources are being explored. The case of oil in Brazil has inspired a number of contributions. Caselli and Michaels (2013) analyse impacts of oil on the structure of local income at the municipality level and find no evidence of the resource curse. However, they find no significant changes in the quality of public good provision either, despite major increases in the revenues of local governments. Brollo and colleagues (2013) study the effect of these additional revenues on political corruption and on the quality of politicians. They show that larger transfers increase observed corruption and result in less educated mayoral candidates. In the context of Peru, Aragón and Rud (2013) examine the local impact of a large gold mine and find evidence of a positive effect of the mining sector's demand for local inputs on real income.

Closely related to our experiment in Mozambique are three other contributions. First, our information and deliberation campaign is inspired by the model of Humphreys and colleagues (2006), who were the first to implement a large-scale deliberative exercise related to the management of natural resources, with the Earth Institute at Columbia University, in São Tomé and Príncipe in 2004. Second, we are endowed with some knowledge about the impact of large-scale civic education campaigns in Mozambique through the work of Aker and colleagues (2017) on political participation. Finally, recent work by Toews and Vezina (2016) shows positive impacts, namely in terms of job creation, of resource-induced foreign direct investment in Mozambique, while employing household and firm-level data.

2. Intervention, theory of change and research hypotheses

2.1 The intervention

The intervention we are evaluating consists of a large information and deliberation campaign about the management of natural resources in the province of Cabo Delgado, focusing on recent natural gas discoveries. A large coalition of international, national and local institutions – both governmental and non-governmental – sponsored the campaign. This group included the provincial government of Cabo Delgado, the Aga Khan Foundation, an international NGO with a strong presence in Cabo Delgado province, the Mozambican chapter of the Extractive Industry Transparency Initiative, two prominent national NGOs (the Christian Council and the Islamic Council of Mozambique), one university (the Catholic University of Mozambique), one newspaper (@Verdade) and two local NGOs (UPC, the provincial farmers' union, and ASPACADE, the provincial association of paralegals). In collaboration with our partners, the information and deliberation campaign was submitted at the community level.

There were three types of campaigns. The first group of communities (Treatment 1 – information to leaders) had the information module about natural resources and its management provided only to the village leaders. In Mozambique, these individuals are well-respected community figures. We targeted the higher-ranked representative of the government in each community. In rural communities, these are known as village chiefs (*chefes de aldeia*) and in urban settlements as neighbourhood chiefs (*secretarios de bairro*). The community typically elects both types of leader, although the ruling party can strongly influence such outcome. Their main competencies relate to conflict resolution, land allocation and formal ceremonies. They also influence the allocation of aid, employment and public programs, such as government funding for small-scale entrepreneurs ('7 milhes' rural development program).

The other groups of communities were as follows. The second group of communities (Treatment 2 – information to leaders and citizens) had the information about natural resources and its management provided to leaders and citizens. Community meetings and door-to-door contact were implemented for this purpose in each community. The third group of communities (Treatment 3 – information to leaders and citizens, plus deliberation) had the same intervention as communities in Treatment 2 plus a deliberation module. This module started with the formation of small citizen committees of around 10 people. Each group was invited to meet and deliberate on priorities for the local spending of natural resource revenues.

The campaign began by defining natural resources and the legal rights of the population (various laws related to land, mines, forests and fishing). This was a pre-condition for understanding, as the concept of natural resources was not present in many communities. The information package then gave details about the discovery of natural gas in Cabo Delgado, including plans for exploration and the implications for communities. The final content was discussed and approved by all sponsoring organisations involved in the project in order to guarantee widespread support and maintain neutrality.[1] Importantly, the information provided underlined the expected size

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[1] The full information manual (in Portuguese) is presented in online Appendix C.

of the natural gas windfall, with significant positive implications for provincial government revenues and job creation.

Due to the low level of literacy in our context, treatments in this experiment focus on verbal communication methods to deliver information:

- Explanation in local language of the information content by trained facilitators. This was done either individually, targeting leaders, or in the context of community meetings (for treatments 2 and 3);
- Live presentation of a community theatre, played by a team of three actors. The play represented a traditional family discussing the management of natural resources after hearing the news about the discovery of natural gas on the radio. The script was written by a local theatre company, in collaboration with the research team, and was meant to communicate the contents of the information package in an informal manner[2]; and
- Distribution of a tri-fold pamphlet, designed in collaboration with a local artist. The pamphlet is predominantly visual and contains the main messages of the information package. It was hand-delivered in each treatment community to the leader (for treatment groups 1, 2 and 3) and to the community members (for treatment groups 2 and 3).

2.2 Theory of change

The central assumption behind our theory of change is that if constituents were better informed about the inner workings of extractives governance and had ways to deliberate publicly, then they would identify and communicate grievances, make claims on the relevant institutions and demand better development and use of resources. The ability to undertake public deliberation is likely to be a crucial element of the mechanism for change we plan to document in this study.

Our theory of change (Figure 1) begins with the discovery of a large amount of a natural resource with the potential for large revenues. From this starting point, the proposed causal pathway begins with an intervention consisting of information distribution in areas affected by resource extraction. Assuming that communities have heterogeneous and incomplete information about natural resource revenues is a reasonable assumption in a country such as Mozambique, where corruption is high and the quality of governance of natural resources is low. Whether communities use benefits from natural resources properly and end up on a positive path, with investment of windfalls in activities that maximise social welfare, or in a vicious cycle, with rent-seeking activities and corruption, depends to a great extent on the interaction between leaders and citizens in a given community.

In the status quo, we assume citizens are uninformed and that information is available to the local elite, who have greater access to information and use it to capture rents. We study the effect of the provision of information about the discovery of the natural resource at different levels: (1) information is provided only to local leaders; (2) in addition to local leaders, information is provided to citizens; and (3) in addition to

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[2] The script of the theater (in Portuguese) is presented in online Appendix D.

information provided to leaders and citizens, a public deliberation is organised to discuss the use of future revenues derived from the exploitation of the natural resource.

The hypothesised primary effect of this intervention is increased awareness and literacy in matters of natural resource development amongst the recipients of the information campaign. Compared to information targeted at leaders only, a campaign that also targets citizens will increase awareness in both groups. When information delivery is restricted to the leaders, citizens could become aware of the discovery if the local elite decide to share the information with them, whereas they might remain unaware if the local elite decide to keep the information private.

Figure 1: Theory of change
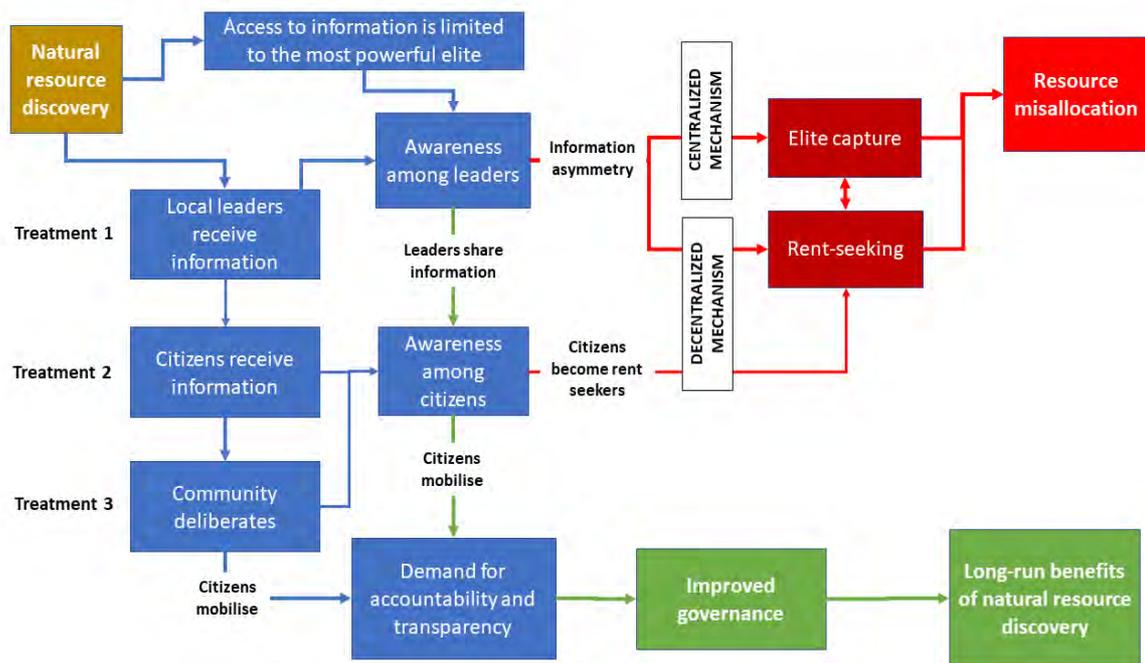
Note: We represent positive outcomes in green and negative outcomes in red.

Our interest in information campaigns presupposes two factors needed to make it viable. The central assertion is that individuals and households have an interest in understanding issues related to the management of natural resources. We also assume sufficient households and leaders are literate and able to effectively process the information they receive on this topic. We expect that information provided with deliberation mechanisms can increase the willingness of common citizens to contribute to the public good or to increase the sense of social cohesion of these communities. Information alone is unlikely to lead to an improved sense of the common good. Still, we test both possibilities by running public good games as measurement instruments for the full sample in our study (Section 4.2).

Private information amongst the elite allows leaders to take advantage of information asymmetries by increasing rent-seeking behaviour and elite capture. Instead, observing the currently high level of opacity in the extractive sector in Mozambique, increased awareness amongst citizens can yield an increased and sustained demand for accountability and transparency, such that the resources benefit communities.

This demand should ultimately translate to improved accountability and transparency, based on politicians' need to be re-elected or be reappointed. Finally, transparency and accountability will improve natural resource governance as elected and appointed leaders more consistently maximise the social utility of public resources.

In our theory of change, the transformation of increased awareness and literacy on the issue into greater demand for transparency is founded on two hypotheses about political participation in Mozambique. The first and stronger hypothesis is that individuals receiving the treatment have established means of making claims on government institutions and officials (local leaders). The second and weaker hypothesis is that, armed with the deliberation mechanism provided in one of the treatment arms, they would be able to make the claims on local leaders.

The link between communities' engagement (through information and deliberative meetings) with national policy is made through sustained, bottom-up pressure from citizens and civil society groups, and through voting. To some extent, national leaders and political representatives are ultimately vulnerable in face of a public that is engaged and interested in the issue. The information to be channelled to the population in our study has a strong local dimension: it includes details of the timing and sequence of the extraction of natural gas in the Rovuma Basin, government and private stakeholders' plans for building new infrastructure in the region, a redistribution plan for public revenues at the local level and intended corporate social responsibility initiatives by the natural gas multinationals in the region. Even though our experimental design is not suited to analyse the national impact of the interventions we study, we are able to qualitatively assess this impact.

Based on an increased demand for transparency from a more informed public, we expect that transparency and accountability increase. This result is founded on the inherent vulnerability of a politician or a bureaucrat in the face of an engaged public. An individual in such a position who wishes to maintain their office, reputation or authority will respond, at least in part, to constituents' demands for better resource management. This station in our theory of change may be problematic when considering some cases, as politicians in highly centralised, one-party or autocratic governments may not derive authority from a public vote, and therefore have little personal interest in what the public demands. In Mozambique, this is relevant although not critical; the multi-party voting system remains semi-democratic, despite high levels of corruption.

To support our assumption, the link between demand for transparency from a more informed public is supported by the fact that local communities' demand for information about natural resource management is expected to be high. We do not have direct evidence on Cabo Delgado communities' receptivity to information on the extractive industry, as no specific survey is available. However, in the 2014 Gas Master Plan, the government of Mozambique identifies community-level provision of information and the management of expectations as one of the pillars of the plan. The fact that the government is emphasising the importance of informed communities in a strategic document supports the potential and centrality of demand for information about revenue expenditures in affected communities such as Cabo Delgado. This demand is expected to become more salient along with the development of the sector, as socio-economic impacts are usually stronger near the area of exploitation (Aragon et al. 2015).

Another study provides support for the large potential of information demand following the discovery of a new natural resource. Humphreys and colleagues (2006) report on a national forum conducted in São Tomé and Príncipe after an important oil discovery. This forum consisted of community meetings throughout the country on the management of natural resources, with a strong deliberation aspect. Approximately 3,500 citizens participated in these meetings (about 2.2% of the population). Personnel of The Earth Institute at Columbia University, with institutional support from the government, organised the meetings. We expect a similar adherence to our interventions in Mozambique.

Aware citizens can also produce an opposite effect. Expecting large returns from the discovery of the natural resource, citizens might deviate resources from productive activities and become rent-seekers in order to obtain benefits from the exploitation of the natural resource. This would lead to increased rent-seeking in the communities and, ultimately, to resource misallocation.

In the scenario where on top of information, community members also have deliberation power, the leader would have limited ability to misallocate resources as citizens deliberate. In this case, the disincentives to rent-seeking behaviour are expected to be higher than the incentive for a more transparent management, where everybody would benefit. However, deliberation processes could still be subject to elite capture, as Humphreys and colleagues (2006) show in the context of the oil boom in São Tomé and Príncipe.

Figure 2 presents a mapping of the outcomes covered in this study, distinguishing between outcomes for leaders and outcomes for citizens.

Figure 2: Mapping of outcomes
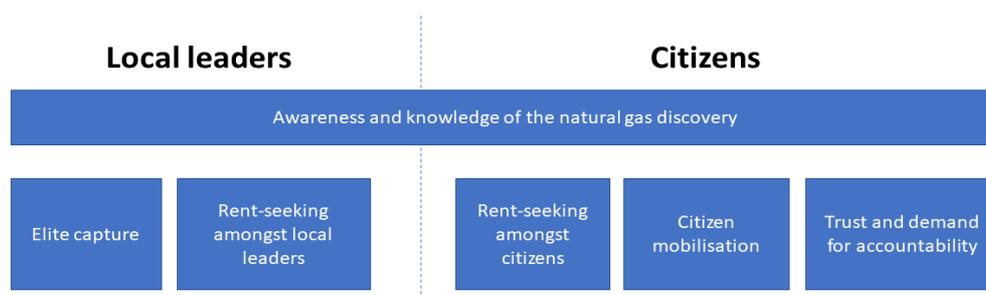
2.3 Hypotheses

Given our theory of change, this study aims to understand the causes leading from a natural resource discovery to the resource misallocation outcome. Following Caselli and Cunningham (2009), we distinguish between centralised and decentralised political economy theories of the natural resource curse. Centralised theories focus on the local elite as the centre of action: when faced with a permanent resource boom, under low institutional quality, they distort allocations to increase the probability of staying in power (Robinson et al. 2006). In this case, resource misallocation is led by local elite behaviour. Decentralised theories relate to generalised movements towards rent-seeking activities, with negative consequences for entrepreneurship and the productive sector (Torvik 2002). In this case, resource misallocation is led by citizens, increasing their rent-seeking.

Our main hypotheses are as follows:

1. *Information on natural resources will affect the elite's provision of public goods and investment in political connections.* Where Treatment 1 is implemented – i.e. where information about a future windfall reaches leaders only and eventually flows from these individuals – we expect elite capture and rent-seeking by leaders to increase as a way to cement local power (politicians distort allocations – centralised mechanism).

2. *Citizens' information on natural resources will affect levels of social cohesion, trust and political accountability in the community.* In a centralised mechanism, treatments 2 and 3 are expected to induce higher levels of citizen mobilisation. It is also expected that Treatment 3 will lead to more citizen mobilisation than Treatment 2 in face of the additional deliberation module.

3. *Citizens' information on natural resources will affect rent-seeking behaviour by citizens.* In a centralised mechanism, treatments 2 and 3 are not expected to increase elite capture or rent-seeking by leaders and citizens, provided higher levels of local accountability. In a decentralised mechanism, we would expect a generalised increase in rent-seeking. Since all treatments include information about a future windfall, all are expected to result in increased rent-seeking by leaders and citizens. Increases in elite capture could accompany this generalised increase in rent-seeking, since capture and rent-seeking by leaders overlap in most real examples.

4. *Citizens' information on natural resources will affect citizens' political participation.* In a centralised mechanism, treatments 2 and 3 are expected to induce higher levels of citizen mobilisation. In a decentralised mechanism, we do not expect clear effects on citizen mobilisation, since politics are not explicitly important.

5. *Elites' information on natural resources will affect citizens' behaviour in 3-5.* In a centralised mechanism, rent-seeking activities by citizens could also increase as a consequence of Treatment 1, as leaders induce movements in linked individuals.

6. *Giving deliberation power to the citizens will affect elites' provision of public goods and investment in political connections, levels of social cohesion, trust and political accountability in the community, rent-seeking behaviour by citizens and citizens' political participation.* In a centralised mechanism, treatments 2 and 3 are expected to induce higher levels of citizen mobilisation, whereas Treatment 3 would lead to more citizen mobilisation than Treatment 2 in face of the additional deliberation module.

3. Context

The northern province of Cabo Delgado, Mozambique, is characterised by significant reserves of natural resources, particularly the natural gas at the Rovuma Basin, which remains to be extracted. The majority of the country's labour force is engaged in agriculture activities, with 81 per cent of the population reporting agriculture as their main occupation.

Cabo Delgado province is in line with the national average for several demographic and socio-economic characteristics. It has 1.8 million inhabitants and, on average, 22.15

inhabitants per square kilometre (National Statistics Office 2013). The province experiences a poverty rate of 37.4 per cent and a child mortality of 180 per 1,000 births, slightly higher than the national average (United Nations 2010).

Mozambique shares a number of similarities with several other countries in the African continent, in terms of characteristics of the economy, quality of institutions, and recent discovery of natural resources. While Mozambique has found some of the largest natural gas deposits, Tanzania, Uganda and Kenya have also recently discovered gas and oil reserves. Similar to Mozambique, these countries share relatively weak institutions and low political accountability. Table 1 presents a comparison on different indicators.

The corruption index shows that these countries face similarly weak institutions. On average, Mozambique is poorer and has higher infant mortality, lower life expectancy and a lower literacy rate. Importantly, these countries have in common a small contribution to GDP from extractives. However, they also share the expectation that this contribution will rise sharply in the coming years.

Table 1: A comparison between Mozambique and other African countries

Indicator	Mozambique	Tanzania	Uganda	Kenya
Corruption index position 2015, Transparency International	119/175	119/175	142/175	145/175
GDP (PPP) per capita US$, 2014, International Monetary Fund	1,174	2,667	2,023	3,084
Population 2010, World Bank	23.4 million	44.8 million	33.4 million	40.5 million
GDP US$, 2010, World Bank	9.59 billion	23.1 billion	17.0 billion	31.41 billion
Infant mortality rate (per 1000) 2010, World Bank	92.2	50.0	63.0	55.1
Life expectancy 2009, World Bank	49.28 years	56.59 years	53.07 years	55.84 years
Literacy rate 2009, World Bank	55.1%	72.9%	72.2%	87%
Total natural resource rents as % of GDP 2011, World Bank	12.5%	9.6%	13.9%	3.4%

Note: PPP stands for Purchasing power parity.

4. Evaluation: design, methods and implementation

4.1 Sampling and randomisation

We studied a sample of 206 communities. These communities were randomly drawn from the list of polling locations in the province of Cabo Delgado that were present during the 2009 and the 2014 general elections[3] and had more than the number of voters

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[3] Fifty-four polling locations across the two elections were dropped because they did not operate in both elections.

corresponding to the fifth percentile of that distribution (207 voters per polling location). The polling locations were located in 16 districts – Ancuabe, Balama, Chiure, Macomia, Mecufi, Meluco, Metuge, Mocimboa da Praia, Montepuez, Mueda, Muidumbe, Namuno, Nangade, Palma, Pemba and Quissanga.[4]

Our final sampling frame comprised 421 polling locations, with 14 in urban areas and 39 in semi-urban areas. Figure 3 presents the sampling procedure we followed for communities and participants.

Figure 3: Flow chart for the sampling procedure
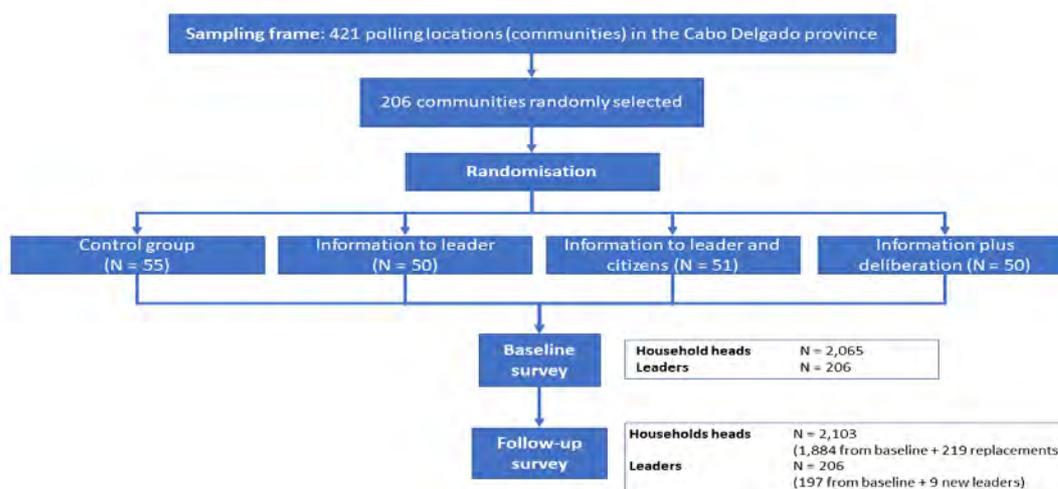
We stratified the sampled communities by the two urban areas (Pemba and Montepuez), semi-urban communities (i.e. the main *posto administrative*, or administrative seat, in each district) and rural communities. Since we aimed for a sample of 200 communities, in urban strata, we selected eight polling locations in Pemba and four in Montepuez; in semi-urban strata, we selected two polling stations per town (or one, if only one was available); the remaining 165 stations were sampled from all other polling stations. We then built blocks of four communities using m-distance (Mahalanobis) relative proximity. To construct m-distances, we made use of the richness of the baseline information we have, including household, leader and community characteristics.

After forming blocks of similar communities, we randomly allocated each community in a block to one of the treatment groups or to a control group, which had no information or deliberation campaigning. Each one of the four possibilities had the same probability, and we made sure each block had the four possibilities. To limit the risk of treatment contagion to other groups, at the end of this procedure we computed the minimum distance from each community to a community in a different group. If two or more communities were closer than 3 kilometres, were control versus any treatment or 'information to leaders' (Treatment 1) versus 'information to leaders and citizens' with and without deliberation (treatments 2 and 3) and were rural, then we selected at random one of these equidistant communities and reassigned the same group to the others.

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[4] These districts represent all but one district of Cabo Delgado, Ibo, excluded because it is an island. We also excluded two polling stations in another island and the 11 polling locations in Palma's *posto administrative* (administrative seat). The reason for the latter is to avoid areas that have been subject of recent violence related to the discovery of natural gas.

We ended up with 50 communities for Treatment 1, 51 communities for Treatment 2, 50 communities for Treatment 3 and 55 communities for the control group. Disparities between the groups are due to the fact that we included nine substitute communities. Results are robust to the exclusion of these substitute locations. Figure 4 presents the geographical area selected for the study.

Sampling of citizens within communities was the product of random walks during the baseline survey. Enumerators were told to select houses by departing in different directions from the centre of the community, as defined by the polling location. They were given a sampling interval for each community, which was a function of the number of registered voters in that community. The sampling interval defined the number of houses in between sampled houses. In each house, the heads of households were sampled for survey interviews and behavioural activities. We interviewed 2,065 heads of household in the baseline survey, approximately 10 per community. Post-treatment attrition was handled through substitutions in the same household, when possible.

See Appendix C for descriptive statistics.

Figure 4: Cabo Delgado province
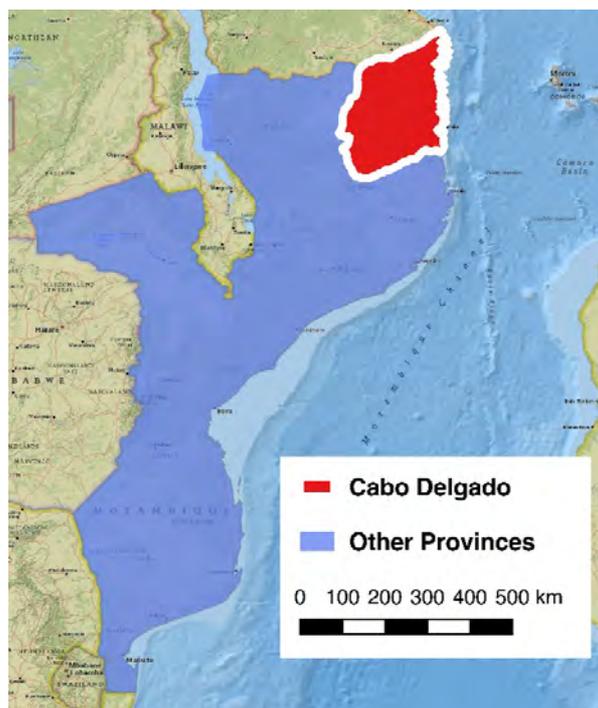
Note: The selected province for the project appears in red. Base map source: ESRI©.

4.2 Measurement

The structure of the measurement in this project included (i) baseline and endline surveys at the household, local leader and community levels, (ii) SCAs aimed at gathering behavioural data (post-treatment) and (iii) the implementation of lab-in-the-field experiments (post-treatment).

Our measurements are such that subjects were aware of being observed. This means that demand or Hawthorne effects – i.e. the possibility that subjects could bias their

behaviour to comply with observer expectations – are difficult to rule out completely in this evaluation. However, we supplement survey-based measurements with behavioural measurements to reduce the risk that survey-based measurements alone could be biased by Hawthorne effects. In fact, behavioural measurements, including lab games and SCAs, incentivise unbiased behaviour, unlike typical survey measurements.

Similarly, John Henry effects – i.e. the possibility that control groups are aware of their condition and could bias behaviour as a consequence – are also minimised by supplementing survey-based measurements with incentivised behavioural measurements. To minimise the risk of John Henry effects, we have also implemented a minimum distance procedure across communities in different treatment groups (Appendix A, Sample design). The use of observed behaviour provides additional support to the stated-preference type of information collected through surveys, which is at higher risk of suffering from different reporting biases.

The baseline data was collected in August and September 2016. Some SCAs were initiated immediately after the treatment activities in March 2017. The endline survey, lab experiments and the completion of SCAs happened in the August–November 2017 period.

We now turn to the details of the design of each type of measurement in this experiment.[5]

4.2.1 Surveys

The household questionnaire was answered by the household head and included questions on the respondents' demographic traits and their households, knowledge relating to natural resources, aspirations, trust, social capital and networks and political views. The leader questionnaire had a similar structure. The community questionnaire included questions on the existence of different types of local infrastructure and natural resources, distance to markets, local associations, community meetings and local political structures. This questionnaire was answered by small groups of (self-selected) community representatives. Most questions in all three questionnaires were present in both baseline and endline.

4.2.2 Structured community activities

These activities followed the nomenclature of Casey and colleagues (2012), who consider SCAs to be 'concrete, real-world scenarios that allow unobtrusive measurement of leader and community decision-making, more objectively than lab experiments, hypothetical vignettes, or surveys'.[6] We divide SCAs between those submitted to local leaders and those submitted to citizens. We implement versions of the three SCAs in Casey and colleagues (2012), as well as some new additions, described below.

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[5] The design of this experiment and corresponding measurements were included in a pre-analysis plan, registered on the American Economic Association Randomized Controlled Trial registry (AEARCTR-0002493).
[6] The SCAs were carefully designed after extensive piloting in the field before the baseline survey.

Leader: zinc roof tiles

In this activity, we endeavoured to measure elite capture of resources. The community leader was given eight zinc roof sheets and told they were 'to be used in a way that benefits the community'. Each zinc sheet was worth approximately 300 meticais, a total value of 2,400 (US$35).[7] The leader was given the zinc sheets in private, as the person representing the community, and the activity was not announced publicly to the rest of the community. Leaders were told they had until the end of August 2017 to use the zinc sheets, otherwise they would be redistributed to other needier communities. A version of this activity is implemented in Casey and colleagues (2012).

During the endline visit to each community, we asked to see each of the zinc sheets and recorded how it was being used. The outcomes of interest involved how the zinc sheet was being used, i.e. for private or public benefit, and the identity and characteristics of the holder of each zinc sheet. We thus interpret the use of the zinc for private purposes as a measure of elite capture.

Leader: funds for meetings

In this SCA, we examine another form of elite capture, i.e. whether leaders appropriated funds that had been set aside to cover food items for the community members during their meetings. Community leaders were given 400 meticais (US$6) and were asked to use the funds to purchase the food items. We observed how many food items were purchased and inquired about the cost of each item at the nearest store. Our main outcomes of interest were the difference between the 400 meticais and the amount spent on food items, i.e. the amount appropriated by the leader.

Leader: appointing a task force

This SCA was intended to measure propensity for favouritism in how leaders chose individuals for specific tasks. In this case, the leader was asked to select five individuals to be submitted to a Raven's test – a nonverbal test used in measuring abstract reasoning and regarded as a means of estimating intelligence, particularly in low-literacy settings. Our version comprised 10 questions, each asking respondents to complete a logical sequence of images.

Leaders were told that, conditional on the performance of the five individuals on the test, they could earn a prize of 1,000 meticais (US$14) for their community. If all five individuals got at least 5 of the 10 questions correct, the prize would be awarded. Leaders were also told that for participating in the activity, each selected individual would receive a 'show-up' bonus of 100 meticais.

Our measurement is thus the performance on the test of the five selected individuals. Additionally, since all surveyed household representatives also took the Raven's test at endline, we have an estimate of the average score for the community. We are thus able to observe a continuous measure of how appropriate the leader's choices were, relative to the community. We also observe basic demographic characteristics of those individuals selected by the leader, as well as their relationship to the leader.

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[7] In our sample, household income at baseline is roughly 4,150 meticais per month.

Leader and community: auctions

In this SCA, we wanted to have a measure of the propensity of both leaders and citizens to engage in potential rent-seeking activities. To get at this question, we conducted an auction that could be for one or two activities. The first activity was a meeting with the district administrator (the main politician at the district level, the administrative level below the province), including lunch and costs of transportation. This activity was thought to provide an environment conducive to possible rent-seeking activities, although there could be other potential benefits. This activity was available to both local leaders and community members.

The second activity related to entrepreneurship and was intended to provide a productive alternative to the first. This activity consisted of a training session on poultry farming (creation and management of a business in this area), including lunch and transportation. Only community members participated in this auction.[8] Each player in these auctions was endowed with 100 meticais. Players asked to bid for both activities, only one of which would later be randomly selected for implementation. Thus, bidders (citizens) had an incentive to bid independently for each of the two activities.

To ensure incentive compatibility of the auctions (i.e. so individuals revealed their true willingness to pay for each activity), the Becker-DeGroot-Marschak mechanism was used. A set of prices was placed in a box and, after the individual had stated their willingness to pay, the actual price was drawn at random. If the willingness to pay was greater than the price, then the individual was forced to purchase the activity at the drawn price. If not, they did not pay anything and did not purchase the activity. This was repeated for the two auctions in the case of community members, with one chosen by the toss of a coin afterwards. All bidders in all auctions were allowed to bid more than 100 meticais, and were told, truthfully, that there could be prices greater than 100 in the box.

The primary outcomes of interest for this activity are the amounts bid in the auction to meet the district administrator and, in the case of community members, the difference in the amount bid for the meeting with the administrator and the entrepreneurial activity.

Community: matching grants

The motivation for this SCA was the measurement of social cohesion and contribution to local public good provision. We gave communities the opportunity to raise funds towards a community objective. Funds were matched at a rate of 50 per cent, up to a maximum of 2,500 meticais (US$35), if the community raised 5,000 meticais or more.

Specifically, we asked communities to form a committee that would raise and hold the individual contributions until August 2017. This committee was offered a book to keep records of the contributions. During the endline visit to the communities, the amounts raised by the communities were verified and the corresponding matching grant was given. This activity was similar to an SCA implemented in Casey and colleagues (2012).

For this matching activity, each community had an official meeting to discuss whether to participate in the activity, and, if yes, which objective the community had for the funds

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[8] The meetings with administrators and the training happened in November and December 2017.

raised under that activity. We therefore collected further behavioural outcomes related to the functioning of the meeting for the matching activity. Each meeting was observed in detail by enumerators, who recorded attendance, characteristics of participants, decisions taken and method of decision-making. The main outcomes of interest for these meetings were participation and whether the meeting was conducted democratically.

4.2.3 Lab-in-the-field experiments

In addition to traditional survey measurements and the SCAs, we conducted a number of lab-in-the-field experiments to further measure behavioural preferences in a controlled framework.

We implemented three types of lab experiments in our intervention: a trust game, a rent-seeking game and a public goods game. The trust and public goods games are fairly standard in the experimental and development literature, while the rent-seeking game is novel. All three games involved the participation of all 10 community members surveyed. The trust and rent-seeking games also included the community leader as a player. The sequence of play was randomized in each community.

Trust game

The trust game involved 10 participants from the community (citizens) and the community leader. The version played corresponds to a standard trust game. Each citizen was given an endowment of 100 meticais in the form of 10 tokens worth 10 meticais each. They had to decide to keep this income for themselves or send a portion to the leader. Funds sent to the leader were tripled. The leader then had to decide how much of this tripled amount to give back to the citizen. For the leaders' decision, we used the strategy method, i.e. we asked the leader to state, for *every* possible amount sent from 1 to 10 tokens (which became 1 to 30), how much they would like to send back to the citizen.

The game also included a punishment option at the end, before any decisions or outcomes were revealed. The punishment option was phrased as follows: 'Imagine the leader sends back less than 50 meticais, after having received 150 meticais. Do you want to punish the leader? Punishment costs 10 meticais and reduces the payoff of the leader by 30 meticais'. All citizens were paid according to the leader's full set of decisions, whereas the leader's payoff was determined by being randomly matched with one individual from the community.

We also elicited beliefs in this game, as citizens were paid 10 meticais each if they correctly estimated the amount the leader would return after having received 150 meticais (corresponding to 50 meticais sent). This trust game measures elite capture from leaders, as well as trust in local leaders and demand for accountability from citizens.

Rent-seeking game

The rent-seeking game is a novel lab-in-the-field experiment. It is intended to measure the willingness to engage in rent-seeking behaviour at the expense of a more productive activity. Participants comprised the 10 citizens and one leader. Each citizen was given an endowment of 10 tokens worth 10 meticais each, for a total of 100 meticais. Next, each citizen had to choose how many of the 10 tokens to send as a 'gift' to the leader

(rent-seeking), with the remaining units 'put aside' (for a productive purpose). The leader had to choose one citizen after observing the behaviour of all of them (the leader never observed the identity of the individuals, only the amounts sent).

For a citizen not chosen by the leader, the units that citizen had sent as a gift accrued to the leader, while the units put aside stayed with the citizen. For a citizen chosen by leader, the leader received the units put aside in addition to the gift sent, and the citizen received a bonus of 300 meticais for being chosen. In other words, the leader received all units sent as gifts, as well as the 'put aside' units of the chosen citizen. Thus, the leader has a dominant strategy, which is to choose the person who has set aside the most funds (the most ambitious entrepreneur). Knowing this, an individual's best response would be to put aside all of their endowments and do no rent-seeking at all.

We also collected belief data in this game, as citizens were asked how they expected the leader to choose. They were asked specifically how many tokens the person the leader chose would put aside. This is equal to 10 (the original amount each citizen received) minus the number of tokens that were sent as a gift to the leader by the chosen person.

Public goods game
The public goods game measures social cohesion and contribution to a common goal. The version we implemented was standard, involving 10 participants from the community and always excluding the leader. Each individual was given an endowment of 100 meticais, in 10 tokens valued at 10 meticais each. They had to decide whether to keep this income for themselves or contribute towards a public account. All contributions in the public account were doubled and divided back equally to all 10 individuals, independently of their individual contribution. Thus, the marginal per capita return to contributing is 0.2, which is on the lower side of public goods experiments.

Belief data was also elicited, as individuals were told one of the other citizens had been selected at random, and that they would receive 10 meticais extra if they correctly guessed the amount that person had contributed.

4.3 Empirical strategy

We adopt standard specifications for the analysis of experiments. Specifically, we employ two types of specifications, depending on the existence of baseline data. We consider outcome variables defined as Y_{ij} (for location j and individual i). Individual i can be a local leader or a citizen. Outcomes defined at the community level are treated in the same way as outcomes defined at the level of the local leader.

The first specification, when baseline data are not available, is:

$$Y_{ij} = \alpha + \beta_1 T1_j + \beta_2 T2_j + \beta_3 T3_j + \gamma Z_j + \delta X_{ij} + \varepsilon_{ij} \tag{1}$$

where $T1_j$, $T2_j$ and $T3_j$ are indicator variables for living in a community in treatment groups 1, 2 and 3; Z_j is a set of location control variables, including strata dummies and community characteristics; X_j is a set of individual characteristics, either for leaders or citizens depending on the outcome at stake; and ε_{ij} is an individual-specific error term, which we cluster at the community level to account for correlated errors within the community.

Community characteristics include district and stratum (rural, semi-urban or urban) indicator variables, an infrastructure index measuring the presence of public goods in the village, presence of natural resources in the village, presence of a market in the village, number of voters (measured by the number of tables at the polling station) and distance to the city of Palma.

The infrastructure index is built by averaging 14 indicator variables for the presence in the village of a kindergarten, a primary school, a lower secondary school, a high school, a health centre, a facilitator, a water pump, a market, a police station, a church, mosque or temple, an amusement area, a room for community activities, and for the access to electricity and to the sewage system.

The presence of natural resources in the village is built by averaging 10 indicator variables for the presence in the community of limestone, marble, sands and rocks, forest resources, ebony and exotic woods, gold, charcoal, graphite, precious and semi-precious stones, mercury, fishing resource, salt and natural gas. When analysing leader-level outcomes, we remove district indicators to avoid collinearity with stratum indicators.

Citizens' characteristics include gender and age of the household head, household size and education, religion and ethnic group indicators, an indicator variable for whether the respondent was born in the village and indicator variables for ownership of a radio and a television. Leaders characteristics include the same variables, but measured at the level of the community leader.

The second specification, when baseline data are available, is:

$$Y_{ijt} = \alpha + \beta_1 T1_{jt} + \beta_2 T2_{jt} + \beta_3 T3_{jt} + \gamma Z_{jt} + \delta X_{ijt} + \theta Y_{ijt-1} + \varepsilon_{ijt} \qquad (2)$$

where Y_{ijt-1} is the baseline value of the dependent variable. McKenzie (2012) supports that this specification maximises statistical power in experiments, if autocorrelations of outcome variables are low. This is arguably the case for most survey outcomes, which are subjective.

In our estimations below, we employ ordinary least squares (OLS) in all regressions, even those with binary outcomes (i.e. linear probability models) and test for the null that the coefficients of each pair of treatments are equal.[9]

5. Programme or policy: design, methods and implementation

5.1 The information package

After collecting the relevant information to share with the communities and before project implementation began, the implementing partners created a manual to guide the intervention. The information distributed included the type of resources discovered, the plans for exploration and the legal rights of the communities involved. The final content of the intervention was discussed and approved by all NGOs and governmental authorities involved in the project in order to guarantee widespread support and

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[9] Results are robust to estimating equations 1 and 2 removing the control variables and controlling only for the strata dummies.

neutrality. Although this is a time-consuming process, we believe it to be a fundamental step for the credibility of the project and to achieve interesting and usable findings for policymakers.

The research team, in collaboration with implementing partners, decided to extend the content of the information dissemination beyond natural gas, to natural resources in general and to other resources present in the province. The reason was that many communities in the sample were identically exposed to the exploitation of other resources, but the concept of natural resources is not present in many communities.

The information package (Figure 5), and the community meetings where the information was provided to the community, was divided into eight sections:

1. *Presentation:* Those holding the meetings in the communities introduced themselves, the implementing partners and the subject of the meeting. This was also a moment for the village leader or any other influential person to explain to the community about the content and objective of the meeting.

2. *Introduction:* In this section, presenters explained that Mozambique is a country with many natural resources; that the natural gas, coal, iron, precious stones and heavy minerals industries are expanding; and that these extractive industries offer potential for investment and creation of wealth. This section also introduced the importance of the natural gas reserves discovered in the Rovuma Basin as, according to the International Monetary Fund, the natural gas industry will account for half of the country's wealth by the 2020s. Data show that the revenues generated by this extraction may heavily influence the future of the Mozambican economy, making Mozambique one of the world's potential gas producers.

3. *Natural resources:* This section included information about the formal definition of a natural resource and the difference between renewables and non-renewables. This explanation was important so the community members would understand that many of their resources, including natural gas, are non-renewables and therefore, sustainable exploration is fundamental. Later, it was explained that sustainable resource management and exploration of resources should benefit present generations in an equitable way, as well as future generations, and should provide economic and social development while considering the environment.

4. *Types of natural resources:* This section presented the types of natural resources with a larger presence and impact in Cabo Delgado: mineral resources, forest resources, fishing resources and natural gas.

5. *Natural gas:* This section presented plans for exploration and transformation of natural gas in the Rovuma Basin in the coming years, followed by an explanation of what natural gas is and how it is used. The teams explained where natural gas had been discovered in Cabo Delgado and when the exploration was planned to start. The presentation also mentioned another province in Mozambique, Inhambane, were natural gas had been discovered in the past, and what lessons could be drawn from that experience.

6. *The importance of natural resources for citizens:* This section described what community members could expect from the exploitation of resources: possible income for families (this is used in regular terms for subsistence), job creation

(formal and informal), increased technical expertise of workers and students who want jobs in the area, the need for extractive companies operating in the communities to be aware of their social responsibility towards the citizens, and that governmental entities should share part of the benefits with the communities affected by the resources (in monetary terms or more indirectly, by investing in the communities' most needed areas).

7. *Practical examples:* After explaining how communities could be involved, the presenters discussed three countries that had discovered natural resources, especially how they were affected by its discovery. Two of the examples were positive (Norway and Botswana), while the third was negative (Nigeria). These examples informed citizens of the desirable and undesirable consequences that can arise from the discovery of natural resources.

8. *Conclusion:* The meeting concluded with a brief review, re-emphasising the main messages. Although community members were allowed to raise questions throughout the meeting, this was usually the time when most people wanted to express their opinions about the topic.

Figure 5: The information flyer

5.2 Community meetings

The community meetings were held by a team of at least three individuals specially trained for the purpose, following the outline of the information package (Section 5.1). Each meeting lasted approximately 60–90 minutes. To ensure those who had attended understood the main messages, the presentation concluded with a 10-minute community theatre production, played by a team of three actors. The play represented a traditional family discussing the management of natural resources after hearing news about the discovery of natural gas on the radio. A local theatre company wrote the script (online Appendix D), in collaboration with our research team. The purpose was to share information in a colloquial way in order to enliven the atmosphere while explaining important matters.

After the play, each person received a flyer summarising information on the main topics (Figure 5), illustrated by a local artist. The flyer uses visuals to present the main messages of the information campaign. It was hand-delivered in each treatment community to the leader (for groups 1, 2 and 3) and to the community members (for groups 2 and 3).

At the end of the meeting, the leader and the 10 baseline respondents were asked to answer a short questionnaire to test their learning.

All the community meetings were implemented without major problems. In general, the community members were very interested in the subject and eager to speak their minds. The team members supervising the meetings were fluent in local dialects, which differed from village to village. On average, 64 people per village attended each community meeting. When asked how they knew that a meeting was going to take place, the majority reported they had received a personal invitation (75.74%) or an invitation from the village leader (19.3%).

5.3 Deliberation treatment

For the communities in the third treatment group, which included the deliberation process, those willing to participate gathered in groups, and the procedure described below was followed.

First, during the community meeting, it was asked which attendants would like to participate in the deliberation. The implementing team explained that the objective of the deliberation was to select three areas needing more investment in their communities, if they were to receive rents from the exploration of natural gas. The results would then be shared with the local government. Then, at least three groups of five people were created, with the number of groups differing according to the total number of people participating in the process. Participants gathered in groups and chose the three main areas.

The voting process was randomly selected from one of three methods:
- Raising hands – after discussing the possible areas, participants voted by raising their hands for the areas they thought were most in need;
- Secret vote – each person secretly voted for the first, second and third areas of interest; or
- Normal method – no restrictions imposed.

One team member explained the process and registered the votes.

6. Timeline

Table 2 presents the timeline of measurements and intervention activities.

Table 2: Timeline of activities

Activity	2016			2017												Year
	8	9	10	11	12	1	2	3	4	5	6	7	8	9	10	11	Month
Baseline survey	██	██	██													
Intervention				██	██	██	██									
SCAs								██	██	██	██	██				
Follow-up survey													██	██	██	██
Behavioural games													██	██	██	██

7. Impact analysis and results of key evaluation questions

We begin by referring to balance checks in our experiment. In Appendix B (Table 11), we show descriptive statistics and differences between the control group and all treatments bundled together under a dummy variable, and between the control group and each of the treatment groups. These differences concern a number of household, leader and community characteristics, as collected in our baseline surveys.

We also depict joint F-tests of the null that the three treatments are jointly equal to zero. Of the 63 individual significance tests relating to each treatment intervention, only one is significant at standard levels: fewer years of schooling for leaders in Treatment 3.[10] No joint significance tests yield a rejection of the null at standard levels. We can conclude that our randomisation procedure was effective in identifying comparable groups in our experiment.

Table 11 also provides us with a simple characterisation of the demographic traits of our sample (control group averages): 27 per cent of our baseline household representatives are female, average age is 45 years, 11 per cent have secondary education or higher and 56 per cent are Muslim; local leaders are almost all men (only 4% are female), average age is 54 years, and average amount of schooling is 6 years; and 9 per cent of our sample is located in urban areas, with 11 per cent in semi-urban areas.

7.1 Information

For treatment effects, we begin by focusing on the effect of the interventions on local leaders' and citizens' awareness and knowledge of the natural gas discovery. For both groups, we focus on a similar set of outcomes, presented in Table 3 and Table 4, respectively, and summarised in Figure 6. Note that when baseline values of the outcome variable are available, we display regressions controlling for those values (specification 2, above) side by side with those employing standard control variables (specification 1, above).

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[10] It is possible that less educated leaders in Treatment 3 could lead to differential treatment effects. We therefore control for leaders' education in all our specifications. It is important to note that inclusion or exclusion of the control does not affect our estimates.

In columns (1) and (2) of the tables, we focus on awareness of the natural gas discovery. Awareness is measured using an indicator variable equal to 1 if the respondent has ever heard about the natural gas discovery and 0 otherwise. In columns (3) and (4), we focus on the level of knowledge about the natural gas discovery. For both leaders and citizens, we build an index by averaging 15 indicator variables concerning knowledge of whether the government was receiving revenues from natural gas extraction, about the firms involved and about the location of the discovery. Each indicator variable is equal to 1 if the respondent gives a correct answer, and 0 otherwise. The index is therefore equal to 1 if the respondent has full knowledge of these elements and 0 if the respondent reports all answers wrongly or has never heard about the discovery.

In columns (5) and (6), we measure the effect on salience, as measured by asking the respondent about three major events in the district in the last five years and leaving the answer open. We then perform content analysis and build an indicator variable equal to 1 if the respondent used the word 'gas' and 0 otherwise.

In columns (7), (8) and (9), we restrict attention to respondents who report that they are aware of the natural gas discovery. In column (7), we focus on self-reported level of knowledge by asking the respondents how informed they feel about the natural gas discovery. The outcome is measured on a scale of 1 to 4, where the value 4 indicates the respondent reports being fully informed. In columns (8) and (9), we focus on the perceived benefits from the natural gas discovery for the community and the household of the respondent. These are indicator variables equal to 1 if the respondent agrees or fully agrees that the discovery of natural gas will create a benefit for the community or the family, and 0 otherwise.

Figure 6: Average treatment effect on natural gas discovery awareness
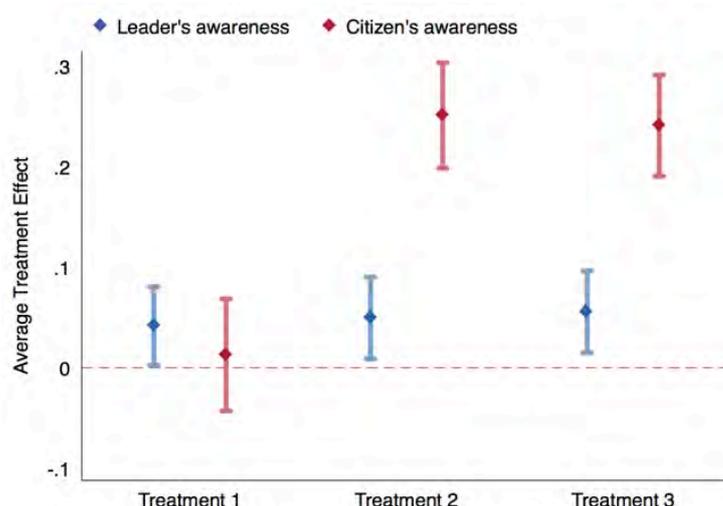
Note: Confidence intervals are built using 95 per cent of confidence. Standard errors are clustered at community level. The dependent variable is awareness of the natural gas discovery, an indicator variable equal to 1 if the respondent reports having heard about the natural gas discovery and 0 otherwise.

We now turn to the analysis of results. We begin with the effect of the interventions on leaders' awareness and knowledge about the natural resource curse (Table 3). First, awareness is increased by roughly 4–6 percentage points across all treatment groups.

This suggests that the information campaign was indeed effective in raising awareness by distributing information to the village leader, especially given the already high level of awareness amongst the elite. We do not observe a differential effect when information is also targeted at citizens and when deliberation is organised.

Knowledge about the discovery also increased significantly across all treatment groups (4–6 percentage points), suggesting that the information campaign had impact not only in terms of awareness, but also in terms of knowledge about the details of the discovery. Relatively small effects in knowledge translated into large effects in terms of salience, but only in communities where the information was also distributed to citizens, suggesting changes in salience across leaders might be associated with the level of information amongst citizens.

In treatments 2 and 3, between 32 and 34 per cent more leaders used the word 'gas' to describe one of the major events in the district in the last five years. When turning our attention to the perception of knowledge and to the perceived benefits from the discovery for the community and the household of the leader, we do not observe any significant effect.

We then focus on citizens' outcomes (Table 3). The intervention created a large increase in awareness of 24–25 percentage points, but only when the information is distributed to citizens. We do not observe an effect on citizens' awareness when the information is distributed to the leader only, suggesting leaders did not introduce any clear within-community effort for distributing the information to citizens. Treatments 2 and 3 not only increased awareness, but also made citizens more knowledgeable about the details of the discovery: the knowledge index increased by around 17 percentage points across both treatment groups. Similar to awareness, we do not observe any effect of distributing the information to the community leader on citizens' knowledge.

In terms of salience, we observe a significant increase in all treatment groups, with a significantly larger effect for treatments 2 and 3. In Treatment 1, around 6–7 per cent more citizens used the word 'gas'. This suggests that information targeted at leaders mainly increased salience amongst citizens who were already aware of the discovery at baseline, perhaps in closer connection to the leader's network. In fact, when restricting our attention to citizens who were aware of the discovery, we also observe a higher (self-reported) degree of knowledge when the information is targeted only at the local leaders. Treatments 2 and 3 lead to a significant increase in the way citizens believe the natural gas will bring benefits to their community and their households. This is not observed when information is targeted at leaders only.

In summary, we can see clear effects of the treatments on awareness and knowledge of the natural gas discovery. This is particularly the case for treatments 2 and 3, for both leaders and citizens. Treatment 1 also has effects on awareness and knowledge of leaders, and on salience and self-reported knowledge for citizens. Citizens also become optimistic regarding the future benefits of the discovery for the community and their households, but only when the information is targeted at the whole community. This effect is mainly driven by rural communities, whereas in urban and semi-urban communities, estimates of the effect are noisier and not significant, even if they are positive in all treatment groups (Figure 7).

Figure 7: Heterogeneous effects of the information treatments
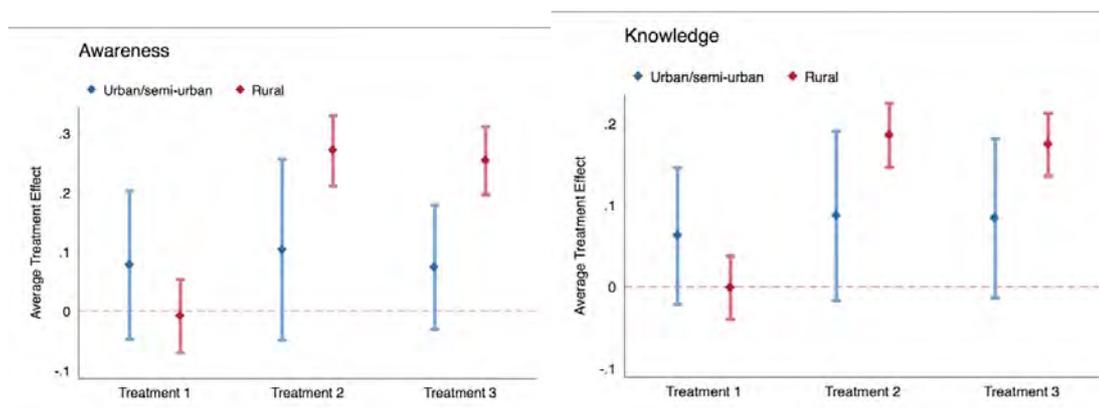
Note: Confidence intervals are built using 95 per cent of confidence. Standard errors are clustered at community level.

Although the design of the experiment allowed treatment units to be separated in distance to avoid information spillovers (Section 4.1), we cannot exclude the possibility that information spread across communities beyond the distance imposed by the researchers. In this case, our estimates would be capturing the effect of the diffusion of information through local knowledge networks, in addition to the effect of the provision of information. To test this hypothesis, we looked at whether the effect of treatments on the knowledge of the natural gas discovery amongst citizens differed in communities closer to or more distant from communities where the information was provided to a leader only (Treatment 1) or to citizens as well (treatments 2 and 3).

To this purpose, we split the sample in communities close to (or far from) another community in Treatment 2 or Treatment 3 and in communities close to (or far from) another community in Treatment 1. We define being 'close to' or 'far from' using the sample median of the minimum distance to another community of these types. Median distance to Treatment 2 or Treatment 3 is 9.65 kilometres and to Treatment 1 is 12.01 kilometres.

We then estimate the effect of each treatment for each sub-group. Figure 8 presents the results. We exclude the presence of large spillover effects since estimates are not statistically different across sub-groups.

Figure 8: Information and spillover
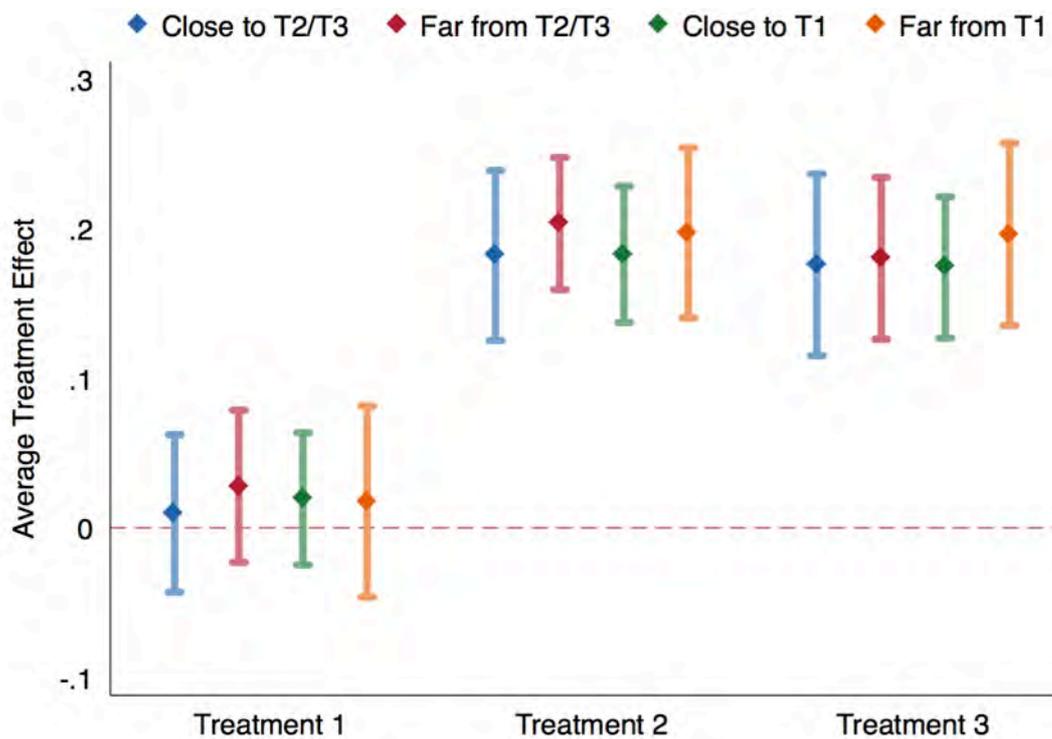
Note: 'Close to' and 'far from' are based on the sample median of the minimum distance of a community to another community in treatments 2 or 3 and in Treatment 1. We split the sample in communities closer to the median minimum distance (close to) and farther away (far from). Median distance to either treatments 2 or 3 is 9.65 kilometres and to Treatment 1 is 12.01 kilometres. Confidence intervals are built using 95 per cent of confidence. Standard errors are clustered at community level.

Table 3: Leaders' awareness and knowledge of the natural gas discovery

Dep. var.:	Awareness		Knowledge		Salience		Knowledge (self-reported)	Perceived benefit to community	household
Sample:	All	All	All	All	All	All	Respondents aware of the discovery		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
(T1) Information to leader	0.042**	0.042**	0.039**	0.042**	0.072	0.085	0.134	0.036	0.031
	(0.020)	(0.020)	(0.018)	(0.017)	(0.088)	(0.089)	(0.125)	(0.065)	(0.081)
(T2) Information to leader and citizens	0.050**	0.050**	0.062***	0.061***	0.317***	0.317***	0.068	0.009	−0.025
	(0.021)	(0.021)	(0.018)	(0.018)	(0.092)	(0.093)	(0.131)	(0.068)	(0.085)
(T3) Information plus deliberation	0.056***	0.060***	0.048**	0.051***	0.335***	0.348***	0.168	−0.034	−0.063
	(0.021)	(0.021)	(0.019)	(0.018)	(0.092)	(0.094)	(0.131)	(0.068)	(0.085)
Observations	206	203	206	203	206	203	204	204	204
R-squared	0.143	0.175	0.231	0.288	0.336	0.340	0.527	0.199	0.129
Mean (control group)	0.964	0.964	0.629	0.629	0.291	0.291	2.585	0.868	0.830
T1 = T2 (p-value)	0.703	0.704	0.214	0.296	0.009	0.014	0.608	0.684	0.505
T1 = T3 (p-value)	0.500	0.381	0.633	0.633	0.005	0.006	0.797	0.298	0.271
T2 = T3 (p-value)	0.762	0.615	0.448	0.580	0.843	0.743	0.439	0.515	0.652
Lagged dependent variable	No	Yes	No	Yes	No	Yes	No	No	No

Note: Estimates based on OLS regression (equations 1 and 2). *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$. Standard errors reported in parentheses and clustered at community level. Columns (1), (3), (5) and (7)–(9) present estimates using equation (1). Columns (2), (4) and (6) present estimates using equation 2, including the lagged value of the dependent variable. Depending on the column, the dependent variables are defined by the following: (1)–(2) awareness: indicator variable equal to 1 if the respondent reports having heard about the natural gas discovery; (3)–(4) knowledge: index built averaging 12 indicator variables concerning knowledge of whether the government is receiving revenues from natural gas extraction, about the firms involved and about the location of the discovery; (5)–(6) salience: indicator variable equal to 1 whether the respondent uses the word 'gas' when asked about the three major events in the district in the last 5 years; (7) knowledge (self-reported): self-reported level of information about the natural gas discovery (1 = not at all to 4 = fully informed); (8) perceived benefit to community: indicator variable equal to 1 if the respondent agree or fully agree the community will benefit from natural gas; (9) perceived benefit to household: indicator variable equal to 1 if the respondent agrees or fully agrees that their household will benefit from natural gas. In columns (4)–(6), the sample is restricted to respondents aware of the natural gas discovery. All specifications include village- and leader-level controls.

Table 4: Citizens' awareness and knowledge of the natural gas discovery

Dep. var.:	Awareness		Knowledge		Salience		Knowledge (self-reported)	Perceived benefit to community	household
Sample:	All	All	All	All	All	All	Respondents aware of the discovery		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
(T1) Information to leader	0.013	0.016	0.011	0.013	0.057**	0.074**	0.125**	−0.000	0.028
	(0.028)	(0.030)	(0.018)	(0.019)	(0.026)	(0.030)	(0.053)	(0.029)	(0.029)
(T2) Information to leader and citizens	0.251***	0.250***	0.172***	0.170***	0.219***	0.219***	0.238***	0.045*	0.069**
	(0.027)	(0.028)	(0.017)	(0.018)	(0.026)	(0.028)	(0.046)	(0.023)	(0.027)
(T3) Information plus deliberation	0.241***	0.238***	0.169***	0.163***	0.233***	0.243***	0.276***	0.044**	0.069***
	(0.026)	(0.026)	(0.017)	(0.017)	(0.030)	(0.032)	(0.044)	(0.020)	(0.025)
Observations	2067	1875	2067	1875	2072	1879	1622	1589	1570
R-squared	0.270	0.283	0.384	0.406	0.174	0.173	0.117	0.149	0.123
Mean (control group)	0.681	0.671	0.462	0.453	0.189	0.182	1.974	0.779	0.692
T1 = T2 (p-value)	0.000	0.000	0.000	0.000	0.000	0.000	0.026	0.100	0.162
T1 = T3 (p-value)	0.000	0.000	0.000	0.000	0.000	0.000	0.003	0.114	0.153
T2 = T3 (p-value)	0.692	0.635	0.862	0.677	0.610	0.437	0.347	0.969	0.988
Lagged dependent variable	No	Yes	No	Yes	No	Yes	No	No	No

Note: Estimates based on OLS regression (equations 1 and 2). *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$. Standard errors reported in parentheses and clustered at community level. Columns (1), (3), (5) and (7)–(9) present estimates using equation (1). Columns (2), (4) and (6) present estimates using equation 2, including the lagged value of the dependent variable. Depending on the column, the dependent variables are defined by the following: (1)–(2) awareness: indicator variable equal to 1 if the respondent reports having heard about the natural gas discovery; (3)–(4) knowledge: index built averaging 12 indicator variables concerning knowledge of whether the government is receiving revenues from natural gas extraction, about the firms involved and about the location of the discovery; (5)–(6) salience: indicator variable equal to 1 whether the respondent uses the word 'gas' when asked about the three major events in the district in the last 5 years; (7) knowledge (self-reported): self-reported level of information about the natural gas discovery (1 = not at all to 4 = fully informed); (8) perceived benefit to community: indicator variable equal to 1 if the respondent agrees or fully agrees that the community will benefit from natural gas; (9) perceived benefit to household: indicator variable equal to 1 if the respondent agree or fully agree that their household will benefit from natural gas. In columns (4)–(6), the sample is restricted to respondents aware of the natural gas discovery. All specifications include village- and household-level controls.

7.2 Elite capture

Table 5 presents estimates of the effect of the three treatment interventions on measures of elite capture, namely, by local leaders. In columns (1) and (2), we focus our attention on attitudes against corruption from the leader surveys. We build a measure for these attitudes by averaging two indicator variables from available questions measuring corruption.

First, an indicator is coded as 1 if the leader disagrees with the statement, 'the best way to overcome problems in public services is to pay bribes'. Second, an indicator is coded as 1 if the leader prefers demanding the governor of the province provide a benefit for the community rather than a job for himself. The exact text of the question reads as follows: 'Imagine that you had the opportunity to have a meeting with the governor of Cabo Delgado and that you could make a request. Please tell me what you would ask'. The measure of attitudes against corruption takes a value of 0 if the leader is strongly in favour of corruption and a value of 1 in the opposite situation. This is the only outcome variable in this table for which we have baseline values of the outcome.

Column (3) is devoted to the zinc roofs SCA; we use a variable averaging across all zinc sheets received by a leader, with the value for each one defined as −1 if the zinc is used privately, 0 if the zinc is not used, and 1 if the zinc is used for community purposes.

Columns (4) and (5) are dedicated to the funds for meetings SCA, through which leaders received funds to organise meetings. Column (4) shows an outcome indicator variable defined as 1 if the leader spent all funds received for the meetings. Column (5) displays a variable defined as the amount spent in the meetings (in meticais).[11]

Columns (6) through (9) show several outcome variables related to the SCA where the leader appointed a taskforce. Column (6) employs the average score in the Raven's test for the selected taskforce. Columns (7) and (8) use indicator variables constructed for the first quintile and for the second to fourth (respectively) in the distribution of the difference between the average score in the taskforce and the average score amongst citizens in the community. The regressions in column (9) take the share of women selected in the taskforce appointed by the leader.[12]

Column (10) regards leader behaviour in the trust game, i.e. the amount (in game units) the leader returned after receiving the transfer from a citizen in the trust game.[13]

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[11] The average total spent was 291 of the endowed amount of 400 meticais. Some leaders used their own money and spent more than 400. Thirty-four per cent of leaders spent the full amount, more than 350; due to possible measurement error, we allow a margin of error of 50 out of 400 meticais.

[12] On average, individuals in the household survey got 5 of 10 answers correct, whereas those chosen by the leader performed on average worse, scoring 3.7.

[13] In the trust game, the average amount sent by citizens was 4 of the 10 tokens, indicating some degree of trusting behaviour. Leaders returned, on average, slightly more than citizens sent, taking home, on average, just under two thirds of the surplus. Aggregate leader behaviour was consistent for different amounts sent by citizens.

Leader attitudes in favour of corruption increase significantly with Treatment 1. When information is targeted only at leaders, attitudes against corruption are reduced by 10 percentage points. The coefficient is also negative for treatments 2 and 3, with a marginally significant effect for Treatment 3 (7–8 percentage point effects). Differences across treatments are found not to be significant. The SCA on zinc roofs does not yield any significant differences. However, we note positive point estimates, which are smallest for Treatment 1 and largest for Treatment 3.

Turning to the funds for the meeting SCA, we find significant negative treatment effect for Treatment 1 when considering the probability of spending all assigned funds. The effect is statistically different from treatments 2 and 3. Still, point estimates are largest in absolute values for Treatment 1 (33 percentage points) and lowest for Treatment 2 (14 percentage points). The only statistically significant effect for amounts spent in the meetings is for Treatment 1: –60 meticais, slightly more than 10 per cent of the total budget.

In the SCA that involved appointing a taskforce, we also show some effects of Treatment 1 in particular. We find that Treatment 1 decreases the probability of selecting top performers (as defined by the first quintile of the distribution of the difference in Raven's scores between appointed individuals and the community) and increases the probability of selecting mid-performers (in the second to fourth quintiles of the same distribution). Note that the probability of selecting top performers also decreases for Treatment 2. We also note that Treatment 1 leads to a decrease, by roughly 8 percentage points, in the share of women selected for the taskforce. This effect is statistically different at the 1 per cent level from the one in Treatment 3, which is not distinguishable from zero.

On behaviour in the trust game, namely, in terms of amounts sent back by leaders, we do not find any significant differences between comparison groups. However, we note a negative point estimate for all treatments. We can conclude for some clear effects of Treatment 1 on increasing elite capture, in terms of more benevolent attitudes towards corruption, use of funds for other than specific public purposes, and appointments of community members for public service – i.e. less meritocratic and involving a lower number of women.

Table 5: Elite capture

Dep. var.:	Attitudes against corruption		Zinc roof usage	Funds for meetings		Average Raven's score	Taskforce activity		Women selected	Trust game
				Spent all budget	Expenses		Top performers selected	Mid-performers selected		Leader returns
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
(T1) Information to leader	−0.106***	−0.101**	0.030	−0.332***	−60.165***	0.321	−0.206***	0.219**	−0.079*	−0.433
	(0.040)	(0.041)	(0.083)	(0.095)	(22.645)	(0.319)	(0.077)	(0.096)	(0.040)	(0.560)
(T2) Information to leader and citizens	−0.050	−0.063	0.071	−0.140	−4.953	0.334	−0.136*	0.135	−0.016	−0.315
	(0.042)	(0.044)	(0.086)	(0.099)	(23.715)	(0.333)	(0.080)	(0.100)	(0.042)	(0.593)
(T3) Information plus deliberation	−0.076*	−0.082*	0.106	−0.154	−5.769	0.264	−0.094	0.124	0.043	−0.753
	(0.042)	(0.044)	(0.086)	(0.099)	(23.696)	(0.333)	(0.081)	(0.100)	(0.042)	(0.592)
Observations	204	192	206	205	205	206	206	206	206	203
R-squared	0.201	0.205	0.306	0.190	0.267	0.181	0.242	0.196	0.277	0.178
Mean (control group)	0.927	0.927	−0.200	0.509	313.000	3.516	0.291	0.491	0.218	5.927
T1 = T2 (p-value)	0.180	0.390	0.628	0.054	0.021	0.971	0.385	0.403	0.134	0.842
T1 = T3 (p-value)	0.479	0.660	0.382	0.078	0.025	0.865	0.171	0.349	0.005	0.592
T2 = T3 (p-value)	0.544	0.689	0.687	0.885	0.973	0.835	0.602	0.909	0.168	0.462
Lagged dependent variable	No	Yes	No	No	No	No	No	No	No	No

Note: Estimates based on OLS regression (equations 1 and 2). *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$. Standard errors reported in parentheses and clustered at community level. Columns (1) and (3)–(10) present estimates using equation 1. Column (2) presents estimates using equation 2, including the lagged value of the dependent variable. Depending on the column, the dependent variables are defined by the following: (1)–(2) attitudes against corruption: average between an indicator variable equal to 1 if the leader disagrees with the statement, 'the best way to overcome problems is to pay bribes', and an indicator variable equal to 1 if the leader would not demand a job when asked, 'Imagine you had the opportunity to have a meeting with the governor of Cabo Delgado and that you could make a request. Please tell me what you would ask'; (3) zinc roof usage: index for community use of zinc roof tiles: (−1) leader's personal use, (0) unused, (1) community use. Funds for meetings: (4) spent all budget: indicator for whether leader used all (> 350 of 400 meticais) funds for meeting; (5) expenses: expenses during the meeting (in meticais). Taskforce activity: (6) average score on Raven's test of individuals chosen by leader; (7) top performers selected: indicator variable for first quintile in the sample distribution of difference between average test score of persons chosen by leader and individuals' scores; (8) mid-performers selected: indicator variable for second to fourth quintiles in the sample distribution of difference between average test score of persons chosen by leader and individuals' scores; (9) women selected: percentage of women chosen by leader for the Raven's test. For the trust game, (10) leader returns: amount leader returned (of 15 tokens). All specifications include village- and leader-level controls.

7.3 Rent-seeking

We now turn to the analysis of treatment effects on outcomes related to rent-seeking by local leaders (Table 6) and by citizens (Table 7). We begin with survey outcomes. In columns (1) and (2) of both tables, we analyse an indicator value assigned value 1 when the citizen knows influential people. Columns (3) and (4) are devoted to an indicator variable taking value 1 if the leader called influential people in the six months before the endline survey. Columns (5) and (6) display results for number of calls to influential people in the six months before the endline survey. These are the only dependent variables in these tables for which we have baseline values, and so are the only ones where we add specifications employing those values as a control variable.

In column (7) of Table 6 and columns (7) and (8) of Table 7, we look at the auctions for meeting with the district administrator (leaders and citizens) and for business training (citizens). Column (7) of Table 6 is built as the log amount bid for meeting the administrator. Columns (7) and (8) of Table 7 are (respectively) the difference between the log amount bid for the meeting with administrator and the log amount bid for the local training, and the share of total bids allocated to meeting the administrator.

In column (8) of Table 6, we consider the action of leaders in the rent-seeking game. Namely, we code the outcome variable as value 0 if the leader behaves rationally (i.e. selects the highest amount put aside by citizens for productive purposes) and as 1 if the leader accepts the highest gift in the game. The final two outcomes in Table 7, in columns (9) and (10), are devoted to citizens' behaviour in the rent-seeking game: the first measures the size of the gift sent to the leader and the second is an indicator variable taking value 1 when the citizen sends a gift (i.e. valued more than zero).

On rent-seeking by leaders, we do not find any statistically significant difference between comparison groups, except for a negative effect of Treatment 1 on the number of calls to influential people (which disappears once controlling for baseline values of the dependent variable). All treatment effects except those on the number of calls are clearly below the size of the corresponding standard error, which may be a sign of relatively low statistical power to detect effects.

On rent-seeking by citizens, we find several clear treatment effects. When employing our survey measures of rent-seeking, we find significant positive effects on rent-seeking of Treatment 1 on all three dependent variables. We also find significant positive effects of Treatment 3 on the probabilities of knowing and calling influential people. In these two variables, treatment effects from treatments 1 and 3 are indistinguishable, but significantly different from Treatment 2 in the case of knowing influential people. The magnitudes of the effects of Treatment 1 are 6 percentage points for knowing influential people, 3 percentage points for calling influential people and 11.5 percentage points for number of calls to influential people.

Turning to the auctions, we also find significant positive impacts on the log of the difference between the bid for meeting and the bid for training, with a magnitude of 15 per cent. These effects are statistically different from the effects of treatments 2 and 3 for the share of the bid for meeting. Finally, in the rent-seeking game, we find a statistically

significant treatment effect (at the 10% level) for the size of gifts sent to the leader only for Treatment 2, while we note positive point estimates across the other two treatments.

We conclude that despite no movements in rent-seeking by leaders, we observe clear and consistent increases in rent-seeking by citizens when faced with information targeting the local leaders (Treatment 1). This emerges for reported contacts with influential people, and in the bidding for meetings with the district administrator. We also identify some scattered positive effects on rent-seeking of treatments 2 and 3, even though most do not appear in behavioural outcomes. Effects of Treatment 1 on rent-seeking may denote movements by those close to leaders, consistent with the effects found on elite capture.[14]

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[14] It is also possible that the measures of rent-seeking used could be less appropriate for leaders than for citizens. We cannot exclude this possibility.

Table 6: Rent-seeking amongst local leaders

Dep. var.	Relationship with influential people						Auction	Rent-seeking game
	Knows any person		Called		Number of calls		Bid for meeting	Degree of rent-seeking
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
(T1) Information to leader	−0.037	−0.035	−0.047	−0.002	−0.648*	−0.577	0.103	0.031
	(0.059)	(0.062)	(0.077)	(0.079)	(0.364)	(0.364)	(0.119)	(0.062)
(T2) Information to leader and citizens	−0.038	−0.038	−0.006	0.019	−0.542	−0.504	0.100	−0.011
	(0.062)	(0.063)	(0.081)	(0.081)	(0.380)	(0.382)	(0.125)	(0.067)
(T3) Information plus deliberation	−0.053	−0.045	−0.034	−0.014	−0.368	−0.354	−0.012	0.032
	(0.062)	(0.064)	(0.081)	(0.081)	(0.380)	(0.383)	(0.125)	(0.066)
Observations	204	198	206	203	206	203	206	201
R-squared	0.206	0.217	0.275	0.299	0.221	0.240	0.238	0.115
Mean (control group)	0.926	0.926	0.800	0.800	3.189	3.189	4.217	0.179
T1 = T2 (p-value)	0.986	0.969	0.617	0.795	0.779	0.848	0.976	0.528
T1 = T3 (p-value)	0.787	0.877	0.883	0.888	0.468	0.565	0.361	0.986
T2 = T3 (p-value)	0.797	0.908	0.727	0.690	0.648	0.699	0.371	0.522
Lagged dependent variable	No	Yes	No	Yes	No	Yes	No	No

Note: Estimates based on OLS regression. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$. Standard errors reported in parentheses and clustered at community level. Columns (1), (3), (5), (7) and (8) present estimates using equation 1. Columns (2), (4) and (6) present estimates using equation 2, including the lagged value of the dependent variable. Depending on the column, dependent variables are defined by the following: for relationship with influential people, (1)–(2) knows any person: indicator variable equal to 1 if the citizen knows influential people; (3)–(4) called: indicator variable equal to 1 if the citizen called influential people; (5)–(6) number of calls: number of calls (in logs) to influential people in the last six months. For the auction activity, (7) bid for meeting: log amount bid for the meeting with administrator. For the rent-seeking game, (8) degree of rent-seeking: amount of rent-seeking as proportion of total possible: varies continuously from 0 (lowest rent-seeking) to 1 (full rent-seeking).

Table 7: Rent-seeking amongst citizens

Dep. var.:	Relationship with influential people						Meeting – training auction		Rent-seeking game	
	Knows any person		Called		Number of calls		Bid difference	Share bid to meeting	Gifts sent	Any gift sent
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
(T1) Information to leader	0.061**	0.062**	0.037**	0.028*	0.134**	0.115**	0.153**	0.028**	0.151	0.039
	(0.030)	(0.031)	(0.017)	(0.017)	(0.058)	(0.058)	(0.076)	(0.013)	(0.216)	(0.025)
(T2) Information to leader and citizens	−0.015	−0.015	0.016	0.013	0.066	0.066	0.061	0.006	0.346*	0.049*
	(0.032)	(0.032)	(0.015)	(0.015)	(0.048)	(0.050)	(0.066)	(0.011)	(0.209)	(0.025)
(T3) Information plus deliberation	0.047*	0.042	0.043**	0.045**	0.063	0.072	0.082	0.007	0.056	0.033
	(0.027)	(0.028)	(0.018)	(0.019)	(0.052)	(0.054)	(0.072)	(0.013)	(0.216)	(0.027)
Observations	2065	1861	2072	1879	2072	1879	2072	2072	2023	2023
R-squared	0.107	0.117	0.064	0.076	0.062	0.073	0.020	0.023	0.117	0.043
Mean (control group)	0.614	0.610	0.064	0.063	0.181	0.176	−0.029	0.499	4.079	0.880
T1 = T2 (p-value)	0.026	0.026	0.271	0.418	0.277	0.428	0.130	0.028	0.300	0.597
T1 = T3 (p-value)	0.673	0.539	0.729	0.391	0.268	0.511	0.289	0.057	0.624	0.778
T2 = T3 (p-value)	0.061	0.090	0.120	0.081	0.962	0.906	0.736	0.891	0.138	0.465
Lagged dependent variable	No	Yes	No	Yes	No	Yes	No	No	No	No

Note: Estimates based on OLS regression (equations 1 and 2). *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$. Standard errors reported in parentheses and clustered at community level. Columns (1), (3), (5) and (7)–(10) present estimates using equation 1. Columns (2), (4) and (6) present estimates using equation 2, including the lagged value of the dependent variable. Depending on the column, the dependent variables are defined by the following: for the relationship with influential people, (1)–(2) knows any person: indicator variable equal to 1 if the citizen knows influential people; (3)–(4) called: indicator variable equal to 1 if the citizen called influential people; (5)–(6) number of calls: number of calls (in logs) to influential people in the last six months. For the meeting – training auction activity, (7) bid difference: difference between the log amount bid for the meeting with administrator and the log amount bid for the local training; (8) share bid for meeting: share of total bids allocated to meeting the administrator. For the rent-seeking game, (9) gifts sent: number of gift tokens (of 10) sent to leader; (10) any gift sent: indicator variable for whether the participant sent any tokens as gift to leader. All specifications include village- and household-level controls.

7.4 Citizens' mobilisation, trust and accountability

Our final set of results relates to citizens' mobilisation, social cohesion, trust and demand for political accountability. Table 8 presents estimates of treatment effects on measures of citizen mobilisation and social cohesion. Table 9 presents estimates of treatment effects on citizens' trust and demand for accountability.

Beginning with Table 8, columns (1) to (4) concern standard social capital measures based on survey questions, namely, on membership in professional organisations or local committees and participation in community meetings. We have baseline values for these outcome variables, and employ them as controls in columns (2) and (4). In columns (5) to (9), we explore the outcomes of the matching grants SCA. The first dependent variable is an indicator for awareness, i.e. whether the individual knew about the matching activity. The next variable in column (6) is an indicator for whether the individual reported contributing a positive amount of money towards the matching activity. The continuous version of this variable is found in column (7), in logarithms.

Columns (8) and (9) are measured at the community level. The first dependent variable is attendance at the meeting, taken as the share of adults who participated from the community; the dependent variable in column (9) is an indicator for whether the community decided the outcome through voting. The regression in column (10) examines behaviour in the public goods game. The outcome is defined as the contribution to the public account in the game. Average contribution in the public goods game was 4.5 out of 10 tokens, with only 6 per cent contributing zero.

We find that social capital measures of membership in professional organisations and local committees increases with information plus deliberation (Treatment 3). Effects on membership in professional or local organisations are 5–7 percentage points. Regarding participation in community meetings, the results are similar. There is a significant increase in Treatment 3; the effects are also significant for Treatment 2. For membership and for active participation, we can reject that the effect size is the same for treatments 1 and 3 at the 5 per cent level, indicating that citizens are more effectively mobilised in treatments where they are targeted to receive information, with the strongest effects when this is bundled with deliberation.

Interestingly, we find a positive effect of information to the community in treatments 2 and 3, on both awareness and participation in the matching grants SCA activity – an effect of 9–11 percentage points. For awareness, we are able to reject that the treatment effects of treatments 2 and 3 are equal to the treatment effect of Treatment 1. However, regarding participation, we can no longer reject equality of the coefficients across all treatments. On average, 70 per cent of individuals report being aware of the contribution activity, while 34 per cent of individuals report contributing positive amounts.

The log contribution amounts in the matching grants follow a similar pattern with higher point estimates for treatments 2 and 3 than for Treatment 1. We also find a statistically significant effect of Treatment 3 when considering the log number of participants in the

meetings. However, once again, we are unable to distinguish this impact from the one of each of the other interventions.[15]

In the last regression involving the meetings SCA, column (9), we examine a dummy for whether the outcome was determined democratically, by voting. Here there is a significant positive impact only for Treatment 3. The effect corresponds to slightly over a 6-percentage point increase in the likelihood that the outcome was determined by voting. Finally, column (10) presents the outcomes of contributions to public goods. We find no significant effects, despite the fact that point estimates are highest for Treatment 3.

Turning to Table 9, in columns (1) to (9) we employ survey outcomes on trust, voice and accountability, and violence. Columns (1) and (2) display the average of all self-reported measures of trust, i.e. trust concerning family, neighbours, local leaders, local people, the district government, the provincial government, Mozambicans and national leaders. We use baseline values of the dependent variable in column (2). In columns (3) to (5) we analyse self-reported trust in the community leaders personally known by the respondent, in the provincial government and in national leaders (respectively). The scale employed in all self-reported questions on trust ranges from 1 (do not trust at all) to 4 (trust a lot).

In columns (6) and (7), we explore the self-reported levels of voice citizens have with provincial and national leaders (respectively), with scale ranging from 1 (no voice at all) to 4 (full voice). The regressions in columns (8) and (9) concern violence: the first dependent variable is defined as an indicator variable equal to 1 if the citizen believes violence is justified to defend a cause; the second variable is defined as an indicator variable equal to 1 if the respondent witnessed any verbal violence in the three months before the endline survey. The final two columns of Table 9 relate to citizens' behaviour in the trust game. The outcome variable in column (10) is the amount sent by the citizens in the trust game, and the one in column (11) is an indicator variable taking value 1 if the corresponding citizen has the desire to punish the leader in the trust game.

We observe clear effects on average trust, namely, negative effects of Treatment 1, with a magnitude of 2 percentage points, and positive effects of Treatment 2, with a magnitude between 2 percentage points. These treatment effects are statistically different from each other, as are the treatment effects of information to the community (Treatment 2) and information plus deliberation (Treatment 3). We find positive effects of treatments 2 and 3 on trusting known community leaders – both close to 6 percentage points of the subjective scale. Trust in the provincial government behaves similarly to average trust, with a significantly higher effect for Treatment 2 than for the other treatments. We observe a significant positive effect of Treatment 3 on trusting national leaders; this is, however, indistinguishable from the other treatment effects.

Turning to voice questions, we identify a larger treatment effect for Treatment 2 than for Treatment 1 when considering voice at the provincial level. Treatment 2 becomes statistically significant when employing voice at the national level: its magnitude is 11 percentage points of the subjective scale. When analysing the questions on violence, we

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[15] The average meeting size was 43 individuals, ranging from 9 to, in one community, 600. We account for village population in the dependent variable.

find a higher point estimate for Treatment 1 relative to the other treatment effects in the regression considering as outcome positive attitudes towards violence, even if no statistical significance is achieved. We observe a significant negative effect of Treatment 3 on the likelihood of witnessing verbal violence (5 percentage points). This is statistically distinct from the effect of Treatment 2. Finally, on outcomes related to the trust game, we find no statistically significant effects on average amounts sent or on the desire to punish.

In summary, we find some evidence that the full treatment (Treatment 3) increased membership in local organisations, awareness and participation in and/or contribution to the matching grants activity, participation in meetings and likelihood of voting being employed in decision-making at the meetings. Information to the community (Treatment 2) increased awareness and participation in the matching grants activity and participation in the meetings. We also observe clear effects of Treatment 2 and/or Treatment 3 on increasing trust at different levels, voice and accountability at different levels, and decreasing the likelihood of violence.

8. Discussion

We find evidence that a community-targeted information campaign in northern Mozambique, relating to the recent discovery of natural gas in the region, was effective in raising awareness and knowledge of the topic by citizens. Some effects were found for leaders as well.

When information is given to local leaders only, we observe an increase in elite capture, as well as in rent-seeking by leaders and citizens. Most of these effects do not seem to emerge when information is given to citizens. Moreover, when information is targeted at the general population, we document increases in citizen mobilisation, trust, voice and demand for political accountability, and a decrease in violence. This pattern of results is consistent with a known mechanism of the resource curse that centres on misgovernance by politicians. It is also consistent with a positive role of information in countering the resource curse.

9. Specific findings for policy and practice

Our study provides important recommendations for policymakers, implementers, and transparency and accountability researchers.

Our study is relevant for policymakers for two main reasons. First, we show that a large-scale information campaign can be effective in raising levels of awareness in the population about a resource discovery and its related management debates. Second, we report clear effects on trust in government at different levels and on decreasing violence. These findings are of crucial importance in face of the known association of the resource curse with localised conflict in resource-producing areas. Appropriate management of expectations of the local population and implementation of inclusive deliberation processes as resource exploration unfolds may be the key to avoiding localised conflict. Information campaigns like the one we study can be seen as a central piece of those efforts.

This report provides important practical insights for implementers interested in raising awareness not only of discoveries of new natural resource reserves, but also of more general events in which the public opinion might have an interest. We show that it is important for these campaigns to target citizens, rather than local leaders. In addition, we show that campaigns designed in a way to attract the audiences' attention and understanding can be functional in raising awareness. Although it is not the objective of this study to provide evidence on different designs for information campaigns, we show that complementing leaflets with community theatre has large effects in terms of awareness.

Our study provides new fundamental findings on the interaction of citizens and local leaders in the setting of a natural resource boom before any revenue windfalls have occurred. This is a unique opportunity to learn about the resource curse, when only information is disseminated. New research can build from our study to learn about potential long-run interactions between information heterogeneity and community behaviour once the extraction starts and revenue windfalls are distributed.

Table 8: Citizen mobilisation

Dep. var.:	Group membership		Community meeting participation		Matching grant activity					Public good game
					Awareness	Contributed	Amount contributed	Attendance	Voting	Contribution
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
(T1) Information to leader	−0.008	−0.032	0.005	0.002	0.019	0.043	0.140	0.024	−0.028	−0.136
	(0.022)	(0.024)	(0.019)	(0.020)	(0.035)	(0.046)	(0.177)	(0.015)	(0.031)	(0.186)
(T2) Information to leader and citizens	0.022	0.003	0.033*	0.034*	0.094***	0.090*	0.259	−0.003	−0.022	−0.134
	(0.022)	(0.025)	(0.018)	(0.019)	(0.035)	(0.051)	(0.192)	(0.016)	(0.032)	(0.208)
(T3) Information plus deliberation	0.067**	0.052*	0.041**	0.041**	0.109***	0.108**	0.388*	0.032**	0.061*	0.028
	(0.027)	(0.030)	(0.017)	(0.018)	(0.033)	(0.049)	(0.197)	(0.016)	(0.032)	(0.206)
Observations	2051	1776	2014	1792	2067	2072	2008	203	206	2023
R-squared	0.106	0.129	0.073	0.089	0.102	0.091	0.085	0.227	0.156	0.071
Mean (control group)	0.232	0.225	0.899	0.892	0.704	0.340	1.217	0.044	0.018	4.479
T1 = T2 (p-value)	0.210	0.149	0.113	0.084	0.027	0.372	0.544	0.083	0.836	0.989
T1 = T3 (p-value)	0.006	0.003	0.059	0.051	0.006	0.217	0.237	0.650	0.007	0.335
T2 = T3 (p-value)	0.107	0.099	0.679	0.687	0.653	0.761	0.568	0.028	0.011	0.381
Lagged dependent variable	No	Yes	No	Yes	No	No	No	No	No	No

Note: Estimates based on OLS regression. *** p < 0.01, ** p < 0.05, * p < 0.1. Standard errors reported in parentheses and clustered at community level. Columns (1), (3), (5)–(11) present estimates using equation 1. Columns (2) and (4) present estimates using equation 2, including the lagged value of the dependent variable. Depending on the column, the dependent variables are defined by the following: (1)–(2) group membership: indicator variable equal to 1 if the citizen is an active member or leader in a professional or local organisation or in a local committee; (3)–(4) community meetings participation: indicator variable equal to 1 if the citizen participated in at least one community meeting in the last 12 months. For matching grants activity: (5) awareness: indicator variable equal to 1 if the citizen heard about the activity; (6) contributed: indicator variable equal to 1 if the citizen reported contributing a positive amount; (7) amount contributed: log of self-reported contribution in matching activity; (8) attendance: (observed) share of adults in the community who attended the matching activity; (9) voting: indicator variable equal to 1 if the decision in the matching activity was determined by voting. For public goods game: (10) contribution: contribution (of 10 tokens) in public goods game. Specifications in columns (1)–(7) and (10) include village- and household-level controls. Specifications in columns (8)–(9) include village- and leader-level controls.

Table 9: Trust and accountability

Dep. var.:	Trust (self-reported)					Voice at		Violence		Trust game	
	Average trust		Community leaders known	Provincial government	National leaders	Provincial level	National level	Attitudes towards	Verbal violence	Amount sent	Desire to punish
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
(T1) Information to leader	−0.023*	−0.025**	0.005	−0.058	0.020	−0.033	0.018	0.034	0.001	0.144	0.043
	(0.012)	(0.012)	(0.035)	(0.039)	(0.039)	(0.046)	(0.046)	(0.031)	(0.029)	(0.169)	(0.037)
(T2) Information to leader and citizens	0.023**	0.025**	0.057*	0.056	0.056	0.086*	0.111***	−0.008	−0.003	0.020	0.046
	(0.011)	(0.011)	(0.032)	(0.037)	(0.038)	(0.049)	(0.042)	(0.027)	(0.026)	(0.171)	(0.039)
(T3) Information plus deliberation	−0.006	−0.004	0.057**	−0.016	0.059*	0.052	0.053	0.005	−0.045*	0.125	−0.020
	(0.012)	(0.011)	(0.023)	(0.042)	(0.035)	(0.049)	(0.046)	(0.032)	(0.026)	(0.182)	(0.038)
Observations	2030	1744	1627	2058	2065	1998	2001	1881	2065	2023	2003
R-squared	0.104	0.133	0.128	0.080	0.085	0.062	0.067	0.056	0.049	0.149	0.047
Mean (control group)	0.767	0.769	2.828	2.440	2.446	2.500	2.488	0.298	0.349	4.053	0.398
T1 = T2 (p-value)	0.000	0.000	0.225	0.003	0.347	0.028	0.060	0.123	0.893	0.499	0.927
T1 = T3 (p-value)	0.165	0.084	0.115	0.358	0.297	0.099	0.471	0.354	0.111	0.928	0.111
T2 = T3 (p-value)	0.017	0.017	0.978	0.087	0.945	0.542	0.216	0.641	0.089	0.581	0.119
Lagged dependent variable	No	Yes	No	No	No	No	No	No	No	No	No

Note: Estimates based on OLS regression (equations 1 and 2). *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$. Standard errors reported in parentheses and clustered at community level. Depending on the column, the dependent variables are defined by the following: for trust outcomes, (1)–(2) average trust: average of all self-reported measures of trust (family, neighbours, local leaders, local people, district government, provincial government, Mozambicans and national leaders) (0 = no trust / 1 = highest trust); (3) community leaders known: self-reported trust for community leaders who are personally known by the respondent (1 = not at all / 4 = trust a lot); (4) provincial government: self-reported trust for provincial government (1 = not at all / 4 = trust a lot); (5) national leaders: self-reported trust for national leaders (1 = not at all / 4 = trust a lot). For voice at, (6) provincial level: self-reported level in which citizens have voice with provincial administrators (1 = not at all / 4 = totally); (7) national level: self-reported level in which citizens have voice with national administrators (1 = not at all / 4 = totally). For violence, (8) attitudes towards violence: indicator variable equal to 1 if the citizen believes violence is justified to defend a cause; (9) verbal violence: indicator variable equal to 1 if the respondent witnessed any verbal violence in the last three months. For the trust game, (10) amount sent: amount sent (of 10 tokens) by the participant in the trust game; (11) desire to punish: indicator variable equal to 1 if the respondent has desire to punish selfish leader in the trust game. Specifications in columns (1)–(9) include village- and household-level controls. Specifications in columns (10)–(11) include village- and leader-level controls.

Appendixes

Appendix A: Sample design

Villages were selected from all but one district in the province of Cabo Delgado. The sampling frame was the electoral one, which yields data on registered voters per polling station. There are 474 polling stations in the province, as of the last national election in 2014. Since one of the study objectives is to understand the relationship between natural resources and political outcomes and we cannot observe voting outcomes at village level, we selected polling stations as our geographical unit of interest.

The selection process excluded islands (two polling stations and all four polling stations of the excluded Ibo district) and polling stations in the Palma administrative seat (11 polling stations). The island stations were excluded due to their unrepresentative isolation. The Palma stations were excluded to avoid communities that would be relocated due to the construction of a liquefied natural gas plant.

Figure 9 presents the geographical distribution of the selected areas, for the whole country and within the Cabo Delgado district. Further exclusions involve polling stations that moved from 2009 to 2014 electoral frames (54 polling stations) and polling stations that were smaller than or equal to the fifth percentile by number of registered voters (corresponding to approximately 200 voters per polling station). The former polling stations were excluded to focus on more stable polling stations and that can therefore be compared over time, while the latter were excluded due to non-representativeness and anticipation of difficulties in household recruitment.

For the random sampling amongst remaining polling stations, polling stations were stratified into three groups: polling stations in urban areas (Pemba and Montepuez), polling stations in semi-urban areas (administrative seats of each district) and all other stations. In this sampling frame, there are 421 polling stations: 14 in urban areas and 39 in semi-urban areas.

Figure A1: Selected districts within Mozambique and within Cabo Delgado
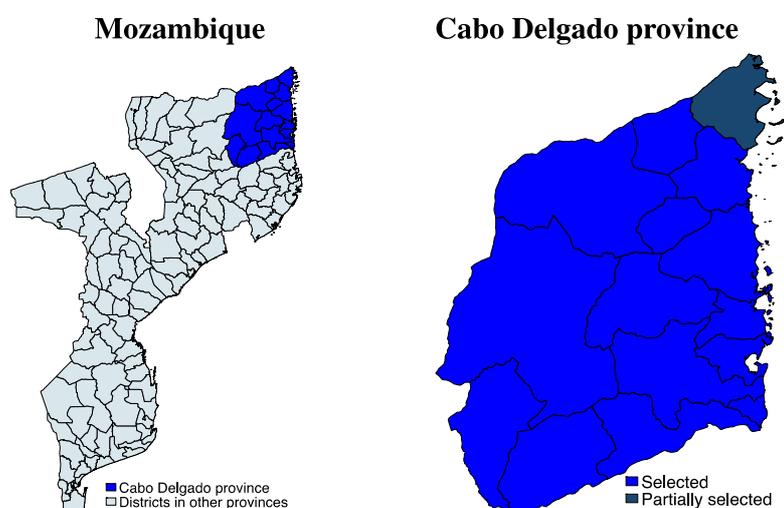
Note: In dark blue, the provinces selected for the project. Credit: authors' calculations; administrative divisions provided by www.gadm.org.

We selected 200 polling stations at random, using the following rules for selection within each stratum. In urban strata, we selected eight polling stations in Pemba and four polling stations in Montepuez. In semi-urban strata, we selected two polling stations per town, except when only one was available (in which case, only one was selected). The remaining 165 stations are sampled from all other polling stations.

Seven other polling stations were added to the sample, following the same sampling rules as before. These additional areas were to be used as a safeguard in case any of the 200 villages had to be excluded during the study. Hence, the baseline was conducted in a total of 207 polling stations. Table 9 shows the list of strata and the number of available and sampled polling stations.

Table A1: Distribution of available and sampled polling stations by strata

Stratum	Name	Polling stations % sampled		
		Available	Sampled	% sampled
URBAN	Pemba	9	8	0.040
URBAN	Montepuez	5	4	0.020
SEMI-URBAN	Ancuabe	5	2	0.010
SEMI-URBAN	Balama	1	1	0.005
SEMI-URBAN	Chiure	1	1	0.005
SEMI-URBAN	Mocimboa da Praia	4	2	0.010
SEMI-URBAN	Macomia	8	2	0.010
SEMI-URBAN	Mecufi	3	2	0.010
SEMI-URBAN	Meluco	3	2	0.010
SEMI-URBAN	Metuge	2	2	0.010
SEMI-URBAN	Mueda	4	2	0.010
SEMI-URBAN	Muidumbe	2	2	0.010
SEMI-URBAN	Namuno	3	2	0.010
SEMI-URBAN	Nangade	1	1	0.005
SEMI-URBAN	Palma	1	1	0.005
SEMI-URBAN	Quissanga	1	1	0.005
OTHER STATIONS	-	421	165	0.825
TOTAL	**-**	**474**	**200**	**1.000**

The sampling design presents an oversampling of urban and semi-urban polling stations in order to have a more representative sample of the few urban settlements in the province. Figure 10 shows a comparison of the distribution of registered voters in the sampling frame and the sampled polling stations. Each distribution is estimated using a non-parametric kernel density of the number of voters per polling station. The blue line represents the distribution of the number of registered voters per polling station in the sampling frame, and the red line represents the same distribution in the sampled polling stations.

The distribution of registered voters in sampled polling stations is more representative of larger polling stations compared to the sampling frame, due to the oversampling. For larger polling stations, the distribution is comparable between sampled stations and their populations.

Figure A2: Distribution of voters in sampled polling stations and all stations
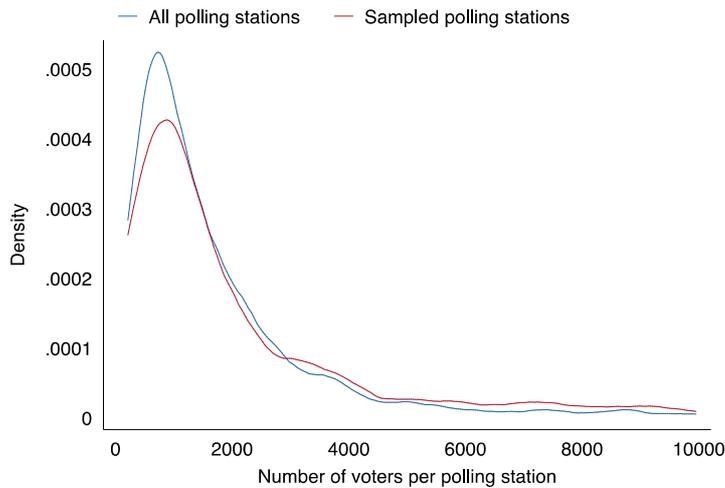
Note: The blue line presents the distribution of the number of registered voters per polling station in the sampling frame, while the red line presents the same distribution in the sampled polling stations. Credit: authors' calculations.

To obtain a geographical representation of sampled polling stations, we present the distribution amongst different districts of the number of polling stations and the number of sampled polling stations. Figure 11 presents the geographical distribution of polling stations in the population and in the sample. The left panel presents the geographic distribution of the total number of polling stations, while the right panel shows the same information restricted to sampled polling stations. We can observe that stratified random sampling tends to replicate the distribution of polling stations in the sampling frame. Although the number of polling stations is comparable across districts, the number of stations is slightly higher in Chiure district, in the southern part of Cabo Delgado. Overall, the sample covers the whole province.

Figure A3: Geographic distribution of polling stations
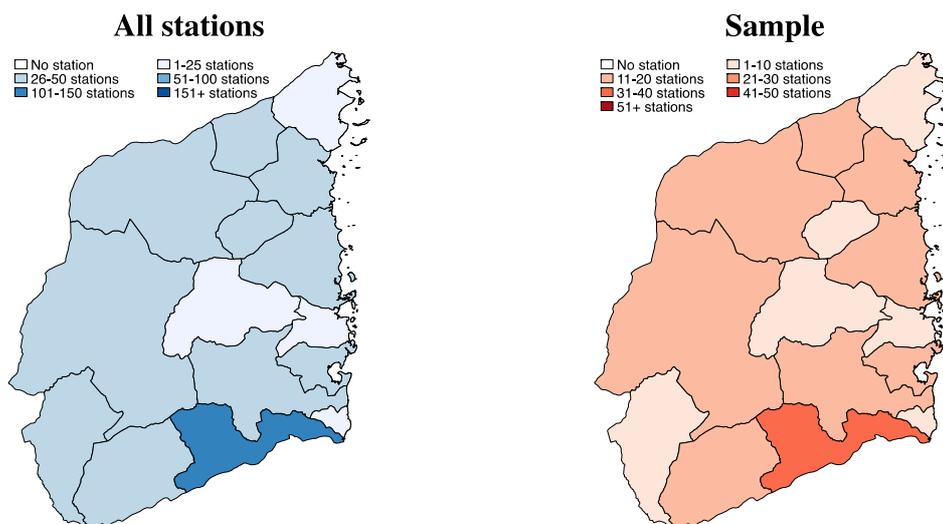
Note: The left panel presents the geographic distribution of polling stations, while the right panel shows the same information but restricted to sampled polling stations. Metuge is included in Pemba district and Ibo is included in Quissanga district. Credit: authors' calculations; administrative divisions provided by www.gadm.org.

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Appendix B: Sample size and power calculations

This study involves measuring outcomes at both the community and individual levels. Community-level outcomes are part of a single or one-level experimental design. Individual-level outcomes involve clustering at the community level and are considered through a two-level design. We present power calculations for one-level and two-level designs with varying levels of standardised effect sizes (from 0.1 to 1).

Figure 12 presents the power calculations for the one-level and two-level designs. In the *one-level design*, we have 50 villages for each comparison group when considering outcomes at the community level. We need relatively high effects to be able to capture these impacts with 80 per cent statistical power. Specifically, the minimum detectable effect (MDE) size (standardised units) for 50 units is 0.57 (see intersection of the different curves in Figure 12 with the 0.8 level of power in the y-axis).

In the *two-level design*, we observe 10 households within each of the 50 villages per treatment arm. To compute the intra-cluster correlation (ICC), we looked at a series of outcomes identified in the pre-analysis plan and averaged the ICCs computed for each of these outcomes. We obtain an ICC estimate of 0.068, in line with the ICC of 0.06 used for the original design of the intervention, which was based on Aker and colleagues (2017). With an ICC of 0.068, we can identify (with 80 per cent power) an MDE of 0.227.

Figure B1: Power calculations

| *One-level design* | *Two-level design* |
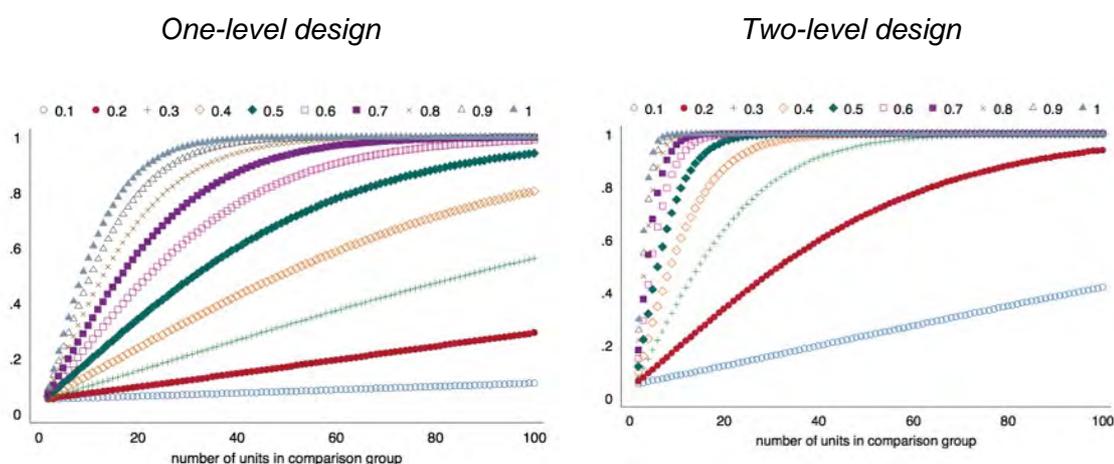
Note: Power calculations are computed using the Stata command *rdpower*.

To approximate the effect sizes in units of each of the outcomes, we focus on the outcome variables identified in the pre-analysis plan. Since standardised effects correspond to the difference in means (across two groups) divided by the standard deviation of the two groups together, we need to multiply our standardised effects by the referred standard deviation. In Table 10, we present the mean, standard deviation and ICC of the selected outcomes in columns (1)–(3). Column (4) presents the standardised effect size based on the evaluation design (50 clusters in control and 50 clusters in treatment and 10 households in each clusters) and the ICC computed using the baseline survey. We implement in this case a model without covariates (unconditional model). We supplement the standardised effect size with the MDEs for the main variables of interest by multiplying it by the standard deviation of the variable.

In addition, in columns (6) to (9), we compute the standardised effect size when we control for basic baseline characteristics. We first compute R^2 by regressing the outcome variable at the household level and at the village level on the selected covariates. We then compute standardised effect size and MDE. Since we include only a very restricted set of controls, this represents a conservative estimate of the gain in power obtained by using baseline information.

Table B1: Minimum detectable effects

| | Mean | Std. dev. | ICC | Without covariates | | With covariates | | | |
| | | | | Std. effect size | MDE | R^2 (hh. level) | R^2 (village level) | Std. effect size | MDE |
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Average trust	0.75	0.25	0.07	0.23	0.06	0.25	0.25	0.25	0.25
Trust: provincial Government	2.34	0.89	0.05	0.22	0.19	0.25	0.25	0.25	0.25
Trust: national leaders	2.28	0.90	0.04	0.21	0.19	0.25	0.25	0.25	0.25
Public funds to influential people	0.56	0.50	0.04	0.21	0.10	0.25	0.25	0.25	0.25
Active member/leader in group	0.22	0.41	0.03	0.20	0.08	0.25	0.25	0.25	0.25
Knows any influential person	0.41	0.49	0.10	0.24	0.12	0.25	0.25	0.25	0.25

Note: To compute the R^2, we consider the same covariates as in the main analysis for individual-level regressions. See Section 4.3.

Appendix C: Descriptive statistics

For each outcome of household/leader *i* living in community *j*, Y_{ij}, we test for balance by first using the following least squares regression:

$$Y_{ij} = \alpha + \beta T_j + \varepsilon_{ij} \tag{3}$$

where T_j is an indicator variable for living in a community in either treatment groups 1, 2 or 3, and ϵ_{ij} is an individual-specific error term which is assumed to be clustered at the community level. We then look at balance specifically within each treatment group, by estimating the following specification:

$$Y_{ij} = \alpha + \beta_1 T1_j + \beta_2 T2_j + \beta_3 T3_j + \varepsilon_{ij} \tag{4}$$

where T_{1j}, T_{2j} and T_{3j} are indicator variables for living in a community in treatment groups 1, 2 and 3, and ϵ_{ij} is an individual-specific error term which is assumed to be clustered at the community level. We test for joint significance of β_1, β_2 and β_3 by using an F-test.

We begin by looking at household-level outcomes. Table 12 presents randomisation checks for respondent, leader and community characteristics. Table 13 presents the main correlates of awareness about the natural gas discovery at baseline.

Table C1: Descriptive statistics

	Control group (1)	Any treatment (2)	Info to leader (3)	Info to leader and citizens (4)	Info plus deliberation (5)	Joint test (3)–(5) (6)
	Mean [Std. dev.]	Diff. (Std. err.)	Diff. (Std. err.)	Diff. (Std. err.)	Diff. (Std. err.)	p-value [N]
Individual characteristics						
Female respondent	0.274	−0.032	−0.036	−0.035	−0.026	0.682
	[0.446]	(0.027)	(0.034)	(0.036)	(0.034)	[2065]
Age in years	44.880	0.233	0.303	0.618	−0.231	0.907
	[16.860]	(1.010)	(1.298)	(1.255)	(1.176)	[2057]
Household size	5.588	0.131	−0.098	0.293	0.193	0.256
	[2.861]	(0.172)	(0.198)	(0.239)	(0.198)	[2063]
No formal education	0.310	−0.020	−0.022	−0.017	−0.020	0.898
	[0.463]	(0.027)	(0.032)	(0.033)	(0.035)	[2065]
Primary education	0.575	0.003	0.025	0.012	−0.029	0.507
	[0.495]	(0.030)	(0.036)	(0.037)	(0.037)	[2065]
Secondary or higher education	0.114	0.017	−0.002	0.004	0.050	0.451
	[0.319]	(0.024)	(0.027)	(0.027)	(0.035)	[2065]
Years of schooling	3.690	0.067	0.004	−0.114	0.314	0.579
	[3.405]	(0.237)	(0.274)	(0.269)	(0.325)	[2065]
Muslim	0.555	0.017	0.015	0.046	−0.009	0.877
	[0.497]	(0.060)	(0.075)	(0.073)	(0.072)	[2065]
Macua ethnic group	0.599	0.048	0.083	0.031	0.031	0.783
	[0.491]	(0.065)	(0.081)	(0.081)	(0.082)	[2065]
Maconde ethnic group	0.294	−0.044	−0.054	−0.061	−0.018	0.834
	[0.456]	(0.063)	(0.078)	(0.075)	(0.078)	[2065]
Semi-urban	0.109	0.005	−0.009	−0.008	0.031	0.926
	[0.312]	(0.049)	(0.060)	(0.060)	(0.065)	[2065]
Urban	0.091	−0.031	−0.031	−0.032	−0.031	0.914
	[0.288]	(0.043)	(0.051)	(0.051)	(0.051)	[2065]
Trust index	0.751	0.005	−0.003	−0.003	0.022	0.591
	[0.246]	(0.017)	(0.020)	(0.020)	(0.022)	[1949]
Public funds to influent people	0.550	0.013	0.009	0.015	0.014	0.970
	[0.498]	(0.028)	(0.035)	(0.034)	(0.036)	[1907]
Ever heard about the natural gas	0.487	0.001	−0.053	0.024	0.031	0.403
	[0.500]	(0.047)	(0.056)	(0.055)	(0.058)	[2064]
Leader characteristics						
Female respondent	0.036	−0.016	−0.036	0.003	−0.016	0.556
	[0.189]	(0.024)	(0.030)	(0.030)	(0.030)	[206]
Leader's age	54.091	0.505	0.549	0.517	0.449	0.991
	[10.624]	(1.556)	(1.940)	(1.930)	(1.940)	[206]
Years of schooling	6.200	−0.783*	−0.500	−0.631	−1.220**	0.182
	[2.946]	(0.446)	(0.554)	(0.551)	(0.554)	[206]
Village characteristics						
Natural resources index	0.044	−0.001	−0.014	0.013	−0.004	0.180
	[0.060]	(0.010)	(0.012)	(0.012)	(0.012)	[206]
Infrastructure index	0.483	0.014	0.00	0.032	0.010	0.703
	[0.150]	(0.025)	(0.031)	(0.031)	(0.031)	[205]

Note: *** p < 0.01, ** p < 0.05, * p < 0.1. Column (1) reports sample mean and standard deviation in brackets for the control group. Column (2) reports the difference between all treatment groups pooled together and the control group using an OLS regression of the corresponding characteristic on the treatment indicator. Columns (3)–(5) report the difference between each treatment group and the control group. Standard errors clustered at community level are reported in parentheses. Column (5) presents a joint test of significance of the coefficients for each treatment dummy.

Table C2: Correlates of awareness and knowledge at baseline

Dep. var.	Awareness		Knowledge	
	(1)	(2)	(3)	(4)
Female respondent	−0.186***	−0.207***	−0.126***	−0.143***
	(0.025)	(0.024)	(0.017)	(0.016)
Age in years	0.014***	0.014***	0.010***	0.010***
	(0.004)	(0.003)	(0.002)	(0.002)
Age in years (squared)	−0.000***	−0.000***	−0.000***	−0.000***
	(0.000)	(0.000)	(0.000)	(0.000)
Household size	0.014***	0.009***	0.009***	0.006***
	(0.003)	(0.003)	(0.002)	(0.002)
Primary education	0.069***	0.080***	0.054***	0.057***
	(0.023)	(0.021)	(0.016)	(0.014)
Secondary or higher education	0.378***	0.335***	0.284***	0.234***
	(0.039)	(0.037)	(0.028)	(0.025)
Muslim	0.136***	0.005	0.094***	−0.009
	(0.026)	(0.026)	(0.018)	(0.017)
Macua ethnic group	−0.288***	−0.032	−0.225***	−0.023
	(0.040)	(0.033)	(0.032)	(0.023)
Maconde ethnic group	0.131***	−0.020	0.044	−0.022
	(0.048)	(0.053)	(0.036)	(0.036)
Group membership	0.153***	0.150***	0.100***	0.104***
	(0.025)	(0.025)	(0.017)	(0.016)
Infrastructure index		−0.080		−0.068
		(0.101)		(0.076)
Natural resources index		−0.137		−0.122
		(0.221)		(0.143)
Village has a market		0.030		0.019
		(0.029)		(0.019)
Polling station size		0.004		0.004
		(0.008)		(0.005)
Below median distance from Palma		0.053		0.057
		(0.052)		(0.036)
Leader's age		−0.003		−0.002
		(0.010)		(0.007)
Leader's age (squared)		0.000		0.000
		(0.000)		(0.000)
Leader has primary education		0.048		0.030
		(0.077)		(0.047)
Leader has secondary or higher education		0.021		0.013
		(0.079)		(0.049)
Observations	1958	1940	1958	1940
R-squared	0.245	0.349	0.256	0.398
Village controls	No	Yes	No	Yes
Household controls	Yes	Yes	Yes	Yes

Note: *** p < 0.01, ** p < 0.05, * p < 0.1. Standard errors are reported in parentheses and clustered at village level. Depending on the column, the dependent variables are defined by the following: (1)–(2) awareness: indicator variable equal to 1 if the respondent reports having heard about the natural gas discovery; (3)–(4) knowledge: index built averaging 12 indicator variables concerning knowledge of whether the government is receiving revenues from natural gas extraction, about the firms involved and about the location of the discovery.

Online appendixes

Online appendix A: Survey instruments

http://www.3ieimpact.org/sites/default/files/2019-02/tw8.1008-Online%20appendix-A-Survey-instruments.pdf

Online appendix B: Pre-analysis plan

http://www.3ieimpact.org/sites/default/files/2019-02/tw8.1008-Online-appendix-B-Pre-analysis-plan.pdf

Online appendix C: Information package

http://www.3ieimpact.org/sites/default/files/2019-02/tw8.1008-Online-appendix-C-Information-package.pdf

Online appendix D: Play script for community theatre

http://www.3ieimpact.org/sites/default/files/2019-03/tw8.1008-Online-appendix%20D-Play-script-for-community-theatre.pdf

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Substantial natural resources have been discovered in the Rovuma Basin in Mozambique in recent years. Resource and revenue mismanagement remain a risk due to weak institutions and limited media independence in the country. This study evaluated the impact of providing information to local leaders and communities in the region, which entailed sharing details about the discovery of natural gas, plans for exploration, and implications for provincial government revenues and job creation. The intervention included citizen deliberation meetings, where the community discussed public policy priorities in relation to the future windfall from natural gas. Authors find that elite capture and rent-seeking activities increase when information is given only to local leaders. On the other hand, the community-targeted information campaign increased citizen mobilisation, trust at different levels, voice and accountability, and decreased the likelihood of violence.

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