

RESEARCH ARTICLE

Adaptation finance failing to reach the most vulnerable: A multi-level model of household political power in Madagascar

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Abstract

International financial support for climate adaptation is expected to double by 2025. As adaptation finance expands, however, concern is growing that it is failing to benefit those most vulnerable to negative climate impacts. Qualitative studies have demonstrated how entrenched forms of inequality, such as patronage, can enable elite capture of international resources and prevent benefits from reaching relatively vulnerable households within communities. This study contributes to the literature on power in adaptation and climate finance by quantitatively analyzing the distributional outcomes of a UN Adaptation Fund project in the Alaotra-Mangoro region of Madagascar. We employ mixed-methods to examine how informal mechanisms of patronage influenced the distribution of project benefits. Using a multi-level model to analyze 599 household surveys, we compare the political connectivity of beneficiary and non-beneficiary households. We find that households that participated had higher levels of political connectivity than those that did not. This finding is robust across three different measures of participation and is reinforced by qualitative findings from formal and informal interviews. We conclude that rather than targeting the most vulnerable, the project likely disproportionately benefited households already better positioned to adapt and exacerbated inequality within targeted communities. By unpacking how household-level political power shaped access to benefits, this study advances discussion on rethinking approaches to power and inequality in internationally financed adaptation.

Introduction

International financial support for climate adaptation is growing rapidly. Under the UN Climate Convention, high-income countries pledged US\$100 billion in annual support for climate action in low-income countries, beginning in 2020 and with a balance between mitigation and adaptation [1, 2]. According to a recent estimate, international adaptation finance—the mobilization of public and private resources to enable deliberate change in response to or anticipation of climate impacts—has grown to US\$46 billion (2019–2020) from

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US\$30 billion (2017–2018) [3]. Nevertheless, wealthy countries have acknowledged falling short of the overall climate finance goal, and particularly short of financing adaptation in low-income countries [4]. They subsequently committed in the 2021 Glasgow Climate Pact to double financial support for adaptation by 2025 [5].

In principle, adaptation finance is intended to benefit those most vulnerable to negative climate impacts. The Paris Agreement states that the provision of climate finance should account for the “needs and priorities of developing country parties, especially those that are particularly vulnerable to the adverse impacts of climate change” [2]. The 2021 Glasgow Climate Pact further encourages multilateral organizations, which deliver a significant proportion of funding for adaptation, to “consider how climate vulnerabilities should be reflected in the provision of scaled-up financial resources” (5). Vulnerability is thus a key principle in the allocation of funding, as well as a primary way in which adaptation finance differs from development finance [6, 7].

As adaptation finance continues to scale up, however, concern is growing that the benefits of international projects and programs are failing to reach the most vulnerable [8–10]. Mounting evidence indicates that the most vulnerable countries receive less funding than moderately vulnerable counterparts [11–13]. Studies at the national-level have shown that vulnerability may play little role in government decision-making and that few international resources trickle down to local levels [14–16]. In a recent review of international adaptation interventions, Eriksen et al. [17] concluded that rather than benefiting the most vulnerable, many interventions actually reinforce and even exacerbate existing inequalities within targeted communities. This has led to calls to “put the needs of the vulnerable first” in internationally financed adaptation [9].

Funders face significant conceptual and practical obstacles, however, in their efforts to ensure that funding reaches the most vulnerable, especially at a community level. Conceptually, there is no agreed definition of vulnerability under the UN Climate Convention [18]. In this paper, we draw on the definition widely accepted within the academic community of vulnerability as a “state of susceptibility to harm from exposure to stresses associated with environmental and social change and from the absence of capacity to adapt” [19]. This conceptualization recognizes that vulnerability differs across scales: country by country, community by community, and between individuals and households (20). Even if exposure is common at the community level, sensitivity to that exposure and adaptive capacity will differ between individuals and households within communities [19, 20].

Relative vulnerability within communities is shaped by a range of interdependent factors: social and political relationships, which are themselves shaped by differences of gender, ethnicity, age, and class; often unequal control of productive assets, such as land, water, labor, and credit in agrarian communities; and differentiated access to information, including climate information that can enable effective adaptation [21–23]. Taylor [23] refers to this as a “disaggregated conceptualization” of vulnerability, in which the “relative security of some and the vulnerability of others are reproduced over time.” This conceptualization contrasts with that of most funders in international adaptation finance who are hesitant to acknowledge social differentiation within populations and therefore tend to aggregate vulnerability at the country and community level [23].

This hesitancy leads to a more practical challenge: how to influence the allocation of funding within countries and within communities. “Who gets what” is strongly influenced by context-specific sociocultural and political dynamics [24–27]. Of particular concern for adaptation finance is the influence of entrenched forms of inequality, such as patronage, when government workers are recruited for partisan reasons and use public office for private gain [28]. Such informal political arrangements have been shown to enable elite capture—the

expropriation of funds by powerful actors—inhibiting benefits from reaching the most vulnerable and politically marginalized [25, 29–32].

Sovacool [29], for example, found that a neo-feudal patronage system in Bangladesh enabled elites to “enclose” land they expected would become valuable under internationally financed adaptation programs. Artur & Hillhorst [30] similarly demonstrated how well-connected elites captured the largest plots of land and best locations for housing under a flooding relocation plan in Mozambique. Nelson & Finan [31] illustrated how long-standing patron-client relations limit the agency of rural farmers in northeast Brazil, trapping them in a state of persistent vulnerability. Eriksen et al. [17] call these forms of capture “accumulation by adaptation” and point to them as a major way that international interventions reinforce and exacerbate inequality. For multilateral and bilateral funders, reaching the most vulnerable thus requires recognizing these informal political dynamics and working within local contexts.

This study quantitatively investigates how patronage influences the distribution of adaptation finance, specifically whether it inhibits benefits from reaching relatively vulnerable households in targeted communities. It examines the distributional outcomes of a UN Adaptation Fund (AF) project in Madagascar. The US\$5 million project—“Promoting Climate Resilience of the Rice Sector through Pilot Investments in the Aloatra-Mangoro Region,” known locally as “AFRice”—was implemented from 2012–2019 by the Malagasy Ministry of the Environment, with support and oversight from the UN Environment Program (UNEP) [33, 34].

We choose to focus on the AF because it has the clearest mandate among multilateral and bilateral funders to reach those most vulnerable to climate change. The AF was established under the Kyoto Protocol to “assist developing country parties that are particularly vulnerable to the adverse effects of climate change to meet the costs of adaptation” [35]. Countries preparing project proposals must demonstrate how the project will provide benefits to the “most vulnerable communities, and vulnerable groups within those communities” [36]. Information on expected beneficiaries should reference the “equitable distribution of benefits to vulnerable communities, households, and individuals” [37]. Despite its targeted mandate, The Adaptation Fund Board has repeatedly declined to define “vulnerability,” illustrating the challenges of operationalizing the principle in adaptation finance overall [38].

We choose to focus on Madagascar for two reasons. First, because it is among the world’s most climate vulnerable countries by many measures [39, 40]. Rising temperatures and shifting precipitation patterns threaten agriculture, especially rice, the staple crop and primary food source for most Malagasy households [41, 42]. A large percentage of the population is chronically food insecure, especially during the annual rainy season [43–45].

Second, we focus on Madagascar because of the well-documented role of informal political patronage in influencing the distribution of public goods in the country [46, 47]. In political terms, the government is often characterized as neopatrimonial, functioning primarily as a patronage system, with employment, government contracts, and other goods distributed largely through affective networks and to political supporters [47, 48]. It is common for government officials to use public office for personal gain [48]. Political and economic power at the national level is held among competing factions of elites, mostly from a single ethnic group, the Merina [46, 49]. Historically, the distribution of public goods has been highly concentrated in and around the capital city of Antananarivo, and among ethnic groups that are geographically and culturally close to the Merina [50].

Outside the capital and its environs, the Malagasy government exhibits little capacity to provide social services or enforce rule of law [47]. In the absence of the state, a corpus of customary law and informal institutions structure social and political life at the local level [51]. These include: *fokonolona* (local community), *dina* (customary codes), *fady* (taboos), *fomban-drazana* (culture or the way of the ancestors), *fomba* (broader cultural norms), and

fiavanana (social harmony and mutual reliance) [52]. In many areas, these informal institutions interface awkwardly with the formal administrative structure of the Malagasy state. *Fokontany* (the smallest administrative unit of the state) roughly correspond to *fokonolona*, and the appointed heads, *Chiefs fokontany*, often share power with village elders, *tangalamena* [53, 54]. *Dina*, decided collectively by *fokonolona*, sometimes contradict and prevail over official law [55, 56].

Informal patronage is also common at this interface. Official positions at lower levels of the state hierarchy (e.g., in district, commune, and *fokontany* offices, as well as in regional Ministry offices) are often obtained through patronage [62]. Resources that reach local levels are often distributed through informal networks of patronage connected to actors with both formal and informal authority: elected and appointed state officials like Mayors and *Chiefs fokontany*, village elders, and other positions of local prominence, like priests. Teachers, doctors, and local security forces often use their positions to pursue personal political and economic incentives [57, 58]. State goods can also be distributed reciprocally through extended family networks (*havana*). Given these dynamics, it is unsurprising that elite capture has been observed in the distribution of international resources at local levels [59, 60].

This study asks whether and if so how informal patronage shaped the distribution of benefits associated with the AFRice project in Alaotra-Mangoro, Madagascar. Drawing on quantitative and qualitative methods, we examine whether politically connected households were more likely to participate in and derive valuable benefits from the project, and therefore whether AFRice reached relatively vulnerable households within targeted communities. By systematically investigating the on-the-ground outcomes of internationally financed adaptation, findings advance research on questions of power in climate finance, especially how entrenched forms of inequality inhibit funders' efforts to enable adaptation among those most vulnerable to climate change.

Methods

This study follows a two-phase, mixed-methods, case study approach [61, 62] (Fig 1). In the first phase, we drew on interviews, document analysis, and participant observation conducted at the national level to develop hypotheses about the AFRice project's distributional outcomes and to inform data collection [63, 64]. Initial findings also informed development of context-specific measurements of relative household vulnerability (based on characteristics of household wealth, food insecurity, land ownership, education levels, and geographic isolation) and household political connectivity (based on connections to positions of formal and informal power). In the second phase, we collected 599 household surveys and used a multilevel model to compare the political connectivity of beneficiary and non-beneficiary households in targeted communities. We draw on findings from formal interviews, as well as extensive informal interviews with local officials and observation in project sites, to elucidate the quantitative results.

Ethics statement

This study was granted ethical approval by the Institutional Review Board of the University of Michigan (#HUM00153820) as well as the Malagasy Ministry of Environment and Sustainable Development (#031/19/MEDD/SG/DGF/DSAP/SCB.Re). Approval to conduct surveys was granted by local authorities in Alaotra-Mangoro, including the Chief of Region, District Prefect, mayors of all four communes, and head of each *fokontany*. Written consent was obtained for all formal interviews and household surveys.

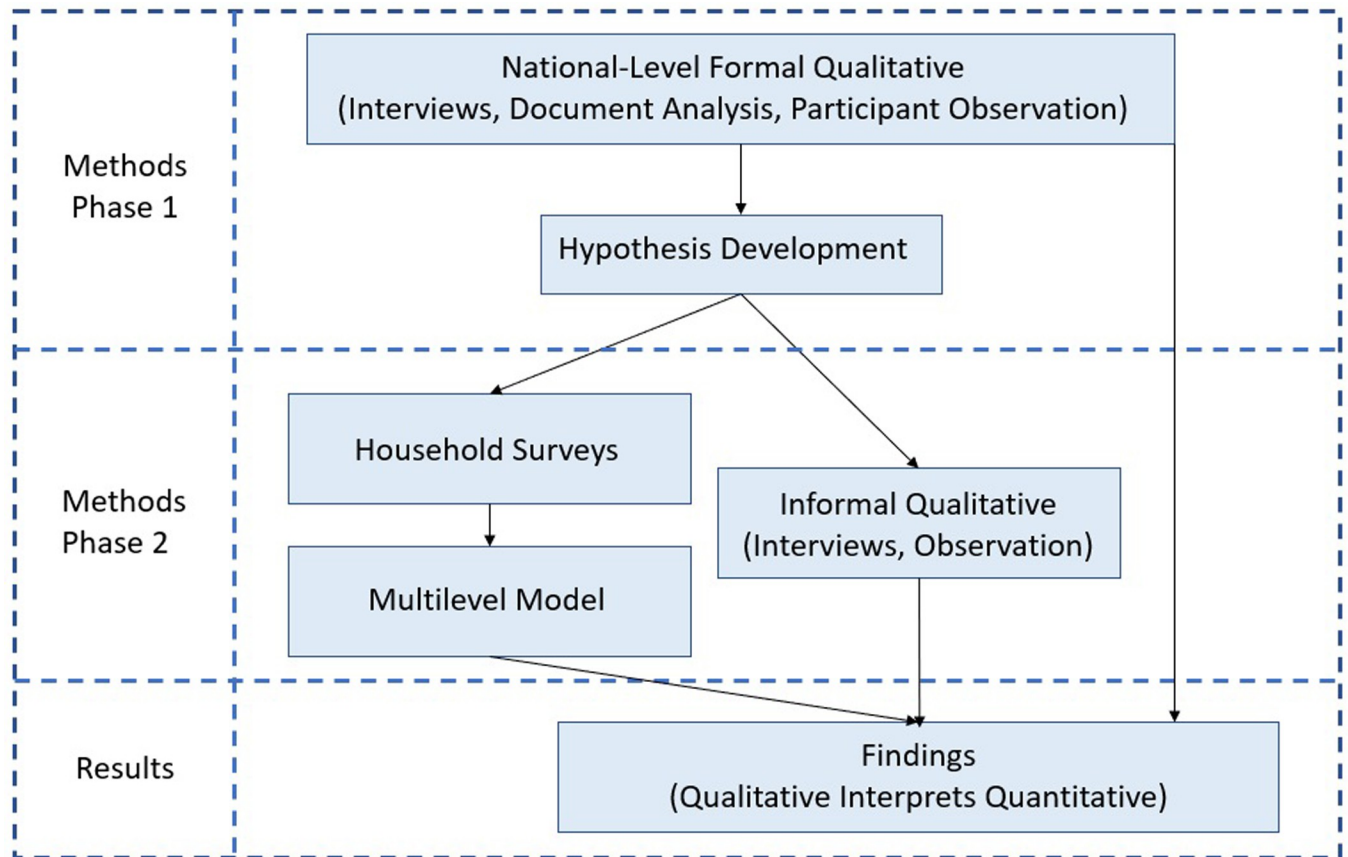


Fig 1. Methodology map.

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Inclusivity in global research

Additional information regarding the ethical, cultural, and scientific considerations specific to inclusivity in global research is included in the [S1 Text](#).

Qualitative methods

As part of a broader comparative study on international adaptation finance and national governance [65], we first conducted 63 interviews at the national level. The goal of this phase was to characterize Madagascar's governance landscape and to investigate how it shaped AFRice project design, implementation, and outcomes. We conducted general interviews with 35 Malagasy policymakers, civil society organizations, and representatives of multilateral organizations and development agencies. We additionally conducted 28 interviews with individuals directly involved in AFRice: members of the project team within the Ministry of Environment, representatives of other government ministries and agencies involved in implementation, UNEP officials, NGOs, private contractors, and international and domestic consultants. All interviews were semi-structured and conducted by the researchers in Malagasy. The majority of interviews were recorded, with the participants' consent, transcribed, and translated into English. The lead researcher coded the transcripts for themes using NVivo software. Findings from the interviews are supplemented by analysis of project documents—including the project proposal, annual reports to the AF, and mid-term and terminal evaluations completed for

UNEP by independent evaluators—as well as participant observation at the project’s closing workshop in Antananarivo.

These methods were further supplemented by informal, qualitative data collection within targeted communities. It is customary when conducting research of any type in rural Madagascar to introduce all members of the research team to local officials: the Chief of District, Mayors, *Chiefs fokontany*, and, depending on the community, village elders (*Tangalamena*). Though this is an important formality, it also presented frequent opportunities to learn informally about perceptions of AFRice in targeted communities, as well as the modes and logics that guided the distribution of project benefits. A three-month survey period also offered opportunities for observation and informal discussion with community members.

Criteria for site and participant selection and distribution of benefits

The AFRice project focused on improving the resilience of rice agriculture to climate variability. At the national level, the primary objectives were to: (a) develop a “resilient rice model” that could be broadly replicated, (b) build capacity in forecasting and vulnerability mapping, and (c) mainstream project findings into broader policy networks [66]. Within Alaotra-Mangoro, the project targeted “low-income farmers” in four communes [67]. It provided participating farmers with a number of direct benefits, both tangible (e.g., adapted rice seed, compost, agricultural tools, fruit tree seedlings) and intangible (e.g., opportunities to participate in agricultural trainings and community activities) [67]. Besides distributing these valuable goods to direct beneficiaries, the AFRice project also generated indirect benefits across the broader region, including upgraded infrastructure, reforestation, and the dissemination of improved climate forecasts and agricultural calendars [66]. These indirect benefits were theoretically accessible to all households in targeted communities.

Official project documents provided explicit but vague information on the criteria by which the Malagasy government selected project sites. The project proposal outlines four primary criteria for the selection of the Alaotra-Mangoro region: demography (number and density of people), social considerations (poverty level), climatic variability (climate risks and occurrence of extremes), and economic criteria (importance to the national economy) [66]. It emphasizes the final criterion, noting that Alaotra-Mangoro is the country’s primary rice growing region. “. . .home to [its] most productive farms, with average yield per ha standing at 25% over the national average” [66]. AFRice targeted three communes within Alaotra-Mangoro for intervention: Manakambahiny Andrefana, Amobhijanahary, and Bemaitso [67] (Fig 2). The proposal notes that the communes were selected “according to a set of social, economic, environmental, and institutional criteria,” though the accompanying annex only lists information for the three districts chosen [66].

The selection of participating households within project sites was unclear and often inconsistent. The proposal states that participants were to be selected “based on local consultations, and in accordance with current practice, among those who are working as community relays in collaboration with the Agricultural Research Institutions” [66]. Except for a single direct benefit, the distribution of fruit seedlings, project documents did not define how beneficiaries were selected [68]. The lack of criteria continued throughout the project’s lifetime, with the mid-term review noting that “the selection process is not clearly defined” [69]. The terminal evaluation similarly observed that: “The project aims to support the livelihood of low-income farmers but does not distinguish between income levels among beneficiary groups” [67].

Many project documents that could have informed analysis of AFRice’s distributional outcomes were either missing, incomplete, or publicly unavailable, a fact noted in the terminal evaluation. For example, of forty-three separate workshops and trainings the project

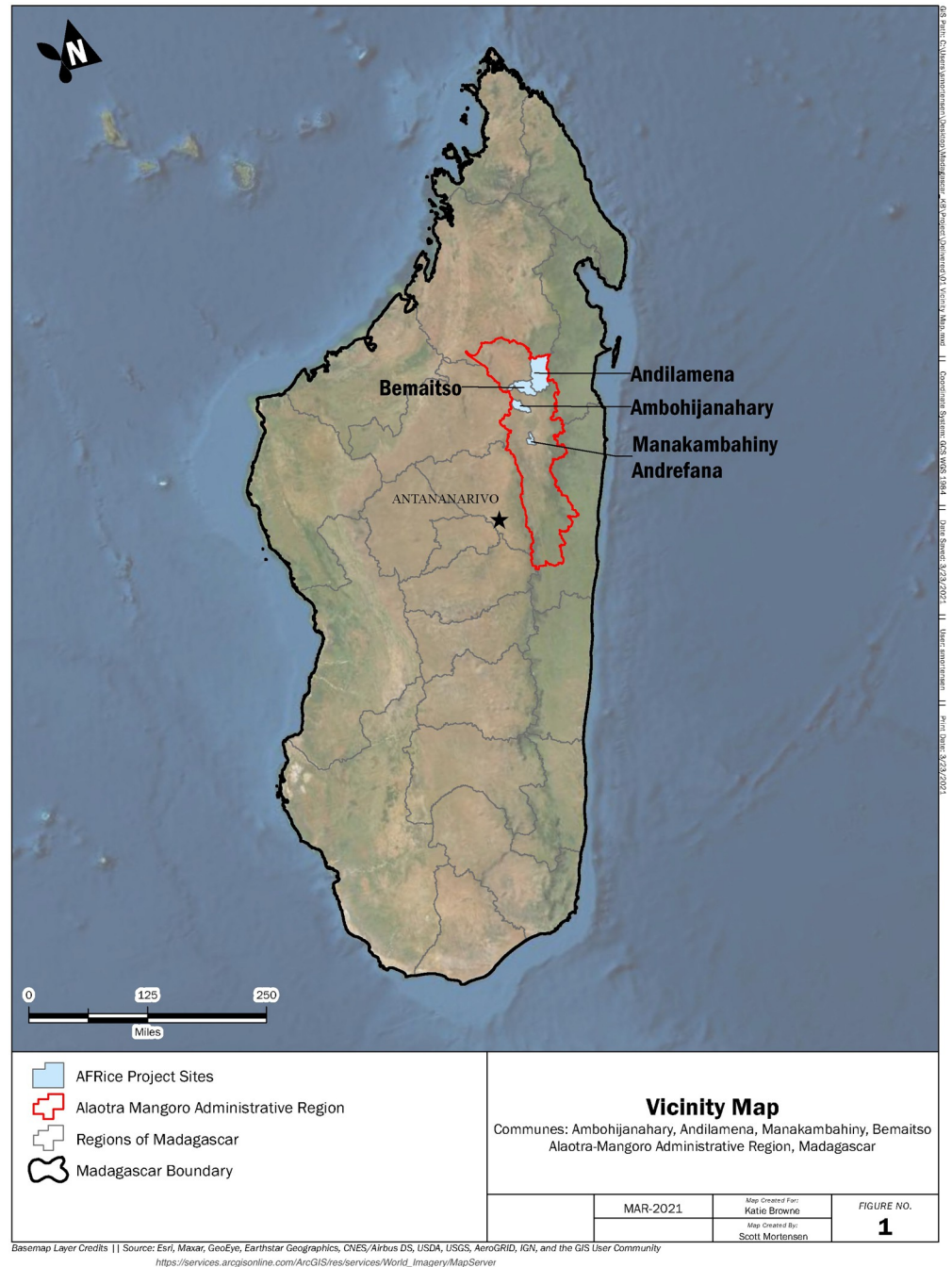


Fig 2. Madagascar area map with Alaotra-Mangoro region and primary “AFRice” project sites.

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conducted from 2012–2019, participant lists were available for only nine. Though trainings on the resilient rice model occurred in Alaotra-Mangoro from 2014–2019, participant lists are only available for 2018. Likewise, where information on beneficiaries was recorded, it was often vague and inconsistent. Project documents provide three different figures for the total number of farmers in Alaotra-Mangoro trained in the resilient rice model: 1,495 [70], 1,761 [71], and 2,349 [67]. Beneficiary lists for the distribution of fruit seedlings could only be found

for one year (2019) of the three years distributed [68]. No information was available on the beneficiaries of goods such as non-rice seed and compost. Some benefits—such as agricultural implements and pumps—were not documented at all and were only identified through initial site visits.

Informal patronage at national and local levels

Interviews with AFRice actors at the national level indicated that patronage strongly shaped the project's overall design and implementation (for detailed findings, see 65). In keeping with the neopatrimonial characteristics of the Malagasy government, project officials frequently used AFRice resources for personal political and economic gain. Through a series of kick-back schemes, officials in the Ministry of Environment directed a significant portion of AFRice funding to a narrow group of elites within and closely connected to the government: high-level bureaucrats, consultants, and private contractors [65].

The selection of Alaotra-Mangoro as the project's primary intervention site also followed a pattern of political and ethnic patronage in the distribution of public goods. Though the project proposal lists "poverty level" among the criteria for site selection, Alaotra-Mangoro is among the more prosperous of Madagascar's twenty-two regions. A survey conducted in 2010—around the time the project was designed—found Alaotra-Mangoro to have the sixth lowest regional poverty rate in the country, at 51% [72]. By comparison, Madagascar's poorest region at the time, Atsimo-Andrefana, had a 97.7% poverty rate, which the authors observe made it "probably the poorest area so defined in the world" [72]. In addition to its importance to the country's economy, however, Alaotra-Mangoro is a politically important region. Located not far from the capital, it is populated primarily by the Sihanaka ethnic group, which is among those that benefit from cultural and geographic proximity to the Merina [46, 50].

Further, interviews at both the national and local levels indicated that patronage influenced the selection of project beneficiaries and the distribution of project benefits. Both international and Malagasy consultants acknowledged that political influence played a role in determining who received benefits, especially *Chiefs fokontany* who had significant leeway to distribute goods. Local project representatives could not describe the process by which beneficiaries were determined. Several project actors said benefits had been distributed through "word of mouth" and "self-designation." A domestic consultant claimed that most of the project's benefits went to elites in targeted communities: the project was for those with "good connections" and therefore "increased the gap between richest and poorest." During preliminary site visits, the survey team also learned that many benefits intended for the commune of Bemaitso had been redirected to a *fokontany* in a neighboring commune outside of official project sites. The survey team also observed that valuable tools appeared to have been distributed to the wealthiest households in project sites. One *Chief fokontany* noted that while most residents in his village had participated in community reforestation projects, only ten residents had received the most valuable benefits: shovels, hoes, and pumps for pesticide use.

Hypothesis development

Given the lack of clear information on criteria for and selection of beneficiaries, direct data collection was the only option to analyze who benefited in the target communities and why. Drawing on findings from interviews and observation, survey design and data collection was driven by four main hypotheses. Hypothesis 1 (H1) was that beneficiary households would have higher levels of political connectivity than non-beneficiary households. Other hypotheses were: (H2) that households with higher levels of participation would have higher political connectivity, (H3) that the more valuable the benefits received from AFRice, the more politically

connected the household, and (H4) that access to indirect benefits of the project, theoretically available to all households in project sites, would also be positively associated with political connectivity. The following household characteristics were also expected to influence household political connectivity: socioeconomic status, education level, land ownership, food insecurity (a proxy of vulnerability), and geographic isolation.

Household surveys

The goal of the household surveys was to measure the distributional outcomes of the AFRice project in its primary intervention sites. A survey team collected 599 surveys from the project's intervention sites (Fig 3). Though the project officially targeted three communes, interviews revealed that it had also unofficially included a fourth, Andilamena. (The sampling design was altered to account for the additional project site). Project documents and interviews with local project representatives indicated that about half of *fokontany* in each commune were selected to participate, with only a select number of households participating within each *fokontany*. Cluster sampling was used to identify a representative sample of three different subject groups in these communes: beneficiary households in beneficiary *fokontany*, non-beneficiary households in beneficiary *fokontany*, and non-beneficiary households in non-beneficiary *fokontany* (see S2 Text for detailed sampling design).

Survey questions captured information about household wealth (as measured by key assets and socioeconomic indicators), education level, land ownership, ethnicity and immigration status, coping strategies, and adaptive capacity (see S3 and S4 Texts for survey in Malagasy and English). The survey used an index to capture each household's current level of food insecurity, an important and nuanced indicator of climate vulnerability because food insecurity is not only widespread but can also vary widely within and between villages.

Survey questions also measured household political connectivity as a product of household and extended family members' (*havana*) positions in government, institutions of customary governance, security forces, and community-level leadership, as well as household members' participation in local committees (Fig 4). This measurement of household political power draws on the concept of communities as networks: "structured by unequal power relations and unequal access to knowledge, resources, and decision-making" [32]. Specifically, this measurement is predicated on the notion that access to state resources in Alaotra-Mangoro is shaped by family connections to both formal and informal institutions, especially positions within the state patronage structure. Power is a complex concept and measuring it quantitatively is inherently problematic [73]. Though the measure may be reductive, taken together with the in-depth qualitative findings, it is an insightful proxy for how a given household's network interfaced with the state apparatus at the time the survey was conducted.

Finally, the survey captured forms of household participation in the AFRice project: how beneficiaries heard of it and were selected to participate; the direct benefits received by beneficiary households, both tangible (e.g., adapted rice seed) and intangible (e.g., agricultural trainings); and the indirect benefits theoretically accessible to all households in the project sites (e.g., benefits from improved infrastructure or access to updated forecasting). Survey questions—particularly the food security index and socioeconomic indicators—were refined to local context with feedback from six focus groups in the three official communes (S5 Text). The survey was additionally tested over two days of survey team training in the regional capital, Ambatondrazaka. It was administered by a small team of local enumerators, in local dialects of Malagasy, over a two-month period (October–November 2019).

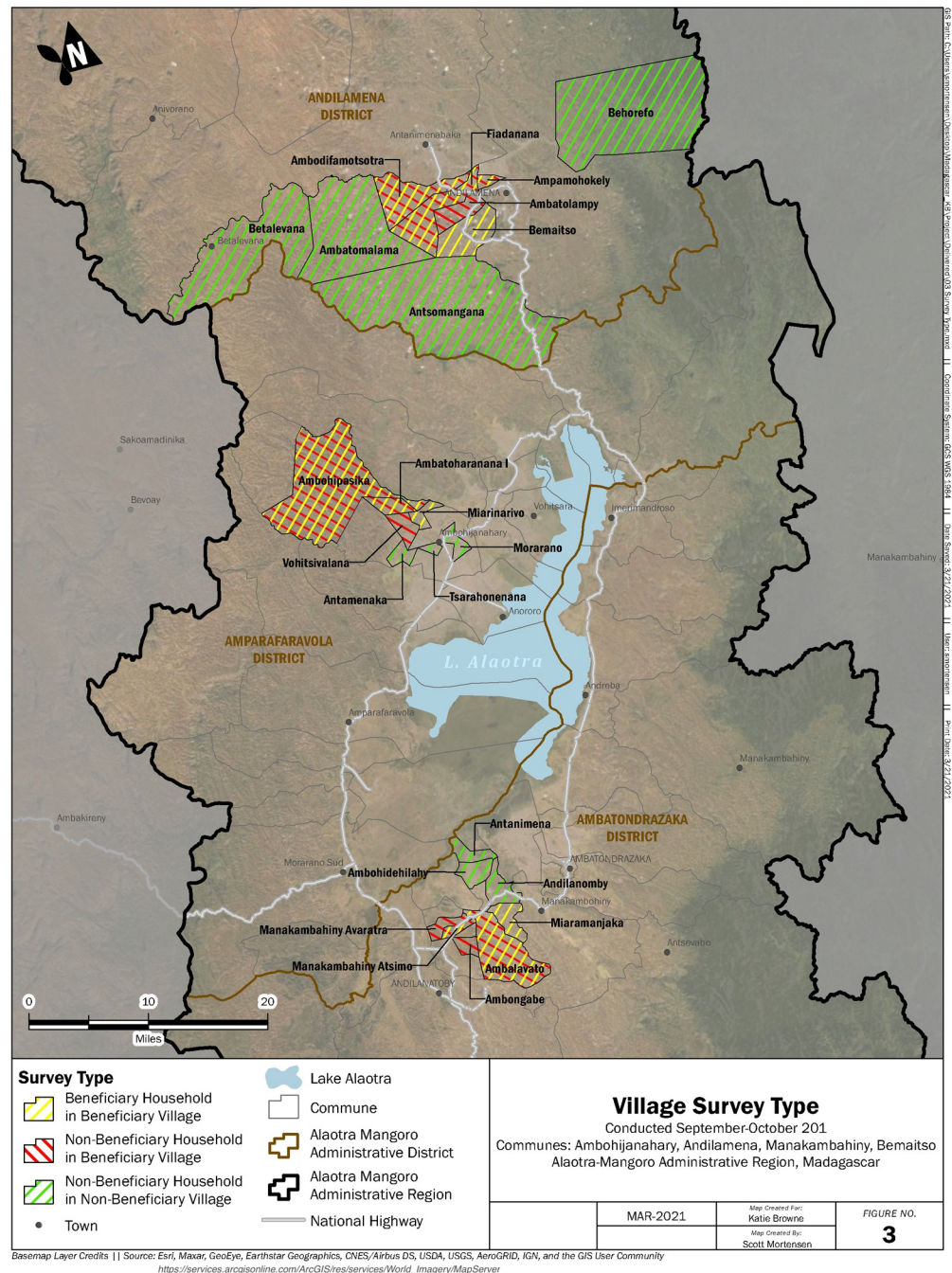


Fig 3. Survey sites in Alaotra-Mangoro, Madagascar.

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Using a multilevel model to understand distributional outcomes

We used a Multi-Level Model (MLM) to explore differences between households that benefited from AFRice and those that did not. MLMs allow the researcher to analyze data in which one set of units is clustered within another set of units [74]. In this case, the households represent the first level of analysis (Level 1) clustered within the secondary level of

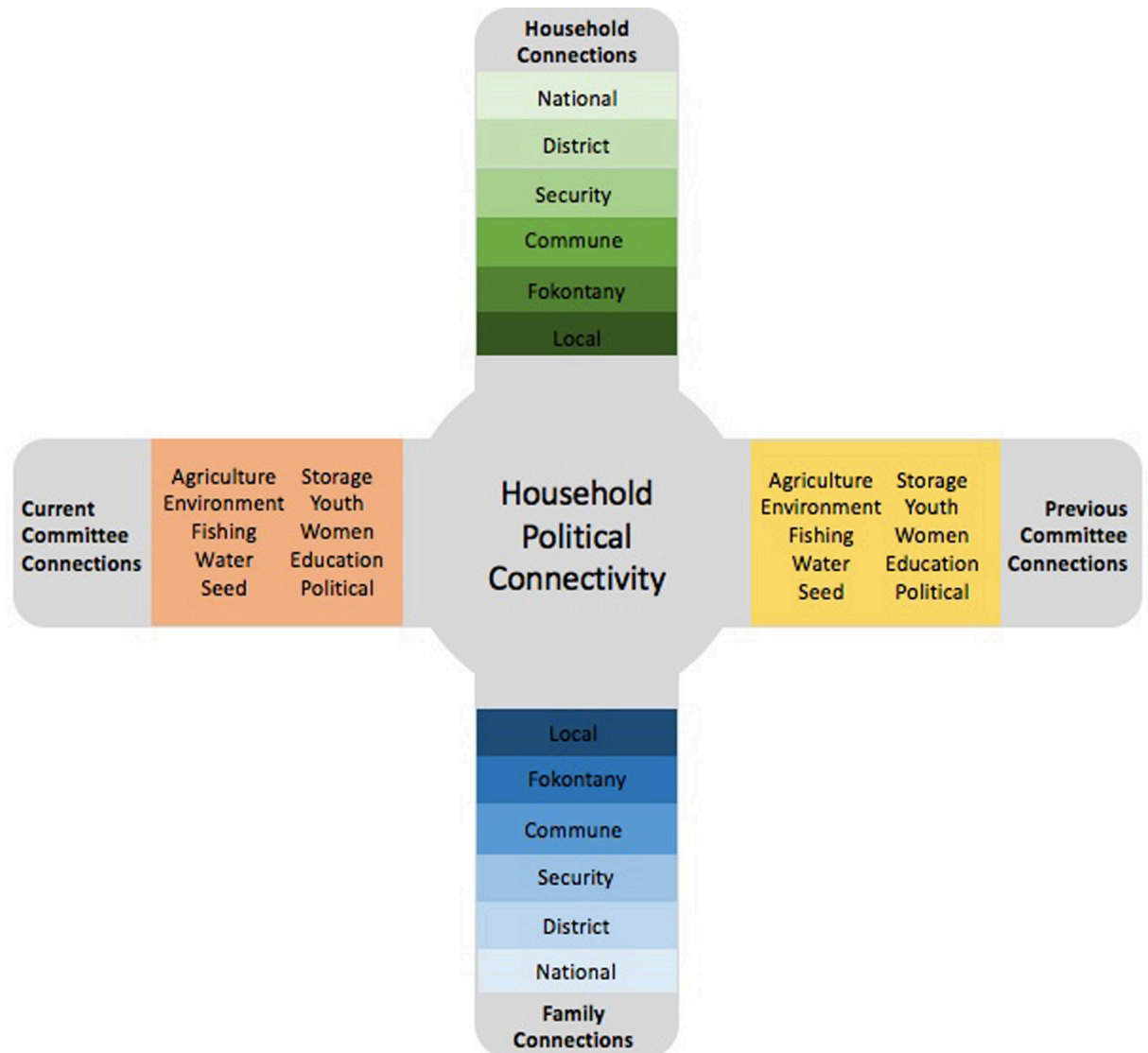


Fig 4. Household political connectivity measured along four dimensions.

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fokontany (Level 2). The data collected represent 599 Level 1 units and 24 Level 2 units. The analysis was conducted in R (version 4.0.1) using the multilevel package.

The MLM incorporates index variables for food insecurity, household assets, political connectivity, and three different measures of AFRice project benefits (Table 1). Other variables in the model include: household land ownership (measured in total hectares), household head education level (measured in years), and village distance from a national highway (a mean of all household responses in a given village, measured in minutes walking). Additional sensitivity analyses were conducted using different measures of land ownership (such as potential agricultural value) but none improved model fit. All control variables, except for village distance, are grand mean centered to ease interpretation.

The model presented below compares the political connectivity scores of two groups (beneficiary and non-beneficiary households), controlling for other household- and village-level characteristics that we hypothesize also influence household political connectivity. The null

Table 1. Index variables.

Index Variable	Method	Detailed Description
Short Term Food Insecurity	Frequency of a household's use of food insecurity coping strategies in past week multiplied by severity weight of each strategy. Strategies identified and weighted in focus groups.	S6 Text
Household Assets	Combined value of household's durable goods and livestock, divided by number of household members.	S7 Text
Political Connectivity	Number of household and extended family connections to political positions (formal and informal) and committee participation (current and previous). Household and family positions consolidated into hierarchy levels. Number of connections at each level summed and weighted according to Principal Component Analysis.	S8 Text
Level of AFRice Participation	Number of forms of direct benefit a household received from participation in AFRice, including tangible (e.g., adapted rice seed) and intangible benefits (e.g., participation in trainings and community activities).	S9 Text
Value of AFRice Benefits	Estimated value of direct benefits a household received from AFRice, based on an assumption of a minimum amount received.	S9 Text
Level of AFRice Indirect Benefits	Number of forms of indirect benefit a household received from participation in AFRice, such as upgraded infrastructure for improved irrigation and access to updated weather forecasts.	S9 Text

<https://doi.org/10.1371/journal.pclm.0000050.t001>

model for this dataset is:

$$POL_{ij} = \beta_{0j} + \gamma_{00} + r_{ij} + u_0$$

It demonstrates that the mean political connectivity score of all households in the data set is 2.341. The Intraclass Correlation Coefficient (ICC) is 0.1964. This ICC indicates that 19.64% of the variation in households' political connectivity is explained by village-level variance, supporting the value of using a multi-level technique.

The model used to compare the political connectivity score of beneficiary and non-beneficiary households is:

$$POLCON_{ij} = \gamma_{00} + \gamma_{01}VDIST + \gamma_{10}BEN + \gamma_{20}ASSETS + \gamma_{30}LAND + \gamma_{40}EDUC + \gamma_{50}FOOD + u_{0j} + u_{1j}BEN + u_{2j}ASSETS + u_{3j}LAND + u_{4j}EDUC + u_{5j}FOOD + r_{ij}$$

Household wealth, land ownership, education level, food insecurity, and village distance are control variables, Level-1 and Level-2 characteristics that we hypothesize will also influence political connectivity. The primary coefficient of interest is project participation (BEN). For the primary hypothesis (H1), we expect that the coefficient on the participation variable (γ_{10}) will be positive.

Results

Household characteristics

[S1 Table](#) provides characteristics of surveyed households. Surveyed households were low-income by international standards, with average value of selected assets estimated at US\$1,514. They demonstrated wide variation, however: the asset value of the poorest household in the sample was estimated at US\$1.30 (the cost of a flashlight); in contrast, the asset value of the wealthiest household was estimated at US\$21,361. Education levels were low at 6.6 years average, but relatively high when considering that 58% of Malagasy citizens have not completed primary school [75]. Other variables of interest also varied widely, including land ownership,

geographic isolation, and food insecurity. Most households had experienced some form of food insecurity in the past seven days.

In addition to low measures of general adaptive capacity (e.g., wealth and education), households demonstrated low specific capacity, characteristics that are necessary for managing climate threats [22]. They had limited access to banking and use of crop insurance was rare. A significant percentage of households, however, accessed and used weather forecasts (60% and 41% respectively). Household livelihood strategies were relatively diverse, with an average of 4.3 different forms of income. Nevertheless, most households (82%) had relied on some form of long-term coping strategy in the previous calendar year.

By design a third of the sample participated in the AFRice project. Of beneficiary households, 55 out of 599 received the most valuable benefit, adapted rice seed. 164 households received the least valuable benefit, payment for tree planting. There was wide variation in level of participation, value of benefits received, and level of indirect benefits. Most beneficiaries reported hearing about AFRice from a local official ($n = 79$) or AFRice representative ($n = 77$). The majority reported volunteering for participation ($n = 177$), with a smaller number reporting they were selected to participate by an AFRice representative or local official. (Responses reported as raw totals rather than percentages because respondents were able to submit multiple responses). Among beneficiary households, 64% believed that participating in AFRice was equitable. Only 47% believed that the distribution of benefits was equitable.

Model outputs

The range of each variable is presented in Table 2. After grand-mean centering, the mean and standard deviation of the four control variables are not particularly relevant.

The correlation between the outcome and predictors are presented in Table 3.

Table 4 displays the primary model output. The expected political connectivity score for a household that did not participate in the AFRice project, and has average household assets, average land ownership, average education level, average food insecurity, and whose village is an average walking distance from a national highway is 2.226. The coefficient on household participation indicates that participation in the AFRice project is associated with a 0.338 increase in the political connectivity score. The coefficient is statistically significant at $p < .05$. This finding indicates that households that participated in the AFRice project are expected to have higher political connectivity than households that did not participate, controlling for other household and village characteristics that might have influenced political connectivity. In terms of other predictors, wealth had a small but significant positive effect on political connectivity, and education level had a relatively large and significant positive effect. Total land ownership, food insecurity, and village distance did not have significant effects. The primary model accounted for an additional 31% of the unexplained variance compared to the null model.

In addition to the primary model, three secondary models predict the association between three additional measures of AFRice benefits and household political connectivity. These three

Table 2. Grand mean centered variables.

	POL	BEN	ASSETS	LAND	EDUC	FOOD	VDIST
Min	-2.34	0	-328.03	-3.17	-6.19	-27.02	-119.80
Max	4.97	1	4584.57	69.23	9.81	130.978	729.86
Mean	0	0.33	0	0	0	0	0
SD	1.67	0.46	527.03	6.83	3.44	27.48	191.22

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Table 3. Correlation matrix.

	POL	BEN	ASSETS	LAND	EDUC	FOOD	VDIST
POL	1	--	--	--	--	--	--
BEN	0.148***	1	--	--	--	--	--
WEALTH	0.184***	0.054	1	--	--	--	--
LAND	0.017	0.074*	0.209***	1	--	--	--
EDUC	0.266*	0.245***	0.230***	0.152***	1	--	--
FOOD	-0.060	-0.031	-0.252***	-0.106***	-0.273***	1	--
VDIST	-0.086**	0.199***	-0.120***	-0.069*	-0.076*	0.100**	1

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measures are: a household’s Participation Level (sum of the number of benefits received and activities in which it participated); the Value of Direct Benefits received by a household from AFRice; and the Level of Indirect Benefits (sum of the number of ways a household indirectly benefited from the AFRice project). [Table 4](#) also displays the output from these models.

For all three additional measures of benefits, the coefficient is positively associated with political connectivity and statistically significant at $p < .05$. For Level of Participation, a one-unit increase in the form of a household’s direct participation in AFRice is associated with a 0.057 increase in the political connectivity score. As the scale for this variable is between 0–21, a household that participated in every AFRice training and activity, and received every tangible benefit, would expect to have a political connectivity score 1.2 points higher than a household that did not participate. For Value of Direct Benefits, a one dollar increase in value of benefits a household received from AFRice is associated with a 0.004 increase in the political connectivity score. As the scale for this variable is between 0–211.2, a household that received the highest value of benefits would expect to have a political connectivity score 0.84 points higher than a

Table 4. Multi-level model outputs.

Dependent Variable	Primary		Secondary	
	Participation	Participation Level	Value of Benefits	Indirect Benefits
	Political Connectivity	Political Connectivity	Political Connectivity	Political Connectivity
AFRice Benefits	0.338** (0.167)	0.057*** (0.016)	0.004** (0.001)	0.049** (0.023)
Household Assets	0.001*** (0.0001)	0.0005*** (0.0001)	0.0005*** (0.0001)	0.0005*** (0.0001)
Land Ownership	-0.018* (0.011)	-0.018* (0.011)	-0.018* (0.011)	-0.020* (0.011)
Education Level	0.111*** (0.021)	0.105*** (0.021)	0.108*** (0.021)	0.113*** (0.021)
Food Insecurity	0.003 (0.003)	0.003 (0.003)	0.003 (0.003)	0.003 (0.003)
Village Distance	-0.0004 (0.001)	-0.0004 (0.001)	-0.0005 (0.001)	-0.0004 (0.0005)
Constant	2.226*** (0.108)	2.205*** (0.104)	2.246*** (0.101)	2.201*** (0.112)
Observations	587	584	584	584
Log Likelihood	-1,089.313	-1,085.940	-1,088.736	-1,089.730
Akaike Inf. Crit.	2,196.627	2,189.879	2,195.472	2,197.461
Bayesian Inf. Crit.	2,235.956	2,229.209	2,234.801	2,236.790

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household that did not receive direct benefits. For Level of Indirect Benefits, a one-unit increase in the form of a household's indirect benefits from AFRice is associated with a 0.049 increase in the political connectivity score. As the scale for this coefficient is 0–15, a household that received all the indirect benefits of the project would expect to have a political connectivity score 0.74 points higher than a household that did not indirectly benefit. Other predictors retain their positive or negative associations, and statistical significance or insignificance, across the three additional models.

Discussion

Reinforcing structural inequality in Aloatra-Mangoro

This study examined whether and if so how informal patronage influenced the distribution of benefits associated with the UN Adaptation Fund “AFRice” project in Madagascar. Findings from 599 household surveys collected across AFRice's primary intervention sites indicate that households that participated had higher levels of political connectivity than those that did not. This was the case even when controlling for other household and village characteristics that could influence political connectivity. The finding was robust across three additional measures of project benefits. Not only was participation associated with higher political connectivity, but so was the degree to which households were involved and the value of benefits they received. Even indirect benefits—theoretically accessible to all households in the targeted communes—were associated with higher household political connectivity.

It is important to note two significant limitations to the use of this model. First, the model is relational, not causal. It enables the comparison of two groups (beneficiary and non-beneficiary) in terms of the outcome variable, political connectivity, accounting for the nested structure of the data and controlling for other variables. The model does *not* evaluate how households changed as a result of participation in AFRice. Adaptive capacity, for example, might be higher among beneficiary households but, through this model, it is not possible to know whether this difference in capacity was the result of participation or of other factors. Political connectivity, however, was unlikely to be altered by project participation.

The second limitation is that, due to the lack of baseline information, the data collected represents only a snapshot in time. The model provides information only about how the groups compared in the final months of the AFRice project in 2019. This limitation also affects specific variables. Food insecurity, for example, fluctuates seasonally in Aloatra-Mangoro [76]. The seven-day recall window of the food security index, which respondents preferred for accuracy, might limit the comparability of households across the 60-day survey period. It is important to note, however, that the survey was conducted during a relatively stable season for food security, before the annual “lean period” [44].

Though the model does not allow claims about causality (i.e., that households were chosen to participate in AFRice because of their political connections), these findings support the hypothesis that households' formal and informal connections to the state apparatus influenced their ability to access AFRice benefits. The project disproportionately benefited relatively less vulnerable households, those already better positioned to adapt by virtue of their socioeconomic status, land ownership, and education levels. These findings are significant because they indicate that the AFRice project reinforced structural inequality within targeted communities in Aloatra-Mangoro. They lend quantitative support to similar qualitative cases where international interventions exacerbated inequality, particularly through patronage [25, 29–31].

The systematic measurement of distributional outcomes, combined with insights gleaned from interviews and observations, also sheds light on how informal networks influenced the distribution of benefits and contributed to inequality. In the following sections, we argue that

the AFRice project reinforced inequality in three ways: first, through elite capture facilitated by patronage; second, through the uneven movement of information and resources through informal kinship networks; and third, by reinforcing deep-rooted inequalities in communities, such as land ownership.

Illustrating elite capture

Eriksen et al. [17] recently argued that international adaptation interventions can contribute to inequality through processes of “accumulation by adaptation,” summarized as “the way in which already powerful members of the community may ‘capture’ and monopolize resources, capitalizing on their own privileged access and in so doing, marginalizing the most vulnerable” [77]. This was the case in Alaotra-Mangoro where, plainly put, more politically powerful households received more benefits and more valuable benefits.

Informal interviews with mayors, *Chiefs fokontany*, and local project representatives illustrate how informal mechanisms influenced the distribution of benefits. Frequently they acknowledged exchanging direct benefits for bribes, “hosting” (see description below), and, in the case of political officials, guarantees of political support. Members of the survey team also observed that project goods remained stockpiled in the houses of some *Chiefs fokontany*, and that elite households (wealthier and more highly educated) appeared to have received a disproportionate share of the most valuable goods, such as rice seed, fruit tree seedlings, and agricultural tools. When considering how valuable goods like rice seed were to households, it is worth noting that consumption of seed stock was cited as a common strategy for coping with food insecurity.

Two specific examples illustrate the ways that this patronage worked in practice. In one case, a prominent family—closely related to the commune’s mayor, many members educated at the university level—repeatedly “hosted” the local AFRice representative, inviting her to spend the night in their home and cooking her high-quality meals. In exchange, the family and several households in their family network, received a large proportion of the goods distributed in that *fokontany*. Because this is considered normal, neither the family nor the project representative hesitated in sharing information about the arrangement.

In another case, a high-ranking regional official intervened to direct benefits intended for the commune of Bemaitso to a neighboring *fokontany*, where family of both he and the local AFRice representative resided. The survey team learned of the change through a domestic consultant, who noted the redirection has fostered significant resentment. Both of these examples align with traditional understandings of elite capture. What is notable, however, is how systematically these informal mechanisms operated: not just in one *fokontany* or commune, but broadly across all of AFRice’s intervention sites in Alaotra-Mangoro.

Thinking beyond “adaptation by accumulation”

The findings also indicate that the AFRice project reinforced structural inequality in ways that cannot be explained solely by elite capture. Households with lower political connectivity were also less likely to access the project’s indirect benefits, goods intended to be dispersed broadly such as updated weather forecasts and crop calendars, upgraded irrigation infrastructure, and access to post-harvest storage facilities. Unequal access to these benefits points to the role played by informal kinship networks and deep-rooted forms of structural inequality.

Examples again help to illustrate this point. Take crop calendars, which provided households with updated information on when to plant and harvest common crops. Households with lower political connectivity were less likely to have heard of these calendars and to have used them. Informal interviews revealed that because the calendars were published in local

newspapers and distributed at AFRice trainings, they were disseminated through networks of more highly educated and literate households. Information about the project, and knowledge produced by the project, thus moved unevenly through community networks, particularly extended family networks, influencing which households were enabled to adapt [32]. One notable exception was weather forecasts broadcast over radio. Both beneficiary and non-beneficiary households widely accessed (61%) and used (48%) the information.

AFRice also reinforced preexisting forms of inequality within the targeted communes. Investments in pre-existing irrigation infrastructure, for example, benefited households that owned valuable agricultural land, usually productive rice paddies (*tanim-bary*) along valley bottoms. Such investments did not benefit households that farmed more marginal lands, usually on hill tops (*tanety*) that irrigation infrastructure did not reach. Similarly, the construction of post-harvest storage facilities at the head of each commune benefited centrally located households, rather than those in geographically isolated villages. Some surveyed households reported that the facilities were more than a 24-hour walk away, rendering them functionally inaccessible.

The challenge of reaching the vulnerable

With the recent pledges of the Glasgow Climate Pact, international funding for adaptation is likely to grow significantly in the short-term. At the same time, multilateral and bilateral funders face growing pressure to deliver financing to the countries, communities, and households most vulnerable to negative climate impacts. These findings highlight how complex and challenging this task will be, especially at national and sub-national levels. It is outside the scope of this paper to draw broad conclusions about international adaptation finance. We will, however, make some preliminary suggestions about how the AF could alter its approaches in Madagascar to ensure a greater share of benefits reaches relatively vulnerable households.

The first would be to clearly define “vulnerability” of beneficiary groups. While the AF requires countries to demonstrate “equitable distribution of benefits to vulnerable communities, households, and individuals,” it does not define this key part of its mandate [37, 38]. In Madagascar, this left distribution of project benefits open to patronage dynamics at both national and local levels, with the result that relatively prosperous households in a relatively prosperous region benefited disproportionately. In Alaotra-Mangoro, context-specific criteria of “vulnerability”-grounded, for example, in food insecurity rather than income-would increase transparency and encourage project actors to direct funding to vulnerable households. Second, the AF could focus on delivering more collective and dispersed goods. Among AFRice’s benefits, only weather forecasts enjoyed broad and relatively equal access, likely because most households (68%) owned a radio. While narrow, these findings could point to the importance of open forms of information in enabling more equal adaptation, especially in poorly connected rural areas.

Finally, the AF could recognize and work within, rather than around, existing forms of patronage in Madagascar. In concrete terms, this could mean providing goods directly to *Chiefs fokontany* to redistribute within communities, requiring that a portion be directed to relatively vulnerable households according to criteria such as food insecurity or geographic isolation. Reaching the most vulnerable households would require the AF to accept trade-offs, in this case the likelihood that *Chiefs fokontany* and other officials would use some project benefits for personal and political gain. As these findings illustrate, AFRice’s vague criteria and lack of transparency obscured significant elite capture at both national and sub-national levels. Bringing these trade-offs to light would at least enable the AF to analyze them.

Any of these approaches, particularly the last, would be controversial. Funders prefer vague and aggregated definitions of vulnerability because recognizing social differentiation would require more overtly political modes of intervention [78]. Working with patronage networks

would demand a total rethinking of current approaches. It would also open the AF to criticism that it tolerates and even enables corruption. All of these approaches would require nuanced understanding of social and political dynamics, long a weak point of international institutions and interventions [79]. Until funders like the AF emphasize context-specific knowledge—in Madagascar and elsewhere—international adaptation finance is unlikely to challenge entrenched inequalities to direct funding to the most vulnerable.

Conclusion

This study measured the distributional outcomes of an internationally financed adaptation project in the Alaotra-Mangoro region of Madagascar. We specifically examined whether patronage influenced the distribution of project benefits and therefore whether funding reached relatively vulnerable households in targeted communities. We used a multi-level model to analyze 599 household surveys and compare the political connectivity of beneficiary and non-beneficiary households.

We found that project participation was strongly associated with household political connectivity, as measured by household and family members' connections to formal and informal positions of power. This finding was robust across four different measures of participation. Drawing on qualitative findings, we conclude that it is likely that the project disproportionately benefited households already better positioned to adapt. The study provides quantitative support for what has previously been only theorized or qualitatively investigated: internationally financed adaptation can exacerbate structural inequality in targeted communities.

The study also unpacked how the AFRice project reinforced structural inequality within Alaotra-Mangoro. We drew on formal and informal interviews and observations from project sites to interpret the quantitative findings. We argued that the project reinforced inequality not only through elite capture, but also through the uneven dissemination of information and resources through extended kinship networks. We also illustrated how the project reinforced preexisting and deep-rooted forms of inequality in targeted communities, such as land ownership and geographic isolation.

These findings do have limitations. Because the model used here is relational, not causal, the quantitative findings alone are insufficient to conclude that political connections played a direct role in influencing project participation and distribution of benefits. Considered in the context of the qualitative findings, however, the data strongly support a causal relationship. It is also important to note the inherent difficulties of measuring political power. The political connectivity variable is a proxy: a snapshot of a given household's connections at the time the survey was collected. Finally, it is important to note that almost all sampled households, including beneficiaries, are vulnerable by international standards: the majority have few assets, rely heavily on agriculture, and demonstrate low general and specific capacity to adapt. The conclusions drawn here speak to the *relative* vulnerability of these households, within project sites and within Madagascar.

Providing international support for the most vulnerable communities, and the most vulnerable households and individuals within those communities, poses a tremendous challenge. There are no easy answers for how multilateral and bilateral funders should navigate structural inequality. We argue that, in Madagascar, the AF could take three specific steps to ensure a greater portion of benefits reaches relatively vulnerable households: defining vulnerability according to context-specific criteria; focusing on dispersed goods; and working within, rather than around, entrenched forms of patronage. Overall, we argue that, in order to reach the most vulnerable, funders like the AF must improve their understanding of social and political dynamics within the countries and communities they target for international interventions.

Supporting information

S1 Text. Inclusivity in global research checklist.

(DOCX)

S2 Text. Survey sampling design.

(DOCX)

S3 Text. Household survey in english.

(DOCX)

S4 Text. Household survey in Malagasy.

(DOCX)

S5 Text. Survey development focus groups.

(DOCX)

S6 Text. Short-term food security index.

(DOCX)

S7 Text. Household assets index.

(DOCX)

S8 Text. Political connectivity index.

(DOCX)

S9 Text. AFRice project benefits.

(DOCX)

S1 Table. Descriptive household characteristics.

(DOCX)

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