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How is disaster aid allocated within poor villages?

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Abstract

How disaster aid is allocated within poor villages is little understood. This paper examines risk-sharing institutions and social hierarchies as village self-allocation mechanisms. Original survey data from Fiji contain rich information about cyclone damage, traditional kin status, and aid allocations over post-disaster phases, at both household and kin-group levels. The paper shows under what conditions the performance of targeting aid to victims can significantly differ from overall risk-sharing outcomes determined by private transfers and aid (i.e., targeting *gap*). Elite domination in aid allocation can occur not only for given damage, but also in targeting on damage (i.e., targeting *bias*).

Keywords: disaster aid; informal risk sharing; social hierarchy; targeting; Fiji

JEL classification: O17; I38; Q18; Q54.

Vulnerability to natural disasters is a major barrier to development and poverty alleviation (Skoufias 2003), and effectively allocating disaster aid is critically important (Strömberg 2007). In rural areas, aid agencies distribute private goods (e.g., food, water) and public goods (e.g., shelter, infrastructure) across villages. Once aid in the form of private goods is distributed to a village, how are provisions allocated among households/individuals *within* the village? This question is critical, because aid supply is often scarce and its provision is commonly delayed; it has not been sufficiently answered, however, especially in developing countries, because of a paucity of data. Morris and Wodon (2003), for example, examine across-household allocation of disaster aid, but their data, which contain only five households per village, cannot address the issue of within-village allocation. As aid agencies' capacity and resources are limited in developing countries, village mechanisms play major roles in aid allocation. Using original, post-cyclone data in rural Fiji, this paper examines risk-sharing institutions and social hierarchies as self-allocation mechanisms.[1]

Informal risk-sharing institutions play central roles as safety nets in poor populations (see, for example, Dercon 2002, Morduch 1999 for reviews). Although a natural disaster is a region-

[1] Obtaining a better understanding of the allocation of disaster aid is of vital importance in small island states (Bertram 1986); some researchers criticize the deterioration of islanders' indigenous mechanisms in coping with cyclones because of their increasing dependency on emergency aid (e.g., Campbell 1984).

wide covariate shock, it may contain significant idiosyncratic components that can be locally shared, as shown by recent empirical studies (e.g., Mozumder, et al. 2009, Sawada and Shimizutani 2008). I propose that although disaster aid is distributed through public transfers to the village, its allocation within the village is part of private risk-sharing arrangements, as found by Dercon and Krishnan (2005) for food aid in Ethiopia. How well local ex post risk sharing can work depends on how much pooled resources that can be shared among people are reduced by the covariate disaster shock and then augmented by disaster aid and how the distributions of resources are altered by the disaster.

Targeting disaster aid toward victims – the greater the damage, the higher the probability of receipt or the greater the amount received – is a common goal. Frequent reports point to an inefficient distribution of disaster relief by uncoordinated agencies who lack pertinent information about the damage (Amin and Goldstein 2008). Importantly, when aid is allocated through risk sharing in a village, targeting performance no longer measures the effectiveness of disaster management. This is because what determines victims' welfare is their overall risk-sharing outcome, i.e., how much net aggregate private transfer, including aid, they receive. Researchers have not yet explored a potential difference between targeting performance and overall risk sharing, which I call a *targeting gap*. Distinct from targeting errors (e.g., inclusion/exclusion errors) determining targeting performance, the targeting gap determines the usefulness of the targeting itself. The paper shows how targeting gaps can be measured and significant.[2]

A social hierarchy can strongly shape the village governance that determines aid allocation. Researchers have given considerable attention to elite capture as a potential drawback of participatory or decentralized development (e.g., Bardhan and Mookherjee 2006, Conning and Kevane 2002, Galasso and Ravallion 2005, Mansuri and Rao 2004). Caeyers and Dercon (2008) find that connection to powerful elites is a strong determinant of food aid receipt within villages in Ethiopia. The paper discusses how bargaining between elites and non-elites can lead to *elite domination*: Elites are more likely to be recipients or to receive a greater amount than non-elites

[2] Targeting gap is related to potential crowding-out of private risk sharing: In the risk-sharing arrangement with limited enforceability, public transfer that increases the value of autarky relative to the value of staying in the contract will reduce the degree of risk sharing (Attanasio and Rios-Rull 2000). Crowding-out of private transfer caused by public transfer in general has been extensively studied in the literature (see Cox and Fafchamps 2008 for a review).

for given damage. In kin-based Fijian society, hereditary elite status is of central importance (Turner 1992); such hierarchical lineage-based societies are also common in Sub-Saharan Africa (Platteau and Abraham 2002). Since my survey stratified households in each village by their kin group and elite status, direct measures of elite status at the household and kin-group levels are available; in standard household surveys, in contrast, elite status is often unobservable to researchers, and even if it is observable, there are too few elites/elite groups to make a statistical analysis possible. As such, I can directly capture elite dominance. Distinct from networks, such as political and risk-sharing ones, kin groups are exogenous as determinants of aid allocation.

Building on kinship, risk-sharing institutions and social hierarchies are not independent of each other. In particular, kin groups are a major village subgroup in both risk sharing and bargaining. The paper shows that the interaction of these two mechanisms can lead to elite domination in targeting on damage, which I call *targeting bias*. Targeting bias is a potential source of systematic targeting errors. Carter and Castillo (2005) demonstrate that trust (measured by trust game) significantly helps asset recovery of hurricane victims in Honduras presumably through stronger informal risk sharing. The paper addresses heterogeneous risk-sharing patterns as an aid allocation mechanism with a focus on social status, but not social capital.

The analysis compares emergency food aid in the relief and early recovery phases and the provision of housing construction materials in the recovery/reconstruction phase (see de Ville de Goyet 2008 for a description of these three phases). It also compares their allocations within the kin group and across kin groups, as well as the allocations of food aid on housing and crop damage. As such, the paper examines how the targeting gap, elite domination, and targeting bias vary over post-disaster phases, at different levels of allocation, and across different shocks.

The paper synthesizes and extends two earlier works using the same Fijian data – Takasaki (2011c) on disaster relief and Takasaki (2011a) on reconstruction. First, building on these earlier works, I develop a conceptual framework of risk sharing, social hierarchy, and their interaction, propose targeting gap and bias as key new concepts, and employ unified empirical models to compare the relief and reconstruction in a consistent way. These conceptual and empirical syntheses lead to richer hypotheses to be tested than those in the previous works. Second, I conduct new empirical analyses on the magnitude of elite dominance and the interaction of risk sharing and hierarchy. In particular, the analyses show under what conditions targeting gaps, elite domination, and targeting bias can be significant.

The rest of the paper is organized as follows. Section I describes the Fijian data and kin-based hierarchy. Section II provides descriptive statistics of cyclone damage, relief, and reconstruction. Section III develops a conceptual framework of aid allocation through risk sharing, social hierarchy, and their interaction, deriving testable hypotheses on the targeting gap, elite domination, and targeting bias. Section IV develops empirical models to test the hypotheses, followed by the results in Section V. The last section summarizes major findings and discusses implications for local disaster management.

I. DATA, KINSHIP, AND HIERARCHY

Data

On January 13, 2003, Cyclone Ami swept over the northern and eastern regions of the Fiji Islands. I conducted two rounds of household surveys in intentionally chosen native Fijian villages with distinct environmental and economic conditions in the northern region (where Ami was the only cyclone from 1991 through 2005).[3] In each village, households were stratified by the smallest kin-group unit (defined shortly) and a combination of individual leadership (also defined shortly) and major asset holdings (e.g., shops) (all kin groups are sampled); in each stratum, households were randomly sampled.

The first-round interviews conducted between late August and early November 2003 among 374 households in 9 villages (including 43 clans, defined shortly) cover the relief and early recovery phases (henceforth called *relief sample*; the analysis is based on 340 households with complete data). The second-round interviews conducted between July and September 2005 among 906 households in 43 villages (including 7 villages covered in the first round, and 146 clans) cover the recovery/reconstruction phase (henceforth called *reconstruction sample*). Both surveys collected information about demographics, assets, production, income, shocks, disaster aid, and private transfers (but not consumption). Like other post-disaster surveys, information about cyclone damage and aid allocation was collected retrospectively; Takasaki (2011a, 2011c) show that systematic measurement errors are unlikely to be a major concern. Labor-transfer data were not collected in the first round, and labor transfers only in the past one year were collected

[3] Almost all villages are located on Vanua Levu and Taveuni Islands, which significantly lag behind the largest island, Viti Levu, where the state capital, two international airports, and most tourism businesses are situated. Fiji is divided almost evenly between native Fijians and Indo-Fijians. My study focuses on native Fijians.

in the second round. The data also lack information about specific process of aid allocation. These data limitations constrain empirical analyses.

Kinship and hierarchy

Each native Fijian belongs to a lineage of the *vanua-yavusa-mataqali-tokatoka* hierarchy: Vanua consists of several yavusa; yavusa consists of several mataqali; and mataqali consists of several tokatoka (Ravuvu 1983). Although vanua ranges over several villages, a village consists of one or few yavusa; mataqali and tokatoka are village subgroups. Fijians' social status is clearly defined as follows. First, among mataqali (henceforth called *clan*), one to which a yavusa or mataqali chief (*clan chief*) belongs holds a higher status than others (there is no takatoka chief). Second, among households, one with a *clan leader* (either a clan chief or non-chief leader, whose status is lower than the chief) who plays a major role in the clan's decision-making and negotiations among clans holds a higher status than other households. Village chiefs are either a clan chief or non-chief leader. These fixed kin groups and hereditary elite status are of central importance for village governance – including within-village benefit allocation such as disaster aid –, ritual, and livelihoods (Turner 1992); in particular, land is communally owned by mataqali and cannot be sold by law.

In the relief sample, about 9% of households have a clan leader and about 22% belong to clan-chief's clans (clan chiefs themselves are very uncommon, see Table 1). About 14% of households have a clan leader or a leader of tokatoka (henceforth called *sub-clan*) (sub-clan leaders' status is lower than clan leaders'), and about 42% belong to clan- or village-chief's clans. The distributions of these elites and elite groups in the reconstruction sample are similar.

II. CYCLONE DAMAGE, RELIEF, AND RECONSTRUCTION

Cyclone damage

The total damage across the country caused by Cyclone Ami is estimated at F$104 million (F$1 = US$.60), of which dwelling damage is F$22 million and crop damage is F$40 million (National Disaster Management Office 2003). Although all villages in the relief and reconstruction samples were damaged, public-health problems were not a major issue: Respondents reported no casualties and very limited injuries and illnesses caused by the cyclone. Household migration after the cyclone was almost nonexistent.

According to respondents' subjective assessments, in the relief sample, 8% and 45% of their main houses were completely destroyed and partially damaged, respectively, and the comparable figures in the reconstruction sample are 19% and 34% (Table 1)[4] (although many, but not all, households also had other free-standing units, such as kitchens, showers, and toilets, the paper focuses on damage to the main houses). Almost 40% of households with housing damaged in the relief sample became refugees who stayed in others' residences in the same village. About two thirds of the refugees lived with households in the same clan; hence, the clan served as a risk-sharing group.

Almost all households engaged in cropping and fishing. In the relief sample, cropping accounted for over one half of the total income before the cyclone, followed by fishing, with a 30% income share. About 87% of households experienced crop damage, and the mean value of damaged crops was F$35 per adult equivalent, which was about 60% of the mean monthly pre-cyclone crop income.[5] As another evidence for the importance of clans as a risk-sharing group, Takasaki (2011b) shows that households without housing damage helped with the housing rehabilitation of other clan members by intensifying fishing.

Relief

The Red Cross, other nongovernmental organizations, and governments provisioned relief. Food aid was the largest form of relief in the region, and all households in damaged areas were eligible. In the relief sample, respondents were asked the quantity of food aid received in each month measured in the number of days it would have taken to consume the food in normal periods, not the actual duration (foodstuffs in relief were mostly uniform across villages). The main delivery started in March; by the end of March, over three fourths of households received food aid; and by April almost all got some (Table 1). In the first three months, recipient households received about 13 days worth of food per month, on average, and the mean amount of food aid received in the six-month period among all households was about 10 days per month. The value of 60 days ration for six months is equivalent to about F$100 per capita, almost three times the average crop damage per adult equivalent. As households also collected harvestable damaged crops, food shortage was not a major issue. Households individually rehabilitated

[4] Relief officers used the same damage categories for their assessments, and thus the damage status of each house was common knowledge among villagers.

[5] Crop damage was calculated based on the quantity damaged for each major crop, as reported by respondents. Households employ traditional cropping practices (using no mechanized equipment or animal traction and limited purchased inputs) to produce mainly taro, cassava, coconut, and kava.

cropping; they planted fast-growing crops (e.g., sweet potato) after seeds were provisioned as part of the relief. Although the harvest had already started at the time of interviews in 2003, the mean crop income was still over 40% lower than the pre-cyclone level; cropping recovered after that time.

Reconstruction

In the recovery/reconstruction phase, housing reconstruction programs targeted households with damaged dwellings (including free-standing units). In the second-round survey, each household was asked whether it had received construction materials, and the recipient was asked about the year and month of receipt and its monetary value. Provisions in the first year (2003) were very limited; only 5% of households were recipients (Table 1).[6]

In addition to the co-residence for refugees, people helped others' housing rehabilitation; at the time of interviews in 2003, 38% of houses completely destroyed had been rebuilt, 62% of dwellings had completed repairs, and refugees were uncommon. Although labor-transfer data in the relief sample are lacking, Takasaki (2011c) offers the following indirect evidence for labor sharing against housing damage. First, households with damaged housing (and larger crop damage) contribute less labor for village rehabilitation. Second, crop income at the time of interviews in 2003 is neutral to crop damage as a result of own crop rehabilitation being intensified in proportion to crop damage. Accordingly, households with greater crop damage contribute less to labor sharing and receive smaller net labor/non-labor transfers, being less likely to complete housing rehabilitation.

Even after the provision of construction materials augmented in the second year, mutual help was crucial; although carpenters were sometimes sent to villages to help build new houses, villagers did most of the work. At the time of interviews in 2005, recipients reached 25% of households; although almost no households without dwelling damage (non-eligible) were recipients (i.e., almost no leakage), the limited supply resulted in significant under-coverage. In particular, provisions of full construction materials for new house building were delayed until the fourth quarter of the second year. The mean amount received among all recipients was F$2,680. Among households with housing completely destroyed, 40% had rebuilt their houses; 51% of recipients and 20% of non-recipients had done so (information about repairing is lacking in the

[6] In the relief sample, 16% of households received tarpaulins that could be used as emergency shelters and for temporary repair (Takasaki 2011c analyses their allocation).

reconstruction sample). Hence, provisions of construction materials greatly helped housing rehabilitation, but the supply was far short of demand, and the amount received by recipients was insufficient, especially for new house building. As a result, self-reconstruction with mutual help was relatively common.

III. RISK SHARING AND HIERARCHY

Risk sharing

I assume that households seek to smooth utility determined by consumption, leisure, and housing quality against crop damage (income shock) and housing damage (preference shock). There is no housing market. Health shock, savings, credits, migration, and across-village transfers are ignored. Ex post risk sharing consists of non-labor sharing – cash and inkind (e.g., food) – to smooth consumption and housing quality and labor sharing for housing rehabilitation within the village. In contrast, crop rehabilitation does not involve labor sharing.

How well risk sharing can work depends on pooled resources that can be shared. On one hand, non-labor resources are greatly reduced by crop damage and for smoothing consumption and rehabilitating housing; on the other hand, given that labor endowment is largely intact, labor resources do not decrease much, except for labor supply for own crop and housing rehabilitation and earning extra income (for example, from fishing). Thus, the potential for labor sharing is higher than that for non-labor sharing. How well labor sharing can work depends on the distribution of potential recipients (those with housing damaged) and potential donors (those without); the smaller the ratio of the former to the latter, i.e., the smaller the degree of covariate shocks, the more effective is the labor sharing. This ratio was about one half in Fiji; in contrast, if all or most villagers suffer in catastrophic hazards, within-village risk sharing is unlikely to work. Overall risk-sharing outcome is measured by net aggregate private transfers (labor and non-labor) received by households against their shocks (as well as the history of their transfer exchange which researchers cannot observe).

Suppose that disaster aid, consisting of non-labor resources distributed to the village by aid agencies, is allocated in the village as part of risk sharing. Disaster aid augments non-labor resources, thereby substituting for non-labor transfers (for simplicity, perfect substitutability is assumed). Then, overall risk-sharing outcome is determined by aggregate private transfers, including aid; in contrast, targeting performance is measured by aid responses to household shocks. The greater the gap between these two, i.e., the targeting gap, the less useful is targeting performance. If risk-sharing groups are clustered in the village so that risk sharing consists of one among households within the group and another across groups, the targeting gap across groups is defined on group-level covariate shocks.

What determines the magnitude of the targeting gap? First, on one hand, in the relief and early recovery phases, when emergency food aid is the dominant form of aid, housing rehabilitation relies on risk sharing; as labor/non-labor transfers for housing rehabilitation and non-labor transfers – including food aid – for consumption smoothing coexist, the targeting gap can be large. In particular, the targeting gap of food aid should depend on whether or not shocks involve labor sharing. On the other hand, in the recovery/reconstruction phase, when consumption smoothing is not a major concern (after crop rehabilitation) and construction materials are the only aid, labor/non-labor transfers for housing rehabilitation are major risk-sharing arrangements. In contrast to food aid, which substitutes for non-labor transfers, construction materials complement labor transfers, because they facilitate rebuilding/repairing; thus, the targeting gap should be small. These relationships are summarized as follows:

Hypothesis 1-1: The earlier the post-disaster phase, the greater is the targeting gap.

Hypothesis 1-2: The targeting gap on housing damage is greater than that on crop damage.

Next, the stronger the risk sharing, the greater is the potential targeting gap. I conjecture that risk sharing is stronger within the group than across groups, not only because of the closer connection among group members (as discussed above for kin groups in Fiji), but also because of a smaller degree of covariate shocks within the group than across groups (as shown in the decomposition of the variance of housing and crop damage, Takasaki 2011b): i.e.,

Hypothesis 1-3: The targeting gap in the within-group allocation is greater than that in the across-group allocation.

Hierarchy

Now I assume that the allocation of disaster aid in the village is determined by bargaining between elites and non-elites, independent of or even with lack of risk sharing (the interaction of these two mechanisms is considered later). Elite domination can take a form of either *elite capture* or norm-based prioritization without involving capturing (henceforth called *elite norms*); in kin-based societies with hereditary elite status like Fiji, strong elite norms underlie social equilibrium. What distinguishes between elite capture and norms is the status quo. On one hand, in elite capture, with elite neutrality as the status quo, elites compare benefits and costs of capturing disaster aid, where social costs can include reputation damage and non-elites' antipathy. It is possible that elites will allocate aid to non-elites (i.e., *elite inferiority*) if the benefits of doing so (social benefits and prioritization in private transfers as a counterpart) outweigh the costs (giving up the aid). Some studies show that elites' capturing program benefits is not necessarily pernicious to community development, because elites might take actions that benefit non-elites (i.e., 'benevolent capture', Mansuri and Rao 2004). On the other hand, according to elite norms with elite dominance as the status quo, non-elites compare benefits and costs of not conforming to such norms (getting the aid vs. social sanction). Differentiating between elite capture and norms requires detailed data on the allocation process (which the Fijian data lack).[7] Bargaining between elite and non-elite groups is analogous.

The magnitude of elite dominance in aid allocation is determined by the difference in social ranks between elites and non-elites. This is because in both elite capture and norms, the larger the rank difference, the smaller is the elites' costs of capturing and the larger is non-elites' costs of non-conformity to the norms;[8] i.e.,

Hypothesis 2: The stronger the social hierarchy, the greater is elite dominance.

In other words, as the rank difference gets smaller, elite dominance becomes weaker; with no rank difference, elite dominance vanishes.

Interaction of risk sharing and hierarchy

Risk sharing and social hierarchy can interact with each other in the allocation of disaster aid in two ways. First, I conjecture that the greater elites' damage relative to non-elites', the smaller are elites' costs of capturing and the greater are non-elites' costs of non-conformity to norms (i.e., elites' relative damage serves like their status).

Hypothesis 3-1: The greater elites' damage relative to non-elites', the greater is elite dominance.

[7] Noncompliance to elite norms is unlikely in the study area (there is no anecdotal evidence for that); then, elite inferiority, if any, is based on elites' decisions.

[8] It is possible that the higher elites' status relative to non-elites', the smaller are elites' benefits of capturing and the greater are non-elites' benefits of non-conforming, because social status can be positively correlated with household assets which determine the household's self-coping capacity. If the elasticity to the rank difference of elites' costs of capturing and non-elites' costs of non-conforming is greater than that of their corresponding benefits, then hypothesis 2 still holds.

A difference in damage by rank can augment or reduce elite domination; it is possible that elites of the same status exhibit inferiority and domination in the allocation depending on their damage.

Second, I conjecture that elites are prioritized in overall risk-sharing arrangements, i.e., aggregate private transfers, including disaster aid, more strongly respond to elites' damage than non-elites'. Whether this pattern is observed in aid allocation depends on the magnitude of the targeting gap.

Hypothesis 3-2: When the targeting gap is small, aid allocation more strongly responds to elites' damage than non-elites'.

Then, targeting performance is stronger for elites than non-elites; that is, elite domination exists in targeting on damage, i.e., targeting bias. The pattern in hypothesis 3-1 also effectively gives rise to targeting bias. As the targeting gap makes targeting performance less useful, targeting bias loses its usefulness as a potential source of systematic targeting errors when the targeting gap is large; for example, elite inferiority in aid allocation may reflect strong elite domination in other private transfers.

Lastly, analogous to hypothesis 2, the rank difference between elites and non-elites determines the magnitude of targeting bias: i.e.,

Hypothesis 3-3: The stronger the social hierarchy, the greater is the targeting bias.

IV. ECONOMETRIC SPECIFICATION

I employ three empirical models for food aid (*relief model*) and housing construction materials (*reconstruction model*). The first model focuses on the allocation of disaster aid within clans. I conjecture that aid allocation to household i, y_i, is determined by household-level disaster damage X_i (targeting through risk sharing) and its social status Z_i (elite domination). A reduced-form model is:

$$y_i = \alpha_1 + \beta_1 X_i + \gamma_1 Z_i + \delta_1 W_i + G + e_i , \qquad (1)$$

where W_i is other household controls that determine the allocation (defined below); G is clan dummies, which control for clan-level covariate shocks, total aid allocated to the clan, and clan's social status; and e_i is an error term.[9] Targeting performance is directly measured by positive β_1.

[9] Whether households rebuild/repair their housing without receiving construction materials certainly affects the allocation, but this endogenous decision does not appear as an explanatory variable in the reduced-form equation (1).

Kin-group affiliation and social status are exogenous as determinants of aid allocation. Elite domination/inferiority is measured by positive/negative γ_1.

Equation (1) can be extended to net aggregate private transfers received (including disaster aid and co-residence); let β^*_1 denote the corresponding coefficient for X_i. The targeting gap is β^*_1 - β_1. For a given level of overall risk sharing β^*_1, the smaller the β_1, the greater is the targeting gap; β_1 can even be negative. The lack of complete information about labor transfers in the current data precludes me from estimating β^*_1 and thus the targeting gap. My empirical strategy to test the incidence of the significant targeting gap relies on aid allocation negatively responding to shocks: Negative β_1 indicates compensated private transfers in other forms (in particular, labor transfers for housing rehabilitation in Fiji, the indirect evidence of which is discussed above). Note that targeting errors per se do not make β_1 negative. If estimated β_1 is negative for food aid and positive for construction materials, then hypothesis 1-1 holds.[10]

The second model captures within- and across-clan allocations in the village:

$$y_i = \alpha + \beta_1 X_i + \gamma_1 Z_i + \delta_1 W_i + \beta_2 X_g + \gamma_2 Z_g + \delta_2 W_g + V + e_i\,, \qquad (2)$$

where X_g ,Z_g, and W_g, respectively, are clan g's cyclone damage, social status, and other controls that affect the allocation (defined below); and V is village dummies, which control for village-level covariate shocks and total aid allocated to the village (as well as village's social status described and analyzed by Takasaki 2011a). If aid is allocated across households only at the village level, clan-level factors are redundant; that is, clans do not serve as a risk-sharing group, or aid allocation is part of risk sharing only at the village level. In contrast, the significant impacts of both clan- and household-level shocks suggest that not only the village but also clans serve as a risk-sharing group, as assumed in equation (1) (e.g., Morduch 2005, Munshi and Rosenzweig 2009), and aid allocation is part of risk sharing at both the village and clan levels. In the relief model, negative β_1/β_2 for housing damage and negative β_1/positive β_2 for crop damage support hypotheses 1-2 and 1-3 (that β_1 is greater for housing damage than crop damage in magnitude cannot be tested, as shown below). Positive/negative γ_2 captures elite clans' domination/inferiority. If the estimation results of household variables in equation (2) are similar to those of (1) with clan factors fully controlled for, then unobserved clan factors in (2) are unlikely to cause significant bias.

[10] Although crop damage is less observable than housing damage, the observability problem may not be so significant among clan members who own land communally.

The third model captures the potential interaction of risk sharing and social hierarchy by adding interaction terms of cyclone damage and social status to equation (2) (considering other potential interaction effects is a straightforward extension):

$$y_i = \alpha + \beta_1 X_i + \gamma_1 Z_i + \eta_1 X_i Z_i + \delta_1 W_i + \beta_2 X_g + \gamma_2 Z_g + \eta_2 X_g Z_g + \delta_2 W_g + V + e_i \,. \quad (3)$$

Distinct from the targeting gap which cannot be estimated with the current data, targeting bias is captured by positive η_1/η_2: Hypotheses 3-1 and 3-2 can be tested by examining the marginal effects of social status and cyclone damage, respectively.

All equations are estimated by OLS. Allocation rules may be distinct between the allocations of recipients and amount received among recipients and may change as aid supplies augment over time. In the relief model, I first analyze receipt (linear probability model) and the amount received per month (log), conditional on receipt, in the first three months (relief phase), and then the amount received per month (log) in six months (including the early recovery phase). In the reconstruction model, receipt and the amount received, conditional on receipt, are estimated in the first year (early recovery phase), in two years (including the recovery/reconstruction phase), and in two years and 9 months (up to the interviews in 2005) separately. This hurdle model is commonly used in previous works (e.g., Dercon and Krishnan 2005, Jayne, et al. 2002).[11] If negative β_1 is found only in the first three months, then hypothesis 1-1 is further supported.

Household damage is captured by a dummy for damaged housing and the value of crop damage per adult equivalent (log) in the relief model,[12] and two dummies for housing completely destroyed and partially damaged in the reconstruction model. Clan damage is measured by the proportion of households with damaged housing in the clan and the clan-mean of crop damage per adult equivalent in the relief model, and two variables for the proportions of households with complete and partial housing damage in the clan in the reconstruction model. Two sets of

[11] An alternative sample-selection model is infeasible with the current data, which lack the identifying instruments required to credibly estimate the selection equation. Estimating the relief model in the second three months and the reconstruction model in the second and third year could be considered, but this would require using the receipt or the amount received in previous period(s) as a lagged dependent variable, the endogeneity of which cannot be controlled for with these data.

[12] Differentiating between complete and partial damage is infeasible, because the former is relatively uncommon (cf. reconstruction sample). Adding an interaction term between housing and crop damage does not alter the results reported below (Takasaki 2011c).

household and clan status are considered: clan leader and clan-chief's clan vs. clan/sub-clan leader and clan-/village-chief's clan. Recall that the former (the latter's subset) captures higher ranks than the latter. If the estimated positive γ_1/γ_2 and η_1/η_2 of the former are greater than those of the latter, then hypotheses 2 and 3-3, respectively, are supported.

In the relief model, household controls include: income per adult equivalent per month (log), land holdings (log), fishing capital (log), a dummy for secondary education among any adults, household adult equivalent size (log), proportions of children and elderly, age of household head (log), and a dummy for female head. All are measured before the cyclone. Although post-disaster income is affected by disaster aid and private transfers, as well as crop damage and rehabilitation, pre-disaster income is not.[13] Clan factors consist of the proportion of households belonging to the same clan in the village (in the population), and the clan-mean of income, land, and capital. Clan size can affect bargaining power; as elite clans tend to be large, controlling for clan size is crucial to identify the effects of clan status. In the reconstruction model, all household factors in the relief model except for income, land, and capital, measured at the time of interviews in 2005, are used as controls. Clan factors are clan size and clan-mean land (communal land is fixed for each clan); as almost no households newly emerged or vanished after the cyclone, these measures largely capture pre-cyclone characteristics. The descriptive statistics of these controls are reported in Table 1.

V. ESTIMATION RESULTS

No interaction of risk sharing and hierarchy

Estimation results of cyclone damage and social status in the relief and reconstruction models are reported in Tables 2 and 3, respectively. In each table, panels A and B, respectively, show results for models with clan leader and clan-chief's clan and models with clan/sub-clan leader and clan-/village-chief's clan (results of cyclone damage not shown in panel B are very similar to those in panel A); in each panel, results of equations (1) and (2) are organized by period of interest and then receipt/amount (robust standard errors are reported and standard

[13] It is still possible that unobserved factors determining income, such as ability, affect aid allocation as part of risk sharing; the same concern also applies to productive assets. I estimated models excluding income, land, and fishing capital, finding almost the same results for the remaining variables.

errors are clustered by clan in models with village dummies).[14] Estimation results of other controls are reported in Appendix A.[15] Probit estimates for receipt in both relief and reconstruction models are very similar to the OLS results.

Estimation results of household variables in equation (2) are almost the same as those in (1). In the first three months, food-aid recipients are more common among households without damaged housing that offered help for refugees and housing rehabilitation than among others that received such help (qualitatively the same comparison holds in the descriptive statistics, Takasaki 2011c).[16] Among recipients, a greater amount is allocated to clans with larger crop damage and then households with smaller crop damage, which could contribute more to labor sharing because of their smaller crop rehabilitation. These findings are consistent with hypothesis 1-3; as private risk sharing, especially labor sharing within the clan, against housing damage was prioritized, a large targeting gap emerged. Consistent with hypothesis 1-2, the allocation in six months is negatively associated with clan-level housing damage only; it is neutral to all other shocks. Thus, the allocation rule in the relief phase was reversed later, supporting hypothesis 1-1.

In contrast, the allocation of construction materials – both receipt and amount received – strongly responded to household damage over time. Thus, combined with the relief results, hypothesis 1-1 strongly holds. As the supplies of construction materials (especially large ones) augment, targeting performance improves: The probability of receipt by households with housing

[14] The relief equation (1) focuses on clans including both recipients and non-recipients; otherwise, clan dummies perfectly predict the allocation of receipt. Similarly, equations (2) and (3) can be applied to villages with such variations (villages with only one clan are excluded). The numbers of observations for the amount equation conditional on receipt further decline. In the reconstruction sample for receipt in the first year, 16% of households are recipients (cf. 5% in the whole sample); the corresponding amount equation is not estimated because of the small number of recipients.

[15] In the relief model, (1) female-headed households are less likely to receive aid in the first three months; (2) smaller households and households with more children receive larger amounts of aid per capita in both three months and six months; and (3) households with lower income and belonging to larger clans (in proportion) receive greater amounts in the six-month period. In the reconstruction model, households with more children and elderly receive larger amounts (the results for elderly in two years are statistically weak).

[16] A potential alternative interpretation is that households with a damaged kitchen cannot store and cook food and take their meals with others, i.e., they receive meal transfers. By analyzing the allocation of food aid in response to kitchen damage, Takasaki (2011c) shows that meal sharing plays a smaller role than labor sharing.

completely destroyed increased from .20 in the first year to .41 in two years and then .63; the probability of receipt by those with partial damage increased from .17 to .31 in two years and then was stable. The allocation is neutral to clan-level shocks; the only exception is that clans with greater damage – both complete and partial damage – receive larger amount in two years. It thus appears that clans play a limited role in the late post-disaster phase (I return to this below).

Social status does not strongly alter the allocation of food aid; although clan leaders are less likely to be recipients in the first three months, this pattern loses statistically significance in equation (3) (according to the joint significant test, as shown below). In contrast, the social status of households, but not clans, positively affects the allocation of construction materials: Clan leaders dominate receipt in two years and in two years and nine months (20% and 14% marginal effects, respectively, in the models with clan dummies) and amount received in two years (54% marginal effect); on the other hand, clan/sub-clan leaders do not significantly affect receipt in two years and nine months. That clan leaders' domination persists longer than sub-clan leaders' supports hypothesis 2. As such, it appears that elite domination at the clan level is nonexistent over the post-disaster phases (I return to this shortly).

Interaction of risk sharing and hierarchy

Estimation results of equation (3) are reported in Tables 4 and 5. Although considering four interaction terms of cyclone damage and social status – two at the household level and another two at the clan level – is possible, I can include only those of crop damage with elite status (household and clan levels) in the relief model (Table 4) and those of clan status with housing damage (complete and partial damage) in the reconstruction model (Table 5); variations in those of housing damage and household status, respectively, are too limited. In the reconstruction model, no amount equation with interaction terms is estimated, because of limited variations among recipients.

I first focus on models with clan leader and clan-chief's clan (panel A). In the allocation of the amount of food aid received, chief's clans with small and large crop damage show elite inferiority and domination, respectively, in both three months and six months (positive η_2) (the joint significance test for clan status is statistically significant in three months and the result in six months is statistically weaker); clan leaders are nonsignificant (this is also true when equation 1 is extended by adding the household-level interaction term). In the reconstruction model, receipt in the first year is dominated by clan-chief's clans with more housing damage (positive η_2

for complete destruction) (the joint significance test for clan status is statistically significant). These results support hypothesis 3-1.

In the allocation of the amount of food aid received in response to clan-level crop damage in three months, the response of clan-chief's clans is over four times more than that of other clans (the joint significance test for clan-level damage is statistically significant at a .1% significance level). The allocation of receipt of construction materials in the first year responds to completely destroyed houses in clan-chief's clans only (the joint significance test for clans' housing complete damage is statistically significant). These results are consistent with hypothesis 3-2 (recall that the targeting gap is small in these allocations). Clan-chief's clans are more likely to receive construction materials in two years and in two years and nine months, unless partial housing damage is very common (I return to this shortly). Note that although clan status with no interaction and clan status interacted with complete housing damage are nonsignificant according to the t test, their estimated coefficients are large and jointly significant at least at a 1% significance level. Hence, distinct from the earlier findings on equation (2), in both relief and reconstruction models, clan-chief's clans with large damage are always prioritized; that is, a strong targeting bias exists in the across-clan allocation.

Estimation results on clan-level partial housing damage in the reconstruction model (negative η_2 for partial damage) are opposite to hypotheses 3-1 and 3-2. First, in the allocation of receipt in two years and in two years and nine months, clan-chief's clans with more partial damage exhibit elite inferiority. Second, the allocation of receipt in two years and nine months negatively and positively responds to clan-chief's clans' and other clans' partial damage, respectively. These patterns coincide with clan leaders' dominance from the second year, when the provision of construction materials augmented. It seems that although households with partial damage were relatively prioritized in the clan in the first year, from the second year, those with complete damage became the dominant priority at the cost of those with partial damage, while maintaining clan leaders' priority.

Estimation results for models with clan/sub-clan leader and clan-/village-chief's clan (panel B) are much weaker, and almost all joint significance tests (corresponding to those shown in panel A) are nonsignificant (results not shown; as the only exception, clan-level crop damage on the amount of food aid received in three months is statistically significant at a 10% significance level). Hence, hypotheses 3-1 and 3-2 much more strongly hold for households and/or clans with higher elite status in both relief and reconstruction models; that is, hypothesis 3-3 holds over post-disaster phases. Nonsignificant results on partial housing damage in panel B buttress the importance of clans' high rank underlying the potential interaction effects discussed above.

VI. CONCLUSION

This paper examined risk-sharing institutions and social hierarchies as self-allocation mechanisms of disaster aid within poor villages. The paper highlighted a targeting gap, a difference between targeting performance and overall risk sharing, which makes standard targeting less useful. First, the earlier the post-disaster phase, the greater is the targeting gap, because private risk sharing significantly makes up limited aid. Second, the targeting gap within kin groups, a major risk-sharing group, is greater than the targeting gap in the across-group allocation. Third, the targeting gap of food aid on housing damage, against which risk-sharing's making-up plays a role, is greater than that on crop damage. Bargaining on aid allocation between elites and non-elites can lead to elite domination, through elite capture or norms, which are difficult to distinguish. Risk sharing and social hierarchy can interact with each other, leading to elite domination in targeting on damage, i.e., targeting bias. The stronger the social hierarchy, the greater are the elite dominance and the targeting bias.

Using post-cyclone survey data in rural Fiji, the paper showed supporting evidence for these hypothesized relationships. First, households with damaged housing and greater crop damage are allocated less food aid in the early phase, because they receive greater net private transfers in other forms, especially in labor sharing for housing rehabilitation; this form of targeting gap is especially strong within kin groups and on housing damage. In contrast, the allocation of housing construction materials in the late phase is strongly targeted on housing damage. Second, elites, especially highly ranked ones, dominate the allocation of construction materials. Third, there exists a strong targeting bias toward highly ranked kin groups in both food aid and construction materials.

These results lead to the following implications for village-level disaster management:

1) For better self-allocation of disaster aid within villages, maintaining and strengthening private risk-sharing institutions are effective strategies. Local disaster management needs to be integrated with broad, community-based development programs (e.g., poverty alleviation).

2) Targeting errors are only a partial problem. In the relief phase with a large targeting gap, overall risk sharing needs to receive direct attention; however, information about it is lacking the most at that time. That is why strengthening existing local institutions *ex ante* is strongly demanded.
3) In hierarchical developing societies, elite domination in aid allocation and targeting – at both household and group levels – can be strong in any post-disaster phase. As risk-sharing institutions are often built on traditional kin-based hierarchies, policies neutralizing elite capture may weaken local safety nets instead of strengthen them; such intervention is also questionable for norm-based domination. Policymakers need to tackle a tradeoff between the efficiency of overall risk sharing and the equity of aid allocation.

Overall, for better allocation of disaster aid within villages, policymakers need to pay attention to targeting gaps, elite domination, and targeting bias. At the same time, more research and data on the process of local benefit allocation is strongly needed.

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Table 1. Household means of social status, cyclone damage, aid, rehabilitation, and characteristics.

	Relief sample	Reconsturction sample
Social status:		
Clan chief (0/1)	0.01 (0.11)	0.03 (0.16)
Clan leader (0/1)	0.09 (0.29)	0.11 (0.31)
Clan/sub-clan leader (0/1)	0.14 (0.34)	0.19 (0.40)
Clan chiefs' clan (0/1)	0.22 (0.42)	0.27 (0.44)
Clan-/village-chiefs' clan (0/1)	0.42 (0.49)	0.47 (0.50)
Cyclone damage:		
Housing damaged (0/1)	0.53 (0.50)	0.53 (0.50)
Housing completely damaged (0/1)	0.08 (0.27)	0.19 (0.39)
Housing partially damaged (0/1)	0.45 (0.50)	0.34 (0.47)
Crop damaged (0/1)	0.87 (0.33)	
Crop damage per adult equivalent (F$)	35.1 (46.1)	
Food aid:		
Receipt in 3 months (0/1)	0.77 (0.42)	
Receipt in 6 months (0/1)	0.95 (0.21)	
Amount per month for 3 months (recipients only) (days)	12.9 (7.9)	
Amount per month for 6 months (recipients only) (days)	9.8 (6.5)	
Construction materials:		
Receipt in 1 year (0/1)		0.05 (0.21)
Receipt in 2 years (0/1)		0.19 (0.39)
Receipt in 2 years and 9 months (0/1)		0.25 (0.43)
Amount received in 1 year (recipients only) (F$)		2159 (2888)
Amount received in 2 years (recipients only) (F$)		2137 (2868)
Amount received in 2 years and 9 months (recipients only) (F$)		2680 (3032)
Rehabilitations:		
Crop income per adult equivalent per month before the cyclone (F$)	60.9 (90.0)	
Crop income per adult equivalent per month at the time of interviews (F$)	34.7 (59.0)	152.2 (325.9)
New house building at the time of interviews (households with housing completely damaged only) (0/1)	0.38 (0.50)	0.40 (0.49)
Recipients of construction materials		0.51 (0.50)
Non-recipients of construction materials		0.20 (0.41)
Complete dwelling repair (households with housing damaged only) (0/1)	0.62 (0.49)	
Household and clan characteristics		
Earned income per adult equivalent per month (F$)	114.1 (116.3)	227.3 (316.4)
Land holdings (acre)	4.94 (6.04)	2.83 (4.82)
Fishing capital (F$)	484 (1505)	313 (2139)
Adults' secondary education (0/1)	0.84 (0.37)	0.81 (0.40)
Household size (adult equivalent)	4.95 (2.25)	4.36 (2.15)
Proportion of children (<15)	0.32 (0.21)	0.28 (0.22)
Proportion of elderly (>65)	0.06 (0.14)	0.09 (0.21)
Age of household head	48.4 (13.7)	51.4 (14.6)
Female head (0/1)	0.11 (0.31)	0.09 (0.29)
Proportion of households belonging to the same clan in the village	0.38 (0.21)	0.42 (0.29)
No. villages	9	43
No. clans	43	146
No. households	340	906

Notes - Standard deviations are shown in parentheses. Household characteristics are measured before the cyclone in the relief sample and at the time of interviews in 2005 in the reconstruction sample.

Table 2. Allocation of emergency food aid - OLS with no interaction term.

Period after the cyclone	3 months				6 months	
	Receipt		Log amount per month among recipients (days)		Log amount per month (days)	
	(1)	(2)	(3)	(4)	(5)	(6)
A. Models with clan leader and clan-chief's clan.						
Cyclone damage:						
Housing damaged (0/1)	-0.127 **	-0.122 **	0.055	0.055	-0.128	-0.133
	(0.053)	(0.057)	(0.068)	(0.081)	(0.087)	(0.083)
Log of crop damage per adult equivalent (F$)	-0.023	-0.023	-0.085 ***	-0.084 ***	-0.019	-0.023
	(0.016)	(0.015)	(0.023)	(0.030)	(0.027)	(0.031)
Proportion of housing damaged in the clan		-0.096		-0.219		-0.459 **
		(0.112)		(0.143)		(0.222)
Clan-mean of log of crop damage per adult equivalent (F$)		0.027		0.254 ***		0.039
		(0.053)		(0.085)		(0.141)
Social status:						
Clan leader (0/1)	-0.185 *	-0.213 *	0.138	0.100	-0.180	-0.170
	(0.111)	(0.117)	(0.176)	(0.188)	(0.150)	(0.176)
Clan-chief's clan (0/1)		0.010		-0.155		0.083
		(0.068)		(0.116)		(0.125)
Clan dummies	Yes	No	Yes	No	Yes	No
Village dummies	No	Yes	No	Yes	No	Yes
R-squared	0.163	0.118	0.480	0.448	0.237	0.158
No. observations	325	327	249	252	325	327
B. Models with clan/sub-clan leader and clan-/village-chief's clan.						
Social status:						
Clan/sub-clan leader (0/1)	-0.103	-0.128	0.060	0.067	-0.091	-0.140
	(0.082)	(0.085)	(0.109)	(0.124)	(0.115)	(0.152)
Clan-/village-chief's clan (0/1)		-0.003		-0.138 *		-0.089
		(0.059)		(0.071)		(0.113)

*10% significance, **5% significance, ***1% significance. Robust standard errors are shown in parentheses; those in columns (2), (4), and (6) are clustered by clan. Other controls not shown here are pre-cyclone income per adult equivalent per month (log), land holdings (log), fishing capital (log), a dummy for secondary education among any adults, household adult equivalent size (log), proportions of children and elderly, age of household head (log), a dummy for female head , and constant. Proportion of households belonging to the same clan in the village, and clan-means of pre-cyclone income per adult equivalent per month, land holdings, and fishing capital are also included in columns (2), (4), and (6). Cyclone damage variables are also included in panel B.

Table 3. Allocation of housing construction materials - OLS with no interaction term.

Period after the cyclone	1 year		2 years				2 years and 9 months			
	Receipt		Receipt		Log amount among recipients (F$)		Receipt		Log amount among recipients (F$)	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
A. Models with clan leader and clan-chief's clan.										
Cyclone damage:										
Housing completely destroyed	0.202 ***	0.166 **	0.411 ***	0.360 ***	2.655 ***	2.150 ***	0.628 ***	0.577 ***	2.734 ***	2.416 ***
(0/1)	(0.066)	(0.066)	(0.053)	(0.066)	(0.297)	(0.511)	(0.048)	(0.053)	(0.233)	(0.356)
Housing partially damaged (0/1)	0.166 ***	0.081 **	0.314 ***	0.228 ***	0.611 **	0.529	0.312 ***	0.227 ***	0.758 ***	0.757 **
	(0.056)	(0.032)	(0.046)	(0.046)	(0.295)	(0.393)	(0.041)	(0.048)	(0.236)	(0.351)
Proportion of housing completely		-0.035		0.079		2.070 **		0.034		-0.133
destroyed in the clan		(0.111)		(0.137)		(0.963)		(0.113)		(0.643)
Proportion of housing partially		0.062		-0.024		2.321 **		0.094		-0.283
damaged in the clan		(0.070)		(0.096)		(0.911)		(0.082)		(0.693)
Social status:										
Clan leader (0/1)	0.028	0.037	0.203 ***	0.131 **	0.540 *	0.977 **	0.137 **	0.109 **	0.375	0.512
	(0.093)	(0.049)	(0.073)	(0.052)	(0.278)	(0.394)	(0.063)	(0.051)	(0.301)	(0.418)
Clan-chief's clan (0/1)		0.040		0.022		0.164		0.045		0.371
		(0.035)		(0.046)		(0.664)		(0.033)		(0.514)
Clan dummies	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No
Village dummies	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes
R squared	0.127	0.093	0.277	0.255	0.685	0.661	0.387	0.376	0.671	0.617
No. observations	262	404	546	568	129	95	615	652	173	137
B. Models with clan/sub-clan leader and clan-/village-chief's clan.										
Social status:										
Clan/sub-clan leader (0/1)	-0.007	0.013	0.143 **	0.128 ***	0.615 **	0.890 **	0.054	0.070	0.410	0.290
	(0.078)	(0.041)	(0.059)	(0.041)	(0.294)	(0.379)	(0.051)	(0.044)	(0.308)	(0.364)
Clan-/village-chief's clan (0/1)		-0.022		-0.035		-0.398		-0.013		0.214
		(0.029)		(0.046)		(0.395)		(0.033)		(0.352)

*10% significance, **5% significance, ***1% significance. Robust standard errors are shown in parentheses; those in columns (2), (4), (6), (8), and (10) are clustered by clan. Other controls not shown here are a dummy for secondary education among any adults, household adult equivalent size (log), proportions of children and elderly, age of household head (log), a dummy for female head, and constant. Proportion of households belonging to the same clan in the village and clan-mean of land holdings are also inlcuded in columns (2), (4), (6), (8), and (10). Cyclone damage variables are also included in panel B.

Table 4. Allocation of emergency food aid - OLS with interaction terms.

Period after the cyclone	3 months		6 months
	Receipt	Log amount per month among recipients (days)	Log amount per month (days)
	(1)	(2)	(3)
A. Models with clan leader and clan-chief's clan.			
Cyclone damage:			
Housing damaged (0/1)	-0.121 **	0.055	-0.133
	(0.056)	(0.083)	(0.084)
Log of crop damage per adult equivalent (F$)	-0.020	-0.086 ***	-0.024
	(0.014)	(0.030)	(0.031)
Proportion of housing damaged in the clan	-0.089	-0.100	-0.412 *
	(0.111)	(0.167)	(0.238)
Clan-mean of log of crop damage per adult equivalent (F$)	0.028	0.223 **	0.033
	(0.054)	(0.091)	(0.143)
Social status:			
Clan leader (0/1)	-0.052	-0.060	-0.246
	(0.295)	(0.332)	(0.389)
Clan-chief's clan (0/1)	-0.394	-2.213 ***	-1.539 *
	(0.452)	(0.617)	(0.896)
Cyclone damage-social status:			
Log of crop damage per adult equivalent × Clan leader	-0.052	0.055	0.022
	(0.083)	(0.076)	(0.090)
Clan-mean of log of crop damage per adult equivalent ×	0.143	0.733 ***	0.580 *
Clan-chief's clan	(0.165)	(0.222)	(0.312)
F tests (p-value)			
for log of crop damage per adult equivalent	0.332	0.018	0.723
for clan leader	0.149	0.572	0.594
for clan-mean of log of crop damage per adult equivalent	0.589	0.000	0.183
for clan-chief's clan	0.687	0.002	0.115
R-squared	0.121	0.455	0.161
No. observations	327	252	327
B. Models with clan/sub-clan leader and clan-/village-chief's clan.			
Social status:			
Clan/sub-clan leader (0/1)	0.014	0.030	0.040
	(0.182)	(0.196)	(0.288)
Clan-/village-chief's clan (0/1)	0.164	-0.390	-0.490
	(0.251)	(0.383)	(0.546)
Cyclone damage-social status:			
Log of crop damage per adult equivalent × Clan/sub-clan	-0.046	0.011	-0.062
leader	(0.050)	(0.043)	(0.088)
Clan-mean of log of crop damage per adult equivalent ×	-0.062	0.096	0.156
Clan-/village-chief's clan (0/1)	(0.092)	(0.139)	(0.195)

*10% significance, **5% significance, ***1% significance. Standard errors in parentheses are clustered by clan. Other controls not shown here are pre-cyclone income per adult equivalent per month (log), land holdings (log), fishing capital (log), a dummy for secondary education among any adults, household adult equivalent size (log), proportions of children and elderly, age of household head (log), a dummy for female head, proportion of households belonging to the same clan in the village, and clan-means of pre-cyclone income per adult equivalent per month, land holdings, and fishing capital, village dummies, and constant. Cyclone damage variables are also included in panel B.

Table 5. Receipt of housing construction materials - OLS with interaction terms.

Period after the cyclone	1 year	2 years	2 years and 9 months
	(1)	(2)	(3)
A. Models with clan leader and clan-chief's clan.			
Cyclone damage:			
Housing completely destroyed (0/1)	0.165 **	0.360 ***	0.577 ***
	(0.066)	(0.066)	(0.053)
Housing partially damaged (0/1)	0.081 **	0.228 ***	0.227 ***
	(0.032)	(0.046)	(0.048)
Proportion of housing completely destroyed in the clan	-0.061	0.100	0.039
	(0.109)	(0.131)	(0.103)
Proportion of housing partially damaged in the clan	0.060	0.063	0.177 **
	(0.071)	(0.087)	(0.077)
Social status:			
Clan leader (0/1)	0.039	0.139 ***	0.115 **
	(0.049)	(0.052)	(0.051)
Clan-chief's clan (0/1)	-0.120	0.159	0.139
	(0.077)	(0.107)	(0.086)
Cyclone damage-social status:			
Proportion of housing completely destroyed in the clan ×	0.623 ***	0.341	0.375
Clan-chief's clan (0/1)	(0.218)	(0.308)	(0.258)
Proportion of housing partially damaged in the clan × Clan-	0.137	-0.539 ***	-0.450 ***
chief's clan (0/1)	(0.148)	(0.196)	(0.170)
F tests (p-value)			
for proportion of housing completely destroyed in the clan	0.021	0.402	0.334
for proportion of housing partially damaged in the clan	0.458	0.026	0.010
for clan-chief's clan	0.025	0.001	0.000
for clan-chief's clan (interacted with proportion of housing completely destroyed in the clan only)	0.012	0.003	0.000
for clan-chief's clan (interacted with proportion of housing partially damaged in the clan only)	0.186	0.004	0.009
R squared	0.100	0.263	0.383
No. observations	404	568	652
B. Models with clan/sub-clan leader and clan-/village-chief's clan.			
Social status:			
Clan/sub-clan leader (0/1)	0.013	0.130 ***	0.070
	(0.041)	(0.042)	(0.044)
Clan-/village-chief's clan (0/1)	-0.060	-0.025	0.015
	(0.065)	(0.087)	(0.080)
Cyclone damage-social status:			
Proportion of housing completely destroyed in the clan ×	0.185	0.262	0.169
Clan-/village-chief's clan	(0.189)	(0.194)	(0.193)
Proportion of housing partially damaged in the clan × Clan-	0.006	-0.152	-0.161
/village-chief's clan	(0.120)	(0.183)	(0.174)

*10% significance, **5% significance, ***1% significance. Standard errors in parentheses are clustered by clan. Other controls not shown here are a dummy for secondary education among any adults, household adult equivalent size (log), proportions of children and elderly, age of household head (log), a dummy for female head, proportion of households belonging to the same clan in the village, clan-mean of land holdings, village dummies, and constant. Cyclone damage variables are also included in panel B.

Appendix A. Determinants of allocation of emergency food aid and housing construction materials unreported in Tables 2 and 3.

	Emergency food aid			Housing construciton materials				
Period after the cyclone	3 months		6 months	1 year	2 years		2 years and 9 months	
	Receipt	Log amount per month among recipients (days)	Log amount per month (days)	Receipt	Receipt	Log amount among recipients (F$)	Receipt	Log amount among recipients (F$)
Corresponding tables, panels, and columns	Table 2, panel A			Table 3, panel A				
	(2)	(4)	(6)	(2)	(4)	(6)	(8)	(10)
Household controls:								
Log of earned income per adult equivalent per month (F$)	-0.005	0.029	-0.124 **					
	(0.032)	(0.043)	(0.049)					
Log of land holdings (acre)	0.033	0.036	0.104					
	(0.052)	(0.068)	(0.084)					
Log of fishing capital (F$)	-0.007	-0.015	-0.009					
	(0.008)	(0.009)	(0.013)					
Adults' secondary education (0/1)	0.111	-0.084	0.061	-0.011	0.018	0.486	-0.019	0.386
	(0.077)	(0.084)	(0.140)	(0.041)	(0.048)	(0.347)	(0.044)	(0.317)
Log of household size (adult equivalent)	-0.011	-0.427 ***	-0.253 **	0.041	0.010	-0.689	0.063	-0.009
	(0.076)	(0.082)	(0.118)	(0.036)	(0.052)	(0.504)	(0.045)	(0.437)
Proportion of children (<15)	0.049	0.472 ***	0.418 **	-0.083	-0.130	2.294 ***	-0.117	1.552 **
	(0.118)	(0.151)	(0.179)	(0.091)	(0.088)	(0.729)	(0.086)	(0.655)
Proportion of elderly (>65)	-0.035	0.196	0.093	-0.050	-0.106	0.780	-0.093	1.186 *
	(0.225)	(0.346)	(0.314)	(0.057)	(0.086)	(0.639)	(0.089)	(0.633)
Log of age of household head	0.155	0.002	0.080	-0.043	0.002	-0.071	-0.007	0.489
	(0.098)	(0.154)	(0.181)	(0.062)	(0.063)	(0.940)	(0.055)	(0.676)
Female head (0/1)	-0.194 **	0.061	0.050	0.019	-0.019	-0.929	-0.026	-0.791
	(0.083)	(0.154)	(0.116)	(0.040)	(0.040)	(0.991)	(0.043)	(0.825)
Clan controls:								
Proportion of households belonging to the same clan in the village	0.194	0.229	0.999 ***	-0.185	0.047	-0.348	0.046	-0.201
	(0.182)	(0.249)	(0.275)	(0.122)	(0.139)	(0.799)	(0.099)	(0.827)
Clan-mean of log of earned income per adult equivalent per month (F$)	-0.066	-0.016	0.077					
	(0.079)	(0.102)	(0.128)					
Clan-mean of log of land holdings (acre)	0.007	-0.008	0.023	0.010	0.032	0.122	0.044	-0.071
	(0.131)	(0.188)	(0.313)	(0.044)	(0.052)	(0.364)	(0.041)	(0.308)
Clan-mean of log of fishing capital (F$)	0.017	-0.029	-0.064					
	(0.022)	(0.039)	(0.049)					

*10% significance, **5% significance, ***1% significance. These controls are measured before the cyclone in the relief sample and at the time of interviews in 2005 in the reconstruction sample.