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Abstract

This paper studies the political economy of relief aid allocation using empirical evidence from relief programs after a major cyclone (Gafilo) hit Madagascar in March 2004. Relief was provided by the Government of Madagascar as well as local and international aid agencies. Aid allocation was generally more likely in areas with a higher need for aid, but there were substantial differences between aid allocation by the government and by international aid agencies. The likelihood of receiving aid from the government was higher in cyclone-affected communes with higher radio coverage and with stronger political support for the government. Relief from aid agencies was not affected by media or political factors but was more likely to go to poorer and easier accessible communes, whether or not they were affected by the cyclone.

Keywords: political economy, natural disasters, aid, Madagascar, Africa

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This paper is dedicated to the memory of Piet Buys.

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1. Introduction

Natural disasters often have strong negative and long-lasting impacts on welfare in low-income countries. Governments and aid agencies have been struggling for decades on how to appropriately design and implement natural disaster relief programs as to mitigate the devastating effects (e.g., World Bank, 2001, 2006). Recent research suggests that targeting of relief is not always effective, for a variety of reasons. One of the key reasons is that, as with any government policy, political considerations affect relief aid allocation. Another reason is that relief aid allocation may be affected by the costs of aid distribution, which itself is a function of local institutions and infrastructure. The nature of the organization in charge of the distribution of relief aid may also matter, as local governments or international institutions are likely to have different incentive structures.

However, in contrast to the determinants of aid overall, empirical evidence on the importance of these factors in relief aid is still scant (e.g. Alesina and Dollar, 2000; Burnside and Dollar, 2000). However, understanding the importance of these factors is important given the importance of relief aid in the aid budget overall (Hoddinott, 1998) and given the desire to more efficiently use these public funds. The limited empirical literature suggests several political economy factors which affect relief aid allocation. First, the demand for assistance and the costs of providing assistance affect relief operations, but not always as expected. In a study of the allocation of natural disaster relief after hurricane Mitch hit Honduras in October 1998, Morris and Wodon (2003) find that, while the probability of receiving aid at household level was negatively correlated with wealth and positively correlated with assets losses, the amount of relief received was independent of these two variables. The amount of aid received by households in Nicaragua following hurricane Mitch

was neither related to the degree of losses suffered nor to their pre-Mitch income level (Lazo and Santos, 2004). Looking at how costs related to existing institutions and organizations affect the supply of aid, Jayne *et al.* (2002) find that food aid allocations by the Ethiopian government together with local and international non-governmental organizations, displayed a large degree of spatial continuity over time which the authors attribute to high fixed costs in the set-up of relief operations and in the process of identifying needs.

Second, Jayne *et al.* (2001) also find that food aid was being used by the Ethiopian government to transfer resources to regions favored by the regime instead of those regions most in need. Similar political pressures in the case of emergencies were shown to exist in India and Sudan (Plumper and Neumayer, 2009).

Third, other studies show that mass media can affect the process of aid allocation, in particular by governments, as the media enable vulnerable citizens to monitor the actions of politicians and to use this information in their lobby activities or voting decisions.[1] Sen (1984) attributes a major role to the freedom and independence of the mass media in India in explaining why the country has historically avoided famines more successfully than China, which lacks free and independent media. Besley and Burgess (2001, 2002) use panel data on public food distribution and calamity relief programs in India to show that a more informed electorate strengthens incentives for governments to be responsive. In their analysis, newspaper circulation plays a substantial role in increasing political accountability. Mass media has also been identified as an important factor in African countries that succeeded in preventing famines (Drèze and Sen, 1990). The media matters for relief aid in developed countries as well. For example, Eisensee and Strömberg (2007) show, based on data from 5000 natural disasters in the US, how relief depends on whether a disaster occurs at the same time as other newsworthy events.

[1] This paper refers to media exposure within the affected regions as opposed to media coverage of the disaster to other locations, which might generate additional aid allocations.

The objective of our paper is to contribute to this literature. Using unique primary data, our paper studies how various factors affected relief aid allocation to rural communities after cyclone Gafilo hit Madagascar in March 2004. Aid was provided by the Government of Madagascar as well as by local and international aid agencies. The Government provided emergency assistance by distributing first aid supplies as water, medication, blankets, shelters etc. The donor agencies mainly organized reconstruction and rehabilitation of public infrastructure, partly through cash-for-work programs.

Our study focuses on the allocation of relief aid to communes. Data on relief aid and community specifics are from a survey of 249 communes at the end of 2004, which we combine with various sources of other information such as the population census and the commune census as well as alternative measures for the local impact of the cyclone, including data on precipitation, satellite and wind speed data as well as the National Disaster Management Agency's (CNS[2]) and the United Nations Office for the Coordination of Humanitarian Affairs' (OCHA) impact assessment of the cyclone.

The paper is organized as follows. The situation in Madagascar in general and in the aftermath of cyclone Gafilo in particular is depicted in Section 2. Section 3 describes the data that we use. The three determinants of aid allocation decisions, as identified in the literature, are discussed in Section 4. Section 5 describes the econometric model. Section 6 presents the results and Section 7 concludes the paper.

2. Cyclones and Relief in Madagascar

Madagascar is one of the poorest countries in the world, with a per capita income of US$320 (World Bank, 2008). Nearly half of the children under five years of age are

[2] The National Disaster Management Agency was referred to in Madagascar as the CNS for 'Comité National de Secours' at the time of the survey. It recently changed names to BNGRC for 'Bureau National de Gestion des Risques et des Catastrophes' which is part of the Ministry of Interior of the Government of Madagascar.

malnourished and the 2008 Human Development Report (UN, 2008) ranks the Indian Ocean island 143 out of 179 countries.

Madagascar is struck by cyclones of varying intensity on an annual basis. The cyclones often cause significant land and infrastructure damage, lead to major decreases in economic and especially agricultural output, and bring about severe food insecurity and increased poverty for a majority of the Malagasy population.

2.1. Cyclone Gafilo

In the first half of March 2004, Madagascar was hit by cyclone Gafilo, the most intense cyclone during the last ten years. It is estimated that 774,000 people were affected by the cyclone, of which 308,000 were in need of urgent emergency assistance (World Bank, 2004). Gafilo killed 172 people while injuring 879 people and leaving 214,260 without a home (Relief Web, 2006). Over 300,000 hectares of agricultural land was damaged, and about 400 schools and health centers were destroyed. Mid-March 2004, the Government of Madagascar declared an emergency and appealed for international assistance (European Commission, 2004).

One of the United Nations Office for the Coordination of Humanitarian Affairs' main tasks is the coordination of humanitarian emergency responses (OCHA, 2006). As part of this assignment, OCHA – in collaboration with the National Disaster Management Agency (CNS) of Madagascar – assessed the damage and created a cyclone impact code that ranges from 0 to 3. Zero stands for no cyclone damage, 1 for moderate damage, 2 for serious damage, and 3 for very serious cyclone damage. OCHA defines combinations of (a) damage to or the loss of certain infrastructure as houses, roads etc., (b) children who are unable to attend school due to damaged school buildings, (c) the loss of agricultural or other income

sources, (d) isolation due to flooding, (e) exposure to epidemics, (f) need of emergency assistance as water, food, medication etc. due to a cyclone as cyclone damage.

Data were collected and compiled by CNS, which is part of the Ministry of Interior. CNS gathered information from local authorities at district and commune level. Annex A.1 illustrates the impact of cyclone Gafilo in Madagascar, according to estimations made by OCHA and CNS on the 15th of March 2004. The circles illustrate the number of persons affected.

After OCHA's mission to Madagascar, CNS continued to alter the cyclone impact map according to updated news from the field. The changes mainly consisted of assigning more districts and communes to the moderate impact zone 1. Annex A.2. depicts the final impact assessment map made by CNS. Further in this paper we will merge both impact assessment maps with rainfall data from 15 weather stations across the country. We will also introduce an additional *Cyclone Path* impact dummy based on wind speed and satellite data.

Overall, the northern and western parts of Madagascar were "very seriously" to "seriously" hit by the natural disaster, while the south-eastern part did not experience heavy losses. Table 1(a) illustrates the CNS cyclone impact codes for the 249 communes in our sample. Seventy-eight percent was classified by CNS as having suffered cyclone damage. Fifteen percent suffered a 'serious' or 'very serious' impact.

2.2. Relief after cyclone Gafilo

In the aftermath of cyclone Gafilo, the Government of Madagascar and the national and international donor community were committed to support the country in dealing with the humanitarian crisis and in rebuilding its infrastructure. The government – with financial support from OCHA and the United Nations – mainly provided emergency assistance by distributing food and first aid supplies such as water, drugs, blankets, shelters, etc.

(Government of Madagascar, 2004; UN, 2004). In some parts of the country, the government also assisted in the reconstruction of public infrastructure as schools, health centers etc. Targeting by the government was solely based on the CNS impact assessment. With this information at hand, the government sent aid to the most affected districts and communes. However, little is known about the actual decision rules and their implementation.

In a first stage, aid was supposed to be sent to the local communities by the government. The second stage of selecting beneficiary households occurred after commune-level allocations had been determined. According to our interviews, local-level responsibility for selecting disaster relief beneficiaries was delegated to the decentralized levels i.e. the commune representatives. Anecdotal evidence suggests that – depending on the scope of the damage in the commune – first aid supplies where handed out randomly in some communes while in others they were allocated to certain households according to eligibility criteria. Unfortunately, as we are not in the possession of household data, we cannot analyze the second stage allocation, so our analyses solely focus on the first stage of the decision process.

The donor community that was directly involved with the implementation of relief programs (in contrast to the UN who transferred money to the government and it was up to the government to decide where to allocate the aid) mainly consisted of the Development Intervention Fund (FID[3]), sponsored by the World Bank, and international and national humanitarian or non-governmental organizations (NGOs) as CARE, Catholic Relief Services, SAHAFA etc. Part of the local NGOs was already operating in the affected regions prior to cyclone Gafilo. There is extensive evidence that all aforementioned aid organizations cooperated as to reach the affected population. Targeting was based on the CNS impact assessments as well as extra information from the agencies' personnel field visits in combination with cyclone impact information from the local partners in the field. The donor group mainly organized reconstruction and rehabilitation of public infrastructure, partly

[3] FID i.e. Fonds d'Intervention pour le Développement.

through cash-for-work programs, to assist in the immediate reconstruction of schools, health centers, and critical infrastructure, and in the longer term, to rebuild infrastructure to withstand future cyclones (World Bank, 2004).[4]

Within these cash-for-work (HIMO[5]) programs, local beneficiaries were employed at a certain wage to carry out simple maintenance and rehabilitation works (clearing streets, canals etc.). On average, the daily wage was equivalent to 1 USD and the programs were in effect for two months after the cyclone. Labor was not expected to be skilled (Minten *et al.*, 2005). A self-targeting mechanism was in place meaning that households decided themselves whether to send members to work in the HIMO programs at the offered wage. While there is evidence that the local and international aid agencies collaborated to ensure coverage of the affected areas and to avoid overlap, our interviews suggest that no formal arrangements were made between the government and the aid agencies to target specific areas. Nevertheless, informal agreements could have been made either at the central or decentralized levels. In the end, the success of targeting will be determined by who received aid and who did not. Hence, we will first conduct our analyses on total relief (provided by the government and/or the aid agencies) and afterwards investigate relief from both sources separately.

Table 1 shows that the central government and the aid agencies were the main providers of relief in the aftermath of Gafilo. The government and the aid agencies intervened in 37% and 50% of the communes considered as affected by CNS respectively. Ten percent of the communes received relief from other, mainly small-scale private donors as the local church, or from other sources. In the remainder of this paper we will focus on the first two types of relief i.e. allocated by the government or aid agencies.

[4] Some NGOs also provided first aid supplies although these cases were very limited in scope.
[5] In Madagascar, cash-for-work programs are referred to as HIMO (Haute Intensité de Main-d'Oeuvre) programs.

3. Data

3.1. Data collection

To evaluate aid allocations in the aftermath of cyclone Gafilo and its determinants, a primary survey was organized by the USAID-funded Ilo project in collaboration with FOFIFA[6] from October through December 2004 in 292 communes.[7,8] The stratified sampling frame of the survey was set up to be representative of the situation at the regional level.[9] In each commune, a focus group was gathered which was representative of the population of the commune. Participants in the focus groups included in most cases representatives of the administration, health workers, teachers and peasants. On average, there were around 10 participants in each group. The enumerators were well trained in structured group interview methods given their extensive experience collecting data with the Ilo project in Madagascar.

3.2. Impact assessments

Before formulating any results based on cyclone impact evaluations, our first task is to verify whether the various impact assessments are unbiased and thus related to weather reports at the time of the cyclone. A tropical cyclone is officially defined as 'a storm system characterized by a low pressure center and thunderstorms, producing flooding rains and strong wind' (NOAA, 2006). To be able to verify the accuracy of the impact assessments made by OCHA and CNS, we collected precipitation data from 15 weather stations across Madagascar. The location of the stations is depicted in Annex A.3. The data were collected and compiled by the Climatic Research Unit (CRU) of the University of East Anglia.

[6] FOFIFA is the National Agricultural Research Centre within the Ministry of Scientific Research.
[7] The survey was financed by the World Bank. For more information, see Minten *et al.* (2005).
[8] Out of 1600 communes in total in 2004, i.e. around 20% of the communes.
[9] To ensure geographical coverage, all administrative regions/districts in the country were visited. The number of communes that were visited within a region was dependent on the relative size of the rural population in that region. However, a lower bound was fixed of two communes per region.

Consistent with CRU's methodology, we consider the rainfall data per station to be valid for the entire district the station is located in. Precipitation variation was measured as the percentage of rainfall in March 2004, i.e. at the time of cyclone Gafilo compared to the rainfall one year earlier in March 2003. We can assume that the latter reflected a regular climatic year as the 2003 precipitation data were found to be consistent with long-term rainfall data according to another independent weather organization, i.e. World Climate (World Climate, 2004). Table 2 shows the correlation between the different impact codes and the precipitation data at district level.[10]

We find a significant correlation between the precipitation data and the CNS impact code that ranges from 0 to 3. However, the correlation is not found to be significant for the OCHA impact code. To further test the reliability of the CNS impact assessment, we continue our analyses with the latter and find that the precipitation variation is mainly consistent with the CNS impact assessments of the regions without an impact or the regions that were seriously to very seriously hit as illustrated in Table 3. The marginal effect of the precipitation variation (*Precipitation*) on the regions defined as moderately hit by CNS is negative (Column 2; Outcome 1) indicating that CNS's assessment could have been influenced by other factors than weather and cyclone damage reports in their assignment of certain regions to the moderate impact zone.[11] Anecdotal evidence from the field supports this view that part of the areas in impact zone 1 did not suffer (not even moderately) from cyclone Gafilo.[12]

Based on this information we construct two dummy variables of which the CNS *Any Impact Dummy* equals one if the areas were considered by CNS as moderately to very seriously hit (i.e. impact codes 1 to 3); and zero otherwise. The CNS *Serious Impact Dummy*

[10] Each of the 15 districts with rainfall data had uniform CNS/OCHA impact assessments within the district.
[11] Alternatively, it might also be that cyclone damage was falsely reported and CNS did not verify the accurateness of the information submitted by the district and commune authorities.
[12] One could argue that there is some threshold of impact, but we believe it is plausible to assume that there is a linear relationship between precipitation and impact.

equals one if the areas were assigned as seriously to very seriously hit (i.e. impact codes 2 to 3); and zero otherwise. Consistent with our expectations, we find the *Serious Impact Dummy* to be significantly related with precipitation variation in contrast to the *Any Impact Dummy* as shown in Table 2. Table 3 shows that a 10% increase in rainfall variation increased the likelihood of an assessment of a positive cyclone impact by the *Serious Impact Dummy* by 2 percentage points. As the results in Tables 2 and 3 support the use of the *Serious Impact Dummy* as an exogenous measure to needs for intervention, we will continue our analyses with the latter.

However, CNS could have assigned areas to the moderate impact zones that did not suffer from heavy rainfall, but that suffered from strong winds. To check the robustness of our results we construct a second impact variable based on wind speed data and satellite images of the cyclone path. The data are obtained from UNISYS. We took into account the characteristics of the asymmetric circulation associated with tropical cyclone motion (Chan and Cheung, 1998) to construct the variable which we will refer to as the *Cyclone Path (Impact) Dummy*. The variable equals one if the commune was hit by the cyclone according to the cyclone path (wind and satellite) data; and zero otherwise. All areas that CNS assigned as seriously to very seriously hit by cyclone Gafilo were confirmed to be hit according to our path measure and take value one. Furthermore, 21 communes were added as they were affected according to the path measure. As illustrated in Table 2, the *Cyclone Path Dummy* is highly significantly correlated with precipitation variation. Map A.4. in Annex depicts cyclone Gafilo's path as well as the CNS *Serious Impact* measure.

3.3. Aid allocation

In total, we are in the possession of relief data on 249 out of the 292 communes from our sample.[13] Overall, 15% and 23% of them was hit according to the first (*Serious Impact Dummy*) and second (*Cyclone Path Dummy*) impact assessment respectively. Our results indicate that approximately three-quarters (77%) of the communes hit according to the *Cyclone Path Dummy* received relief from the government and/or the aid agencies. Moreover, the probability of assistance was higher in areas with cyclone damage as illustrated in Figures 1 and 2. Of the 249 communes in our sub-sample, 37 communes were classified by CNS as having suffered serious to very serious cyclone damage.[14] Eighty-four percent of those communes received relief: 49% received government aid and 73% aid agency relief.[15]

Overall, there is a significant correlation between the two relief programs and 18% of our sample received both types of relief. Figure 1 and Table 1 illustrate that the probability of assistance increased with the severity of cyclone damage in a consistent way. Of the communes with very serious cyclone damage, 57% benefited from government assistance and 86% from aid agency relief.

There is an extensive literature on the efficiency of targeting mechanisms (e.g., Cornia and Stewart, 1995; Lanjouw and Ravallion, 1999; Ravallion, 2000; Bigman *et al*., 2000; Coady *et al.*, 2004). In general, there are two types of mistakes to which any targeted intervention may be subject. The first is that of failing to reach the affected population. Cornia and Stewart (1995) define this as an F-mistake, that is, a failure in the primary objective of the intervention.[16] The second type of mistake is referred to by Cornia and

[13] There are no systematic patterns in the reasons for the missing data and there is no link with the cyclone impact.
[14] According to our focus groups on average 85% of the households in these communes suffered from damages to their agricultural output or personal goods. Moreover, at the time of the survey i.e. approximately 8 months after the cyclone, a majority of the respondents declared not to have fully recovered yet.
[15] As aforementioned, government assistance mainly consisted of the distribution of food (75%) and first aid supplies (70%). In a quarter of the communes the government also assisted in the reconstruction of public infrastructure.
[16] An F-mistake can also be referred to as a type I error or U-mistake (e.g., Coady et al., 2004).

Stewart (1995) as an E-mistake[17] as it is the mistake made when the intervention reaches the non-target population and hence it involves excessive coverage. Our data which are based on aid allocations at the community level illustrate an F-mistake of 16% meaning that one-sixth of the seriously to very seriously affected communes did not receive relief from the government or the aid agencies after cyclone Gafilo. A rough estimate indicates that this involves approximately 121.000 people. On the other hand, our findings depict an E-mistake of 25% meaning that more than half of the non-affected communes (with a CNS impact assessment equal to zero) received relief after cyclone Gafilo.[18] Looking at the results based on the *Cyclone Path Dummy* in greater detail, we find that 23% of our sample suffered from cyclone damage (Table 1). Of these communes, approximately one quarter (23%) did not receive government or aid agency relief and 17% did not receive any help.[19]

Table 4 illustrates the geographical distribution of relief in the aftermath of cyclone Gafilo. The data demonstrate strong provincial differences. A high 67% of the communes in the central province of Antananarivo received relief while there was no commune in that province suffering from serious to very serious cyclone damage both according to the impact assessments by CNS as well as the precipitation, satellite and wind data. This compares to only 77% of the communes in the western province of Mahajanga receiving aid while almost the entire province suffered from heavy destruction. The regional variations in our findings suggest that relief was not only provided according to cyclone damage, but was also influenced by other factors.

In the following sections we first develop a series of hypotheses on the determinants of aid allocations and afterwards we discuss the formal econometric analysis.

[17] An E-mistake can also be referred to as type II error or L-mistake (e.g., Coady et al., 2004).
[18] We do not consider the communes in the CNS impact zone 1 in these calculations due to aforementioned problems.
[19] Finally, as aforementioned we do not possess household data and hence are not able to calculate F- or E-mistakes within communes, but distribution within communes could be another source of both types of error.

4. Hypotheses on Determinants of Relief Aid Allocation

In this paper we do not attempt to develop a theoretical political economy model to formalize hypotheses on the determinants of relief aid allocation. Instead, we draw on the literature to forward a series of hypotheses on the incentives for governments and aid agencies to deliver assistance (e.g., Besley and Burgess, 2002; Morris and Wodon, 2003; Lazo and Santos, 2004).

First, our most straightforward hypothesis relates to the demand for relief assistance. One should expect the probability of aid to increase with the cyclone impact, i.e. that those who suffered most have the highest probability of receiving assistance.

Second, the cost of providing relief assistance will also affect the incentives to provide assistance. The cost of relief aid provision is related to the institutional and infrastructural capacity of the affected regions where the aid has to be delivered, and with access to the target population. For example, Besley and Burgess (2002) argue that highly populated or more densely populated communes are more capable of responding to shocks as these characteristics increase the ease of reaching the affected population, or in other words, reduce the cost per capita of the target population. On the other hand, geographical isolation or remoteness is expected to decrease the ease of reaching target populations.

Third, richer communes are expected to have more developed response mechanisms as they have more financial means to develop and invest in such mechanisms. This, ceteris paribus, reduces the costs for governments and aid organizations to provide relief aid.

Fourth, relief aid is a highly visible policy and hence it is very attractive for politicians to use for political purposes, such as targeting relief aid to groups of the populations from which they obtain political support – or expect to do so in the future. For example, Jayne *et al.* (2001) find evidence that the allocation of food aid was used by the

Ethiopian government to transfer resources to "politically favored regions". In line with this argument (e.g. Moser, 2008), one might expect the Government of Madagascar to transfer resources to favored regions. On the other hand, one of the main priorities of the Malagasy government at the time of the cyclone was to achieve better governance which, if implemented, would predict less politicization of relief operations.

Fifth, several recent studies show the importance of free and independent media as a key factor in ensuring protection for the poor and vulnerable (e.g., Drèze and Sen, 1990; Stapenhurst, 2000; Besley and Burgess, 2001, 2002; World Bank, 2002; Strömberg, 2004; Reinikka and Svensson, 2004, 2005). In particular, governments and politicians tend to favor informed citizens for two reasons: not only are well-informed citizens more likely to vote than uninformed ones, but they are also more likely to vote for those candidates who further their interests (World Bank, 2002). Hence, our final hypothesis is that an electorate better informed by mass media strengthens incentives for a government to be responsive and therefore, we expect the likelihood of government relief to be higher in communes with better media access.

The impact of some of several of these factors is likely to be different for governments in providing aid than for independent aid organizations. For example, we do not expect aid agency relief to be similarly influenced by the media as re-election incentives are absent. Hence, estimating the impact of the indicator variables for relief aid provided by the government and by independent aid organizations will provide additional insights on the importance of these various hypotheses.

5. Econometric Model

The empirical estimation includes one model with three definitions of the dependent variable. The first dependent variable is defined as a dummy variable with value one if the

commune received relief from the government and/or the aid agencies in the aftermath of cyclone Gafilo; and zero otherwise. The second dependent variable equals one if the commune received emergency assistance from the government; and zero otherwise. The third dependent variable takes value one if the commune received relief from the aid agencies after Gafilo; and zero otherwise. All dependent variables are commune-specific measures and the empirical model is of the following form:

$$y_c = \alpha i_c + \beta k_c + \delta q_c + \gamma (i_c)(q_c) + \varepsilon_c \quad (1)$$

where y_c represents the dependent variable, i_c captures the need for intervention, k_c is a matrix of provincial dummy variables to determine fixed effects not captured by the other explanatory variables, and ε_c refers to the error term. Furthermore, our model identifies a vector q_c of economic, media, and political variables that we might expect to affect aid allocation decisions (y_c). The q_c variables enter two times i.e. as level terms, and interacted with the variable that captures the need for intervention.

As indicator for the need for intervention after cyclone Gafilo hit Madagascar in March 2004, we use both the (CNS) *Serious Impact Dummy* and the *Cyclone Path Dummy,* for the aforementioned reasons. We expect the probability of both government and aid agency relief to be higher in areas with cyclone damage implying a higher need for intervention.

The variable *Pop_dens* measures the population density in the commune. The average household expenditures per commune per month are determined by *Mean_exp*.[20] As discussed earlier, we might expect more densely populated or richer communes to have more developed response mechanisms.

Remoteness quantifies the geographical isolation of the communes and is measured by a commune remoteness index – developed by Stifel *et al.* (2003) – that is the outcome of a

[20] Data are obtained from the Madagascar poverty map developed by the World Bank (Mistiaen *et al*., 2002).

factor analysis of various isolation measures collected in the commune census of 2001.[21] By construction, the index permits us to rank communes by degree of isolation (Stifel *et al*., 2003). Given the general lack of infrastructure in Madagascar, our hypothesis is that remoteness decreases the ease of reaching target populations. This hypothesis is consistent with the finding of Francken *et al.* (2009) that remoteness increases capture of public education funds by local officials, because of a lack of top-down monitoring i.e. by the central authorities in more remote areas.

Despite the fact that communities could be remotely situated from a hospital, a school etc. they could still have a taxi-bus transport facility and are therefore easier accessible compared to other remote areas without this facility. To control for this, we include the variable *Transport_facility* in our analyses which equals one if there is a taxi-bus service in the commune; and zero otherwise. The privately run taxi-buses are the main means of transport in urban as well as rural areas of Madagascar and could be an indication for the accessibility of the commune. Our hypothesis is that the likelihood of relief is higher in areas with a taxi-bus transport facility.

Descriptive statistics are reported in Table 5. The average population density of the communes in our sample equals 190 inhabitants per square kilometers. However, there are large variations, with a maximum population density of 7,050 inhabitants per square kilometers. The average household expenditures per commune per month equal 301,170 Malagasy Francs. This is equivalent to approximately 60,200 Malagasy Ariary or 28 USD.[22] The median remoteness index equals -0.28, with the lowest geographical isolation at -0.66 and the highest at 6.85. Half of the communes in our sample have a taxi-bus transport facility.

[21] Distances to health facilities, banks, schools, courts, input markets, agricultural extension services, veterinarians.

[22] The Malagasy Franc was replaced by the Malagasy Ariary on January 1, 2005. Our data are consistent with the fact that more than 70% of the Malagasy population lives under the national poverty line (World Bank, 2004).

To estimate the impact of mass media we use several indicators. The three main sources of mass media communication in Madagascar are radio, television, and newspapers (Francken *et al.*, 2009). Radio is the most common and important means of communication, especially in rural areas. The National Household Survey of 1997 (INSTAT, 1997) showed that 45% of all households are in the possession of a radio and according to the Commune Census of 2001 (Cornell University, 2001), approximately half of all communes (48%) has access to a regional radio outlet. This compares to 18% which has access to regional television. According to a recent study of Andriantsoa *et al.* (2005) only 6% of the Malagasy population reads a newspaper. Newspaper circulation is concentrated mostly in urban areas, and few newspapers are available in remote and rural areas. Moreover, illiteracy rates are high in these areas.[23]

Therefore, in this paper we focus on radio access instead of newspapers. More specifically, we use the variable *Radio_coverage* as indicator of access to mass media. This variable measures the percentage of the commune population listening to the radio in November 2001, according to estimations of the focus groups. First, using radio coverage rather than an indicator whether there is a radio station (or the number of radios) is more likely to be an accurate measure of access to mass media, since there is no obvious relationship between the (number of) radios and its audiences in villages in Madagascar. Second, to avoid endogeneity problems, we use a media variable which captures the radio coverage situation prior to the cyclone. Cyclone Gafilo hit Madagascar in 2003 and our survey took place eight months later. It is plausible that the government or aid organizations provided assistance by setting up media stations in the aftermath of the cyclone in order to get information out to the affected regions. Given that the president of Madagascar is the owner

[23] Concerning press freedom, Freedom House ranked the media in Madagascar during the last five years as 'partly free' (Freedom House, 2005).

of one of the private media companies in the country[24] and put considerable efforts in starting up radio stations all over the country, also in the aftermath of cyclone Gafilo, it could be that taking into account media access at the time of our survey would induce endogeneity problems.

On average, 47% of the population in the communes listened to the radio in 2001. Table 6 illustrates the degree of variation of radio coverage between and within the six provinces of Madagascar. Overall, radio coverage varies considerably between and within provinces. Historically, media activity was concentrated in the central province of Antananarivo (Andriantsoa *et al*., 2005). In recent years, external investments often through support from international non-governmental organizations, as e.g. the Andrew Lees Trust Fund, made radio access as well as radios available even in extremely remote and poor areas with low population density.

In order to investigate the impact of mass media – in particular on government aid allocation – in greater detail we asked the communal focus groups three hypothetical questions which are depicted in Table 7. The answers to these questions are not used as indicators in the regressions, but show that media matters to the people as on the first question a high 71% of the respondents answered to believe that, in case of a cyclone, the media and in particular the radio would probably report on the local cyclone impact. On the second question, whether they would go to the media themselves to report problems, a vast majority (82%) of the communes reported that they would probably do so. We further asked the communal focus groups on their perception of the impact of the media on government responsiveness, in case of a cyclone. Only 9% of the communes perceived that there would probably be no impact of the mass media on government responsiveness. Yet, half of the communes believe that the media would probably influence political decisions and improve

[24] The current president, Marc Ravalomanana, is the owner of Malagasy Broadcasting System (MBS). His firm broadcasts on radio as well as television.

responsiveness. Large differences are noticed between provinces. In general, the differences are in line with the differences in radio coverage. Based on earlier studies as well as the findings from our interviews, our hypothesis is that mass media, in particular radio coverage, increase the probability of government relief in the aftermath of natural shocks.

Our remaining hypotheses relate to the political situation in Madagascar at the time of cyclone Gafilo. Achieving better responsiveness to citizens' needs as a means of enhancing the well-being of the poor has been one of the main priorities of the Malagasy government[25] which took office in June 2002. Previously, Madagascar was characterized by low government accountability (e.g., Marcus, 2004; Transparency International, 2004; Kaufmann *et al.*, 2005).[26] President Marc Ravalomanana promised a positive change towards good governance and improved activism and responsiveness.

To measure whether there was any bias towards communes which politically supported the government, we include the variable *Major_president*, which is a dummy variable with value one if more than half of the electorate voted for Marc Ravalomanana during the presidential elections in 2001. Overall, he won with absolute majority in 36% of the communes (Table 5). It is reasonable to believe our variable is a reliable reflection of the political situation at the time of the cyclone i.e. approximately one and a half year after his appointment.

Finally, about half of the Malagasy population is Christian, evenly divided between Roman Catholics and Protestants. Many of the Christian churches are influential in politics. The best example of this is the Reformed Protestant Church of Jesus Christ (FJKM[27]). During the 2001 presidential campaign, FJKM supported Ravalomanana in his successful bid

[25] This priority is stated in the Poverty Reduction Strategy Paper (PRSP) of Madagascar.
[26] Kaufmann *et al.* (2005) present a set of governance indicators covering 209 countries over the period 1996-2004. The indicators capture six key dimensions of institutional quality or governance as among other things government effectiveness. In 2002, an estimated 60% of the total sample of countries showed better government effectiveness than Madagascar.
[27] Fiagonan'i Jesoa Kristy eto Madagasikara.

for president. The latter's position as a lay Vice President of FJKM still generates some political criticism alleging church and state interests are not kept entirely separate (U.S. Embassy in Antananarivo, 2004). The variable *Protestant* equals the percentage of Protestants i.e. members of FJKM in the commune in 1990, according to the focus groups during our field work in 2004. Measuring the percentage of Protestants more than 10 years before the presidential elections in 2001 reduces potential endogeneity and correlation problems. Table 5 illustrates that on average there were 29% Protestants in the communes in our sample, with a minimum of zero and a maximum of 90%. Consistent with the incumbent's promises, our hypothesis is that the government provided emergency assistance independent from religion. Aid agency assistance is expected to be neutral and hence not to be influenced by electoral support nor religion.

6. Results

6.1. Determinants of relief after cyclone Gafilo

We will first investigate the allocation of total aid, by the government as well as the aid agencies in the aftermath of cyclone Gafilo. Later, we will investigate whether there are differences in determinants of relief from the government and relief from aid agencies separately.

To address the problem of any kind of intra-district correlation and arbitrary heteroskedasticity, we use robust standard errors that are adjusted for clustering on the districts. In addition, we examine the conditioning of the matrix of independent variables following Besley, Kuh, and Welsch (1980). If this number is large, there may be collinearity problems. Our conditioning value equals on average 16, below the threshold value of 30 suggested by Besley *et al.* (1980) implying that there are no important collinearity problems. The results are shown in Tables 8 to 12.

The first column of Table 8 shows that the likelihood of relief was significantly higher in communes with a higher need for intervention as measured by the *Serious Impact* dummy or by the *Cyclone Path* variable (Column 4). The findings suggest that living in a commune hit by the cyclone increased the probability of receiving cyclone relief by between 36 and 41 percentage points. Both relief from the government (Columns 1 and 4 of Table 10) as well as from the aid agencies (Columns 1 and 4 of Table 11) was higher in cyclone-affected areas. This result is as expected as both were supposed to target their interventions to cyclone-affected communities. Our findings are further robust when we use the third indicator of need, i.e. precipitation data from the smaller sub-sample of 47 communes that are situated in the 15 districts with weather stations' information (Table 9).

We next discuss results that concentrate on the level effects. These effects represent determinants of relief unconditional on need after cyclone Gafilo. They may measure responses to shocks or damage not captured by our cyclone impact variables. However, they are more likely capturing the impacts of determinants of aid allocation, other than cyclone impact.

The results in Column 2 of Table 8 indicate that the likelihood of receiving relief was found to be higher in poorer areas as the coefficient of the variable *Mean_Exp* is highly significant with a negative sign, ceteris paribus. However, this effect is conditional on the impact of the cyclone, as can be seen from the results when including the interaction effects as shown in Columns 3 and 5 of Table 8. We find that, for the areas where there was no impact of the cyclone, relief aid was more likely to go to poorer areas. However, for the areas where there was an impact, relief aid was more likely to go to richer areas (Columns 3 and 5 of Table 11). Interestingly, these results for total relief aid are caused particularly by the aid agencies activities. As can be seen from Columns 3 and 5 of Table 10, the conditional effects are not found to be significant for government aid. In contrast, these effects are very

significant for the regression of aid agencies relief where average wealth in the commune had an important impact on donor relief aid with opposite effects in cyclone affected areas and elsewhere (see Columns 3 and 5 of Table 11).

In results not reported in the tables, we found that the result that relatively wealthier communities in cyclone-hit areas received more aid from donors is not driven by the fact that certain NGOs were already active in specific areas. The findings seem to suggest that consistent with our hypothesis, the donor agencies targeted aid to relatively richer communes probably due to the fact that the latter have better developed response mechanisms, for example, because they have more financial means to develop and invest in infrastructure, storage facilities, systems of distribution etc.

In contrast, our field interviews suggest that the result that, in regions not affected by the cyclone, poorer communes were more likely to receive aid, could be due to the fact that this relief was provided by non-governmental organizations that were already active in certain poorer areas of Madagascar before March 2004. The latter organizations were asked to cooperate in the donor relief operations after Gafilo while they were not situated in the cyclone-affected areas and were not able to move their operations to those areas due to budget constraints or other reasons.

The results also indicate that accessibility matters for relief allocation. Column 2 of Table 8 suggests that, unconditional on cyclone damage, relief was allocated to easier accessible communities i.e. those with a taxi-bus transport facility. The result is valid for both government (Column 2 of Table 10) as well as donor relief (Column 2 of Table 11). The findings remain robust when including the interaction effects (Columns 3 and 5 of Tables 8, 10 and 11). More specifically, the results suggest that living in a commune with a taxi-bus service increased the probability of receiving relief after Gafilo by 31 percentage points at the means of all other variables (Column 5 of Table 8). Considering general budget limitations

of relief operations, our findings seem to indicate that non-affected, but easier accessible communities received aid at the expense of affected ones.

Turning to the mass media variables, we find that there was no unconditional impact of mass media coverage on relief. However, mass media played a significant role in cyclone affected regions. The likelihood of relief was higher in cyclone-affected areas with higher radio coverage as the interaction variable *Impact*Radio_coverage* enters significantly with a positive sign (Columns 3 and 5 of Table 8). Interestingly, we find that this effect is only significant for the allocation of relief by the government as it was significantly higher in cyclone-affected areas with radio coverage (Columns 3 and 5 of Table 10) and not for relief allocated by donor agencies which do not appear to have been influenced by the mass media (Columns 3 and 5 of Table 11).

For government relief, in results not reported in the tables, we calculated that living in a commune where a majority of the population has radio access increased the probability of government relief after Gafilo by 24 percentage points (at the means of all other variables). These findings are consistent with our hypothesis and earlier qualitative results that citizens better informed by mass media strengthen incentives for governments to respond, thus emphasizing the importance of the development of regional media outlets as to stimulate government action.

Votes and political preferences also seem to have played a role in the provision of relief. There is no impact of the political support for the government, measured by commune votes for the president, unconditional on the cyclone impact. However, in areas which were hit by the cyclone, the probability of relief was higher in communes with a majority of votes for president Ravalomanana during the elections of 2001 (Column 5 of Table 8). This result is driven by the government's aid allocation decisions in the aftermath of cyclone Gafilo, and not those of the donors. The results in Column 5 of Table 10 indicate that living in a

commune with a majority of votes for the incumbent at the time of the 2001 elections increased the likelihood of receiving government relief by 37 percentage points at the means of all other variables. Aid from the donor agencies did not appear to be determined by this factor (Columns 3 and 5 of Table 11).

Several explanations for this observation are possible. On the one hand, communes with stronger political support for the incumbent may have stronger belief in the government and hence are more likely to report problems and request assistance. On the other hand, the finding could indicate that the Malagasy government targeted aid to favored regions which could indicate that emergency aid was used as a highly visible and hence politicized means of reacting to natural shocks. The latter interpretation is consistent with findings on public food distribution during periods of famines in other countries (e.g. Jayne *et al.*, 2001; Besley and Burgess, 2002). This issue deserves further research.

Finally, more densely populated or less remote areas or areas with a higher percentage of Protestants do not show to have had a higher probability of relief aid.

6.2. Robustness tests

We conducted some additional tests which are not reported in the text, but can be obtained from the authors upon request to check the robustness of our results. First, we tried to verify our findings on the determinants of aid on the smaller sub-sample of 47 communes that are situated in the districts on which we have precipitation data. As there are some problems due to the small sample size and a lack of variation in the independent variables *Transport_facility* and *Major_Rav*, we could only focus on the effect of certain economic, media, and political variables in the cyclone-affected areas. We considered areas with any rainfall increase compared to last year as affected by the cyclone. The results confirm our

earlier findings and show that in cyclone-affected areas the likelihood of relief was significantly higher in richer areas and in communes with higher radio coverage.

Second, to show that our results capture a causal effect of economics, radio, and politics rather than unobserved variation in other local characteristics, we included three additional variables as controls. One might argue that not only radio, but also television had an impact on relief allocation decisions. Therefore, we included a dummy variable for television access (*TV_access*) in our analyses.[28] There was no significant effect on the results and *TV_access* was not found to be important.

Disaster relief operations require certain logistics and facilities. It could be argued that they are better developed in areas with availability of potable water or electricity. We created a *Water* variable, i.e. a dummy variable with value one if there is potable water in the commune, either provided by the national energy and water company, JIRAMA, or by another provider; and zero otherwise. An *Electricity* dummy equals one if there is electricity in the commune; and zero otherwise. Overall, 54% of the communes has access to potable water and 21% has electricity. The results of this analysis suggest that the presence of these facilities did not have an impact on relief, while our earlier findings remain the same. As there could be some concern of multicollinearity of both variables with population density or average wealth in the commune, we excluded the latter variables from the analyses. Still, the variables were not found to be significant and there was no important effect on the results.

Last, using the CNS impact code that ranges from 0 to 3 as our cyclone impact measure led to the same findings.

In summary, our results based on aid allocations at communal level convincingly show that the likelihood of aid in the aftermath of Gafilo was higher in areas with a higher need for intervention. Moreover, aid was determined by economic, media, and political

[28] Overall, 42% of the communes had access to the national television station in 2001. However, this variable suffers from overestimation as during our field interviews we discovered that some rural areas only receive a very unclear broadcasting signal.

variables. The likelihood of relief from the donor organizations was higher in wealthier cyclone-affected communes. In addition, the probability of government aid was higher in cyclone-affected communes with higher radio coverage and stronger political support for the government. Unconditional on need, our data suggest that aid was allocated to poorer and easier accessible communities.

7. Conclusions

This paper sheds light on the targeting of relief aid in the aftermath of natural disasters. While relatively more aid is being given through these relief aid actions to developing countries (Hoddinott, 1998), there are relatively few studies on the efficiency and targeting of these interventions (e.g. Owens et al., 2003). Our study contributes to this lack of knowledge. We investigate the political economy of relief aid allocation after cyclone Gafilo hit Madagascar in March 2004 using unique nationally representative data from 249 communes at the end of 2004.

The analyses in this paper highlight five key findings. First, the likelihood of government and aid agency relief was higher in cyclone-affected areas. This finding is robust when using different impact assessments, including information from 15 weather stations across the country as well as satellite and wind speed data regarding the cyclone path. However, we also find that a number of communes that were not affected by the cyclone received aid and some communes that were seriously affected by the cyclone did not receive aid at all. This puts into question targeting mechanisms used in relief assistance.

Second, in cyclone-affected communes, donor-provided relief allocation is found to be more likely in relatively richer areas which is probably driven by the fact that richer communes have better developed response mechanisms as they have more financial means to develop and invest in infrastructure and facilities that are required for relief operations. In

contrast, in regions not affected by the cyclone, donor-provided relief allocation is found to be more likely in poorer areas which could be due to the fact that this relief was provided by NGOs that were already active in certain poorer areas of Madagascar before the cyclone and these NGOs did not have the capacity or financial means to swiftly move their operations to the affected regions after the cyclone. Hence, in order to reach poorer and affected areas in the aftermath of natural disasters, targeting would need to be improved.

Third, in cyclone-affected communes, government relief was determined by the mass media. We find that the likelihood of receiving aid from the government was higher in affected communes with higher radio coverage. This evidence underlines the importance of independent mass media in order to enhance government activism in the aftermath of natural disasters.

Fourth, our results suggest that the government targeted relief to cyclone-affected areas with stronger political support for the ruling administration in previous elections. However, this finding should be interpreted with caution and several explanations are possible. For example, communes with stronger political support for the incumbent put more trust in the government and therefore are more likely to reports problems and request assistance. Conversely, this result could indicate that the Government of Madagascar targeted relief disproportionally to favored regions as a reward (e.g., Jayne *et al.*, 2001).

Finally, our data indicate that aid was also allocated to easier accessible communities that were not affected by the cyclone. While in a country like Madagascar where poverty is endemic and excessive coverage is not really a major concern, it might however indicate fungibility of relief aid in that certain non-affected communities received relief at the expense of affected ones.

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Table 1: Impact assessments and relief after cyclone Gafilo

	(a) *CNS Impact Code*			
	0 = No	*1 = Moderate*	*2 = Serious*	*3 = Very serious*
Number of communes	56	156	30	7
Percentage of communes (%)	22	63	12	3
% of communes that received government relief	14	34	47	57
% of communes that received aid agency relief	18	45	70	86
% of communes that received relief from other sources	0	9	20	0
% of communes that did not receive any relief	75	33	10	14

	(b) *Cyclone Path – Dummy*	
	No impact	*Impact*
Number of communes	191	58
Percentage of communes (%)	77	23
% of communes that received government relief	28	43
% of communes that received aid agency relief	36	66
% of communes that received relief from other sources	6	14
% of communes that did not receive any relief	46	17

Table 2: Correlation between impact assessments and precipitation data at district level

	CNS Impact (0 to 3)	*CNS Any Impact Dummy*	*CNS Serious Impact Dummy*	*OCHA Impact (0 to 3)*	*Cyclone Path Dummy*
Precipitation	0.51*	0.30	0.50*	0.25	0.77***

Note: Significance levels of 10, 5 and 1 percent are represented by *, ** and ***.

Table 3: Impact assessments and precipitation data: results of analyses at district level

	CNS Impact[0]				*CNS Serious Impact Dummy*
	Outcome 0	*Outcome 1*	*Outcome 2*	*Outcome 3*	
Precipitation	-0.0021**	-4.77e-06**	0.0006**	0.0014**	0.0023*
	(2.29)	(2.29)	(2.29)	(2.29)	(1.68)
No. observations	15				15
Pseudo R2	0.134				0.273

Note: [0] The z-value is 2.29 and hence overall *precipitation* is significant at the 5-percent level; This table reports marginal effects; Significance levels of 10, 5 and 1 percent are represented by *, ** and ***.

Table 4: Cyclone impact and relief per province (in % of communes)

	Serious Impact - Dummy	*Cyclone Path – Dummy*	*Government Relief*	*Aid agencies Relief*	*Total Relief*
Madagascar	**15**	**23**	**32**	**43**	**57**
Per province					
Antananarivo	0	0	55	35	67
Fianarantsoa	0	4	21	35	44
Toamasina	12	12	15	64	70
Mahajanga	50	90	43	63	77
Toliara	20	38	23	30	38
Antsiranana	43	43	17	52	52

Note: Total relief equals one if the commune received relief from the government and/or the aid agencies in the aftermath of cyclone Gafilo; Source: Commune Survey, Ilo, 2004

Table 5: Descriptive statistics

Variable	*Unit*	*Mean*	*Med.*	*St. dev.*	*Max.*	*Min.*	*Obs.*
Cyclone Impact							
Precipitation	Percent	150.24	150.10	82.27	316.15	32.04	47
Serious Impact	Dummy	0.15	0.00	0.36	1.00	0.00	249
Cyclone Path	Dummy	0.23	0.00	0.42	1.00	0.00	249
Determinants of Relief							
A. Economic							
Pop_density	1000 Inhab/km^2	0.19	0.05	0.76	7.05	0.01	245
Mean_exp	1000 FMg	301.17	281.24	102.55	926.23	163.67	247
Remoteness	Index	-0.03	-0.28	0.84	6.85	-0.66	249
Transport_facility	Dummy	0.50	1.00	0.50	1.00	0.00	247
B. Media							
Radio_coverage	Percent	46.68	50.00	28.43	100.00	0.00	249
C. Political							
Major_president	Dummy	0.36	0.00	0.48	1.00	0.00	234
Protestant	Percent	29.14	30.00	18.67	90.00	0.00	247
Control Variables							
TV_access	Dummy	0.42	0.00	0.50	1.00	0.00	248
Water	Dummy	0.54	1.00	0.50	1.00	0.00	249
Electricity	Dummy	0.21	0.00	0.41	1.00	0.00	249

Table 6: Geographical distribution of radio coverage (in % of population)

	Mean	*Median*	*St. dev.*	*Max.*	*Min.*	*Obs.*
Madagascar	**46.68**	**50.00**	**28.43**	**100.00**	**0.00**	**249**
Per province						
Antananarivo	54.70	60.00	25.86	95.00	0.00	66
Fianarantsoa	39.51	40.00	25.95	90.00	1.00	57
Toamasina	52.88	50.00	23.77	95.00	8.00	33
Mahajanga	64.27	72.50	23.27	100.00	20.00	30
Toliara	24.60	10.00	28.82	100.00	0.00	40
Antsiranana	47.96	40.00	26.81	90.00	5.00	23

Table 7: Perceived power of the media/radio on government responsiveness

Nov/Dec 2004	*% of answers of focus groups to the questions:*			
	Probably	Maybe	Probably not	Total
Percent				
1/ 'In case of a cyclone, do you believe that the radio will report on the local impact/damage?'				
Madagascar	**71**	**13**	**16**	**100**
2/ 'In case of a cyclone, will you contact the media/radio and report on the local impact/damage?'				
Madagascar	**82**	**13**	**5**	**100**
3/ 'In case of a cyclone, do you believe that those radio reports improve government responsiveness?'				
Madagascar	**50**	**41**	**9**	**100**
Antananarivo	64	29	7	100
Fianarantsoa	30	65	5	100
Toamasina	76	24	0	100
Mahajanga	70	17	13	100
Toliara	10	65	25	100
Antsiranana	70	30	0	100

Source: Commune survey, Ilo, 2004

Table 8: Total (government and/or aid agencies) assistance: Probit regression results

	(1) dF/dx	**(2) dF/dx**	**(3) dF/dx**	**(4) dF/dx**	**(5) dF/dx**
Impact (Serious Impact)	0.3608***	0.4533***	-0.6984*		
	(3.11)	(3.81)	(-1.78)		
Impact (Cyclone Path)				0.4060***	-0.6561**
				(3.04)	(-2.10)
Pop_density		-0.0560	-0.0488		-0.0486
		(-1.08)	(-0.95)		(-0.97)
Mean_exp		-0.0010**	-0.0015***		-0.0014**
		(-2.18)	(-2.73)		(-2.53)
Remoteness		0.0308	0.0315		0.0617
		(0.69)	(0.68)		(1.21)
Transport_facility		0.2619***	0.2776***		0.3062***
		(4.04)	(3.89)		(4.10)
Radio_coverage		0.0004	0.0007		0.0001
		(0.32)	(0.52)		(0.01)
Major_president		0.0985	0.0911		-0.0456
		(0.82)	(0.71)		(-0.34)
Protestant		-0.0017	-0.0018		0.0001
		(-0.66)	(-0.67)		(0.01)
*Impact*Pop_density*			-0.3184		-0.4731
			(-0.69)		(-1.16)
*Impact*Mean_exp*			0.0029**		0.0025***
			(2.09)		(2.59)
*Impact*Remoteness*			0.2026		0.0131
			(1.38)		(0.14)
*Impact*Transport_facility*			-0.1932		-0.0808
			(-0.75)		(-0.46)
*Impact*Radio_coverage*			0.0087*		0.0088**
			(1.66)		(2.36)
*Impact*Major_president*			~		0.3719*
					(1.89)
*Impact*Protestant*			0.0082		0.0086
			(1.06)		(1.41)
Provincial Dummies	Yes	Yes	Yes	Yes	Yes
No. observations	249	227	221	249	227
Pseudo R2	0.103	0.184	0.190	0.115	0.231

Note: ~ The interaction term *Impact*Major_president* predicts outcome 1 perfectly and therefore the variable is dropped and 6 observations are not used; dF/dx reports marginal effects and, by default, the discrete change in the probability for dummy variables; results with robust standard errors adjusted for clustering on districts; z-statistics are reported in parentheses; significance levels of 10, 5 and 1 percent are represented by *, ** and ***.

Table 9: Assistance after cyclone Gafilo: Probit analyses – robustness tests

	Marginal Effect
A. Government assistance	
Precipitation	0.0017**
	(2.46)
Provincial Dummies	No
No. observations	47
Pseudo R2	0.132
B. Aid Agencies assistance (i.e. FID and/or NGO assistance)	
Precipitation	0.0014*
	(1.68)
Provincial Dummies	No
No. observations	47
Pseudo R2	0.049

Table 10: Government assistance: Probit regression results

	(1) dF/dx	**(2) dF/dx**	**(3) dF/dx**	**(4) dF/dx**	**(5) dF/dx**
Impact (Serious Impact)	0.3784***	0.4847***	-0.4493*		
	(3.01)	(3.81)	(-1.88)		
Impact (Cyclone Path)				0.3914***	-0.2865
				(3.29)	(-1.23)
Pop_density		-0.0249	-0.0214		-0.0236
		(-0.61)	(-0.55)		(-0.64)
Mean_exp		-0.0008**	-0.0007		-0.0005
		(-2.00)	(-1.44)		(-1.04)
Remoteness		0.1022**	0.1208**		0.1586**
		(2.10)	(2.26)		(2.31)
Transport_facility		0.1643***	0.1588**		0.2209***
		(2.65)	(2.43)		(3.26)
Radio_coverage		0.0001	-0.0007		-0.0014
		(0.05)	(-0.52)		(-0.96)
Major_president		0.1285	0.1122		-0.1343
		(1.15)	(0.87)		(-0.95)
Protestant		-0.0009	-0.0035		-0.0014
		(-0.42)	(-1.30)		(-0.50)
*Impact*Pop_density*			0.3077		0.2709
			(1.21)		(1.40)
*Impact*Mean_exp*			0.0010		0.0008
			(1.27)		(1.26)
*Impact*Remoteness*			0.1047		-0.0929
			(0.66)		(-0.94)
*Impact*Transport_facility*			-0.1272		-0.1177
			(-0.65)		(-0.97)
*Impact*Radio_coverage*			0.0116**		0.0067**
			(2.02)		(2.05)
*Impact*Major_president*			0.7162**		0.6518**
			(2.42)		(2.54)
*Impact*Protestant*			0.0170***		0.0102**
			(3.46)		(2.45)
Provincial Dummies	Yes	Yes	Yes	Yes	Yes
No. observations	249	227	227	249	227
Pseudo R2	0.132	0.225	0.286	0.133	0.308

Note: dF/dx reports marginal effects and, by default, the discrete change in the probability for dummy variables; results with robust standard errors adjusted for clustering on districts; z-statistics are reported in parentheses; significance levels of 10, 5 and 1 percent are represented by *, ** and ***.

Table 11: Aid agencies assistance: Probit regression results

	(1) dF/dx	**(2) dF/dx**	**(3) dF/dx**	**(4) dF/dx**	**(5) dF/dx**
Impact (Serious Impact)	0.3385***	0.4745***	-0.5141		
	(2.65)	(3.25)	(-1.33)		
Impact (Cyclone Path)				0.3718**	-0.5737*
				(2.49)	(-1.65)
Pop_density		0.0118	0.0240		0.0246
		(0.22)	(0.45)		(0.46)
Mean_exp		-0.0007	-0.0013**		-0.0013**
		(-1.53)	(-2.19)		(-2.02)
Remoteness		-0.1012*	-0.1388*		-0.1413
		(-1.68)	(-1.78)		(-1.54)
Transport_facility		0.2413***	0.2616***		0.2994***
		(3.26)	(3.30)		(3.61)
Radio_coverage		0.0003	0.0008		0.0003
		(0.21)	(0.48)		(0.16)
Major_president		-0.0559	-0.0001		-0.0850
		(-0.47)	(-0.00)		(-0.63)
Protestant		-0.0027	-0.0041		-0.0038
		(-1.02)	(-1.42)		(-1.26)
*Impact*Pop_density*			-0.3619		-0.3852
			(-0.80)		(-0.96)
*Impact*Mean_exp*			0.0026**		0.0026**
			(1.97)		(2.24)
*Impact*Remoteness*			0.2172		0.1588
			(1.33)		(1.17)
*Impact*Transport_facility*			0.0324		-0.1466
			(0.12)		(-0.83)
*Impact*Radio_coverage*			0.0022		0.0047
			(0.47)		(1.13)
*Impact*Major_president*			-0.1720		0.1362
			(-0.58)		(0.51)
*Impact*Protestant*			0.0134		0.0158**
			(1.60)		(2.08)
Provincial Dummies	Yes	Yes	Yes	Yes	Yes
No. observations	249	227	227	249	227
Pseudo R2	0.082	0.152	0.181	0.088	0.190

Note: Dependent variable equals one if the commune received assistance from aid agencies after cyclone Gafilo; dF/dx reports the change in the probability for an infinitesimal change in each independent, continuous variable and, by default, the discrete change in the probability for dummy variables; results with robust standard errors adjusted for clustering on districts; z-statistics are reported in parentheses; significance levels of 10, 5 and 1 percent are represented by *, ** and ***.

Table 12: Total (government and/or aid agencies) assistance: Results of robustness tests

	Marginal Effect
Sample of areas with cyclone impact (precipitation>100%)	
Precipitation	-0.0009 (-0.40)
Pop_density	1.2831 (0.71)
Mean_exp	0.0045** (2.16)
Remoteness	0.0650 (0.96)
Radio_coverage	0.0115*** (3.13)
Protestant	0.0043 (0.44)
Provincial Dummies	Yes
No. observations	31
Pseudo R2	0.444

Note: Results with robust standard errors adjusted for clustering on the districts; z-statistics are reported in parentheses; significance levels of 10, 5 and 1 percent are represented by *, ** and ***.

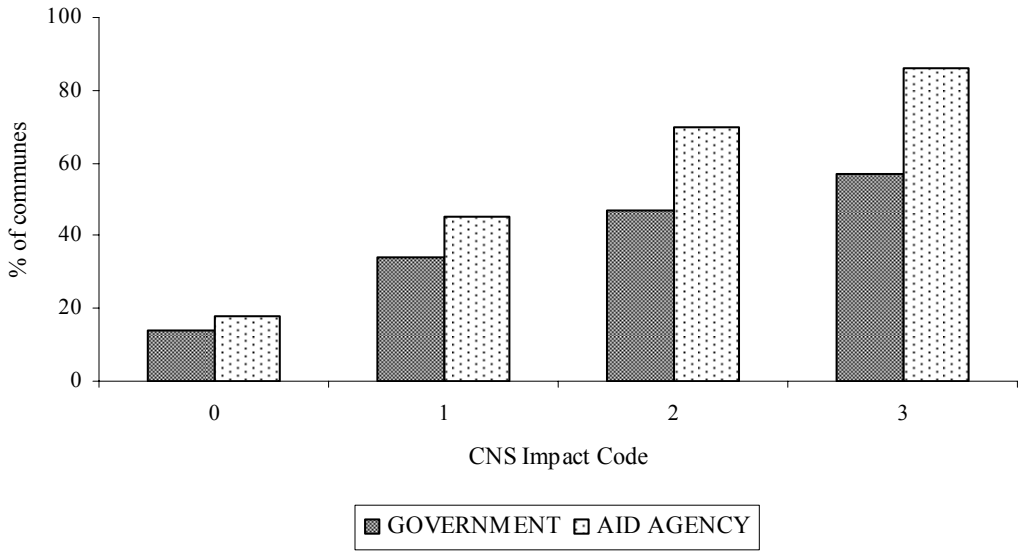


Figure 1: Government and aid agency relief after cyclone Gafilo with impact according to CNS impact assessment codes

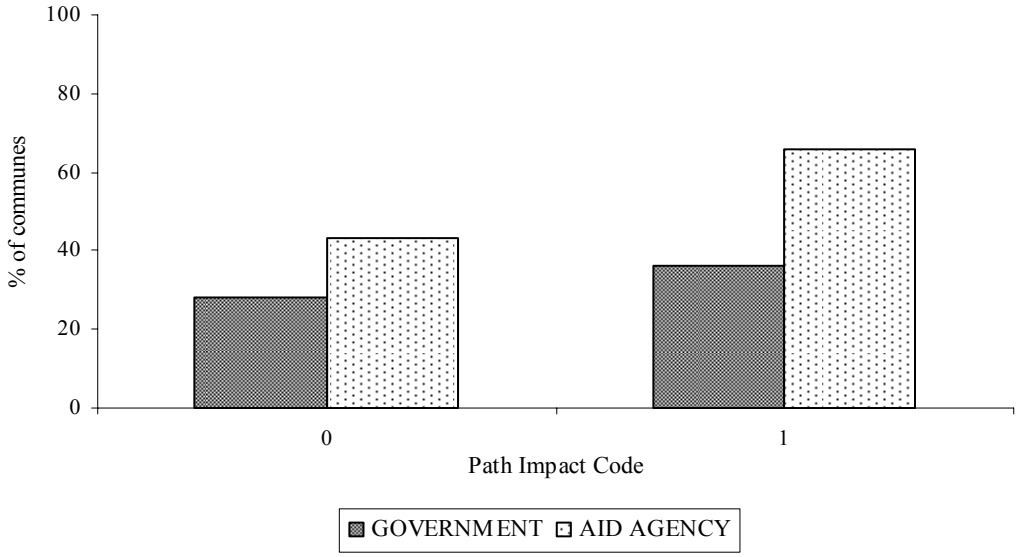
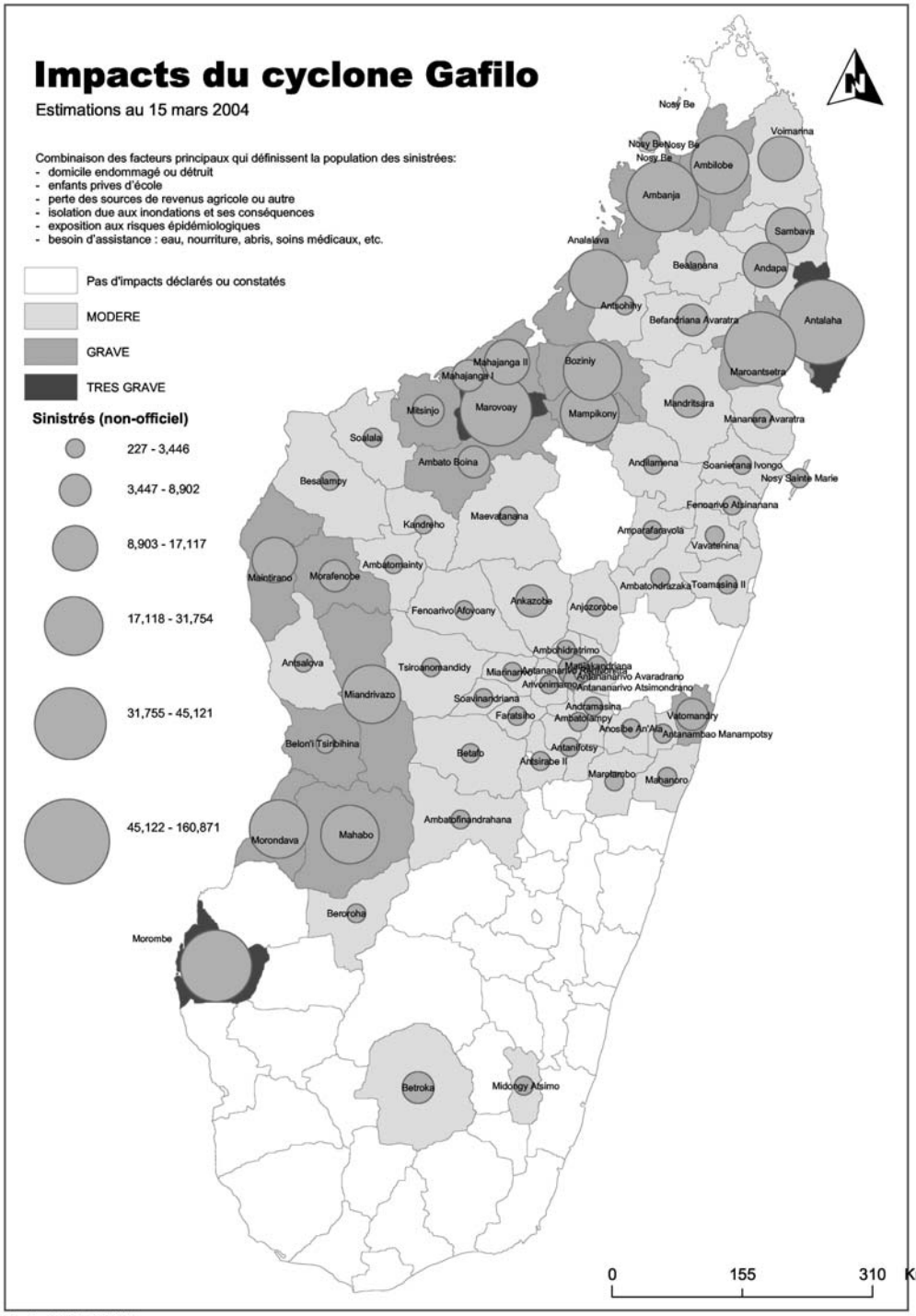


Figure 2: Government and aid agency relief after cyclone Gafilo with impact according to the cyclone path impact assessment codes

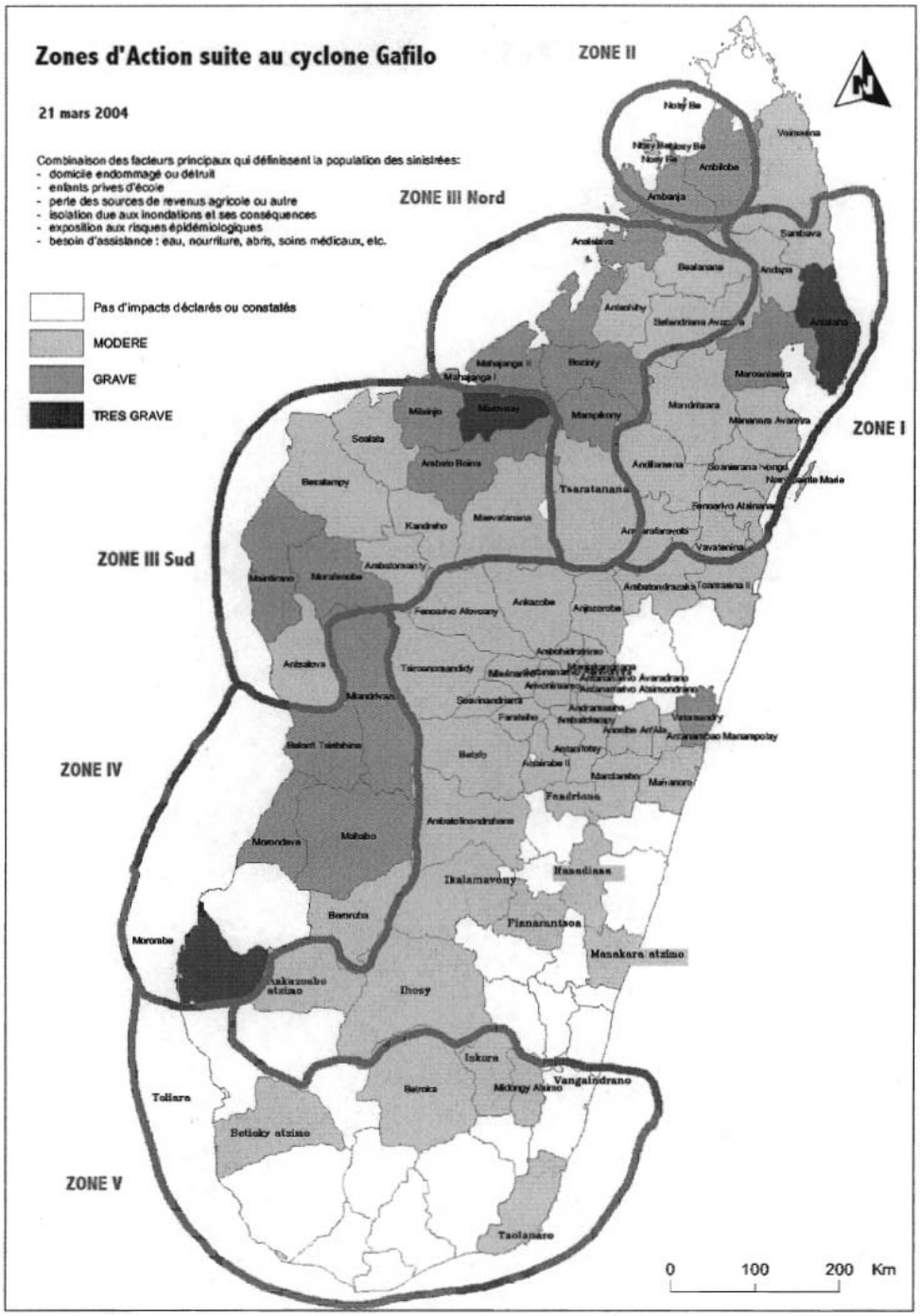
ANNEX

A.1. Impact assessment of cyclone Gafilo in Madagascar – Source: OCHA

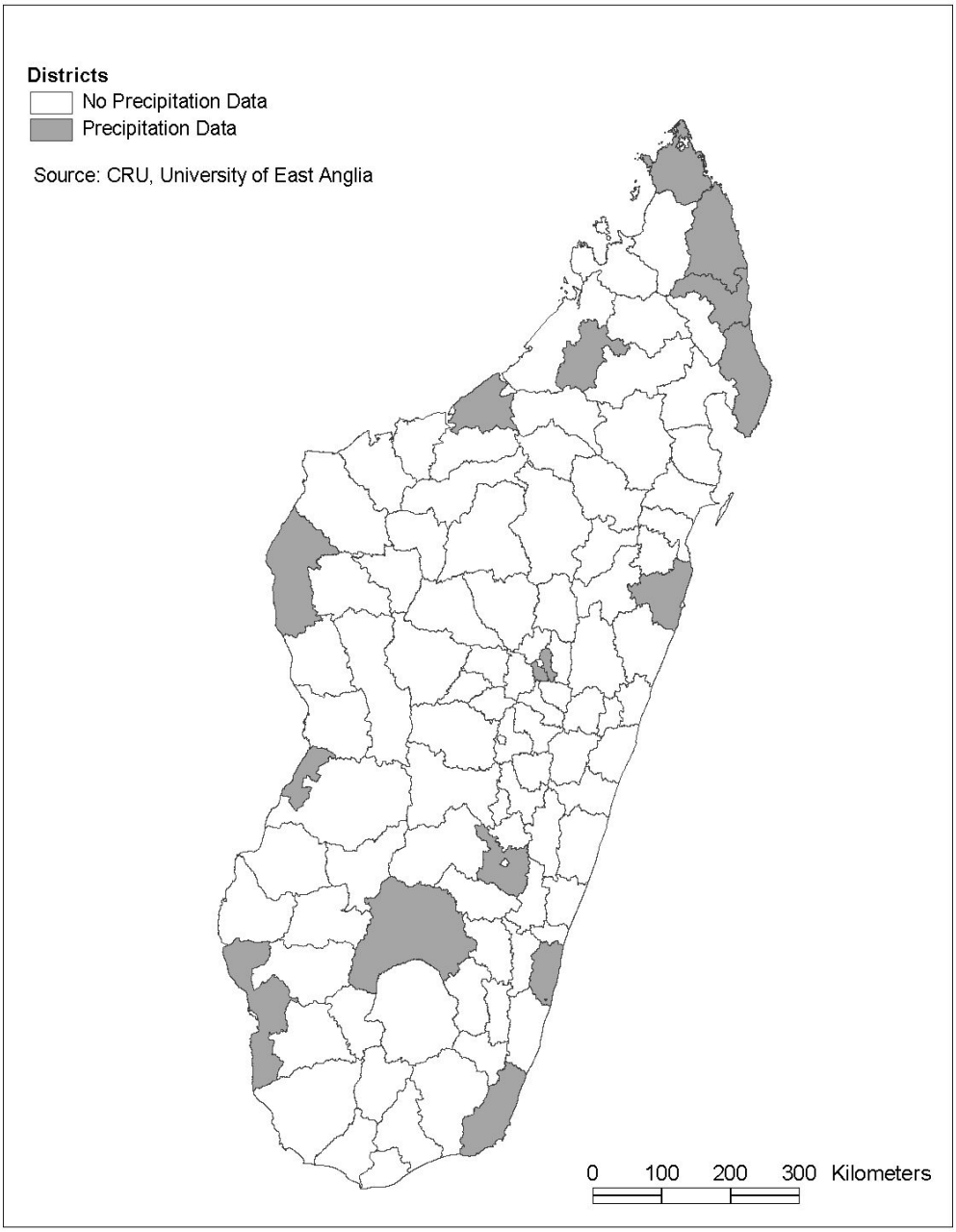


Map by OCHA - SAHIMS
OCHA Support Mission to Madagascar 10 March 2004
Data Collection and Compilation by the National Disaster Management Agency / CNS - Conseil National de Secours - Antananarivo

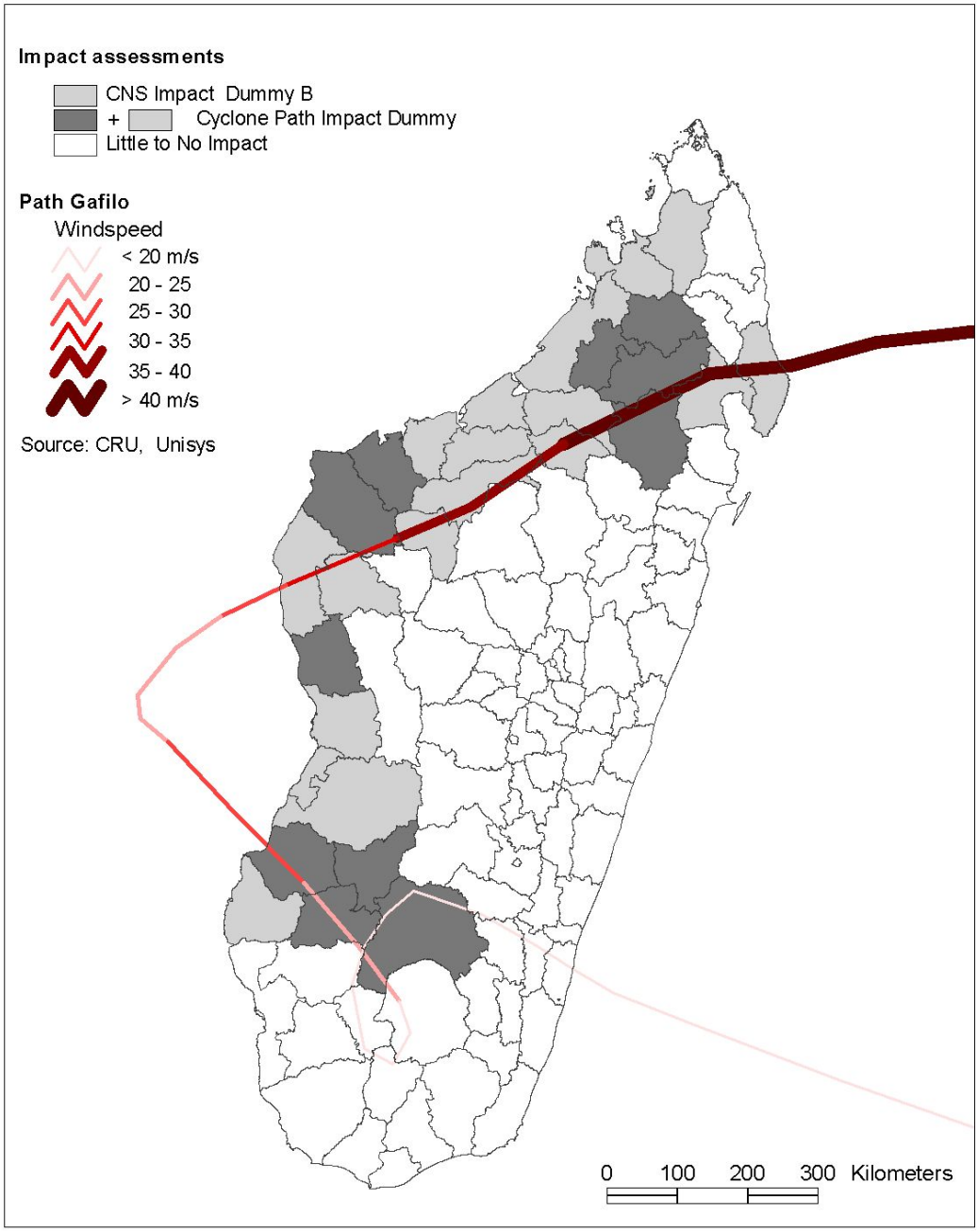
A.2. Impact assessment of cyclone Gafilo in Madagascar – Source: CNS



A.3. Districts with rainfall stations in Madagascar



A.4. Cyclone path and impact assessments



Note: CNS Impact Dummy B refers to the *Serious Impact* Dummy

A.5. Data description

Total assistance = dummy variable which equals one if the commune received aid after cyclone Gafilo from the Government of Madagascar and/or the aid agencies (Source: Commune Survey, 2004).

Government assistance = dummy variable which equals one if the commune received emergency aid from the government in the aftermath of cyclone Gafilo (Source: Commune Survey, 2004).

Aid agencies assistance = dummy variable which equals one if the respective aid agencies (FID and/or local or international NGOs) provided assistance as cash-for-work programs and/or aid to the reconstruction and rehabilitation of public facilities in the aftermath of cyclone Gafilo (CS, 2004).

Precipitation = the % increase in precipitation at the time of cyclone Gafilo (March 2004) compared to the precipitation one year earlier i.e. in March 2003 (Sources: CRU, Univ. of East-Anglia).

CNS Impact Code = cyclone impact code, created by the National Disaster Management Agency of Madagascar, that ranges from 0 to 3. Zero stands for no cyclone damage, 1 for moderate damage, 2 for serious damage, and 3 for very serious cyclone damage (Source: CNS, 2006).

(CNS) Any Impact = dummy variable which equals one if the *CNS Impact Code* equals one, two or three; and zero otherwise (Source: CNS, 2006).

(CNS) Serious Impact = dummy variable which equals one if the *CNS Impact Code* equals two or three; and zero otherwise (Source: CNS, 2006).

OCHA Impact Code = cyclone impact code, created by OCHA, that ranges from 0 to 3. Zero stands for no cyclone damage, 1 for moderate damage, 2 for serious damage, and 3 for very serious cyclone damage (Sources: OCHA, 2006; Relief Web, 2006).

Cyclone Path = dummy variable that equals one if the cyclone passed by the commune or district based on satellite images and wind speeds; and zero otherwise (Source: UNISYS, 2006).

Pop_density = population density in the commune (Source: Commune Census, 2001).

Mean_exp = average household expenditures per commune per month (Population Census, 1993).

Remoteness = commune remoteness index that is the outcome of a factor analysis of various isolation measures collected in the commune census of 2001. By construction, the index permits us to rank communes by degree of isolation (Source: Stifel *et al*., 2003).

Transport_facility = dummy variable with value one if there is a taxi-bus transport facility/stop in the commune; and zero otherwise (Source: Commune Survey, 2004).

Radio_coverage = % of the population in the commune that listened to the radio in November 2001 i.e. before the presidential elections (Source: Commune Survey, 2004).

Major_president = dummy variable with value one if more than 50% of the electorate voted for the president, Marc Ravalomanana, during the presidential elections in 2001 (G.O.M., 2004).

Protestant = percentage of Protestants in the commune in 1990, according to the focus groups (CS, 04)

TV_access = dummy variable with value one if there was access to a TV outlet in the commune in November 2001; and zero otherwise (Source: CS 2004).

Water = dummy variable with value one if there is potable water in the commune, either provided by the public water company, or by another provider; and zero otherwise (CS, 2004).

Electricity = dummy variable with value one if there is electricity in the commune; and zero otherwise (CS, 2004).