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Military Response to Inland Natural Disasters: The Case of Floods in Brazil

Renata Albergaria M. Bandeira (re.albergaria@gmail.com)

Vania Barcellos G. Campos (vania@ime.eb.br)

Adriano P. Fontainhas Bandeira (bandeira@ime.eb.br)

Instituto Militar de Engenharia (IME)
Praça General Tibúrcio, 80
Praia Vermelha, Rio de Janeiro, RJ, Brasil

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1. Introduction

Factors such as global warming, environmental degradation and increasing urbanization expose a greater number of people to the threat of natural disasters. In the last three decades, the rate of disasters has risen from 50 to 400 per year (Kovacs and Spens, 2009) and it is still expected to increase five times more on the next 50 years (Thomas and Kopc Zack, 2007). In 2010, 207 million people suffered from disasters, which caused 296.800 deaths and losses of 109 billion dollars (Sapir, 2011). In the last decade, Brazil has suffered, on average, six natural disasters per year (UN, 2011) and, in 2008, it was the thirteenth country most affected by natural disasters, having 2 million victims affected mainly by floods or landslides (Lima *et al.*, 2011).

All these natural disasters require the immediate mobilization and action of multiple stakeholders due to the unexpected nature and amplitude of the event, the diversity and quantity of supplies and services needed by the victims (Chandes and Paché, 2009). Besides, emergency relief operations can be distinguished in the times before a disaster strikes (the **preparation phase** or **preparedness**, that refers both to preparation and prevention), instantly

after a disaster (the **immediate response phase**, that refers both to emergency relief and transition) and in the aftermath of a natural disaster (the **reconstruction phase**, that refers to activities related to recovery, rehabilitation, and development) (Kovács and Spens, 2007). Different resources and skills are needed for these three distinct phases, so both the activation of different stakeholders and the challenges of humanitarian logistics depend upon the phase of disaster relief (Kovács and Spens, 2009).

This increasing number of stakeholders that acts on different phases of the operation and the lack of resources pose a problem of coordination in emergency relief aids (Balcik *et al.*, 2010). According to Rey (2001, apud Balcik, 2010), lack of coordination is still a fundamental weakness in humanitarian operations, even though coordination is a direct condition for a successful aid. Therefore, in order to improve the efficiency of humanitarian aid, actors will have to learn how to co-elaborate and co-manage relief chains (Chandes and Paché, 2009). Nonetheless, it is a very complex process considering the variety of actors (which can be donors, volunteers, public agencies, government, military, non-governmental organizations, private companies, logistics services operators etc.) widely different in nature, size and specialization, that are compartmentalized in their operating modes.

Examining past experience reveals the critical need for collaboration and coordination among humanitarian organizations, the military, private and humanitarian sectors (Apte, 2009). The private sector and foreign and national military are increasingly part of the relief effort and therefore affect coordination efforts (The Sphere Project, 2011). On the other hand, it is very complex to establish coordination among stakeholders with highly-distinct organizational cultures such as the military. NGOs and the military strongly held negative organizational stereo-types and perceived ideological differences (Tatham and Kovács, 2010). Although the goal of both military and NGOs in humanitarian operations concerns the

stabilization of the situation and a return to normalcy, they have different perspectives on how the goal is to be achieved and how long it will take (Davidson *et al.*, 1996). Besides these differences, a common thread to many recent disasters has been the significant involvement of militaries (Weeks, 2007). The military has typically played an important role in providing support during disasters (Apte, 2009) and, since the 1990s, there has been an explosion of Western Military involvement in complex emergency situations, requiring cooperation with relief agencies (Byman, 2001). Therefore, coordination among these two communities is a necessity to improve efficiency in humanitarian supply chains (Apte, 2009). Pettit and Bersford (2005) evaluated a number of disaster relief and recovery models and proposed a humanitarian logistics framework combining military and NGO experience.

For that reason, this paper examines the role of the militaries in emergency disaster relief operations and their relationship with non-governmental agencies. Successful cases of military experience in humanitarian logistics, found in international literature, are also presented and analyzed. Finally, as the field of Humanitarian Logistics is still incipient in Brazil, military support could help to ensure effectiveness for these operations. Therefore, the paper analyzes the immediate response operation after the floods occurred in Rio de Janeiro in 2011, focusing on the support provided by the Brazilian Army, and, based on the successful cases studied, insights will be presented for military practices in humanitarian operations.

2. Militaries in emergency disaster relief operations

Military participation in humanitarian aid operations in cases of conflict or natural disasters is not a new phenomenon. Military (especially in the United States) has typically played an important role in providing support during disasters due to its strength in logistical and organizational structure (Apte, 2009). According to Apte (2009), there have been numerous instances, including during Hurricane Katrina, where division of United States

Marine Corps, “Combat Logistics Battalion for Marine Expeditionary Unit has the inherent mission of providing initial support to humanitarian assistance operations.”

The military’s primary missions in disaster response are to establish a secure environment and make it possible for relief organizations to operate, providing transportation and communication (Davidson *et al.*, 1996). A secondary mission concerns the creation of conditions that will permit the return of the disaster area to normality, but this is a controversial mission that requires the military to perform duties different from its primary responsibility of ensuring a secure environment (Davidson *et al.*, 1996). Nonetheless, these two missions are often blurred in complex emergencies. Wassenhove (2006) remarks that, in the harsh reality of a disaster, the lines between the military and humanitarians have sometimes been blurred.

On the other hand, the main goal of the military is fighting wars and this goal may be perceived to be in some-what of a conflict with the goal of humanitarian assistance (Pettit and Beresford, 2005). Besides, for Grossrieder (2003), there is a wide gap between military humanitarian action and NGOs operations due to the principle of neutrality that cannot be implemented by soldiers, only by independent humanitarian organizations. Thus NGOs may fear that, in the long run, association with militaries threatens their impartial image and thus endangers them (Byman, 2001). In fact, local population’s or local government’s view of the military or coalition forces greatly affects the success of a foreign disaster assistance operation and NGO willingness to be associated with the military. For instance, in Bangladesh, local populace had a positive view of the US military, greatly enhancing the chances of operation success and ensuring a positive NGO response to cooperating with (Davidson *et al.*, 1996). However, in Afghanistan, one of the main challenges for humanitarian efforts was to disassociate the activities of the humanitarian community and the

military, thus the humanitarian community could not have visible contact with the combatant military force – the US-led coalition (Wassenhove, 2006). Therefore, The Sphere Project (2011) recommends that, even if NGOs work together with the military in humanitarian operations, they must remain clearly distinct from the military to avoid any real or perceived association with a political or military agenda that could compromise the agencies' independence, credibility, security and access to affected populations. Although it is an important point to be considered, this applies only for military forces acting in international operations and mainly in case of conflicts, not in the case of inland natural disasters, such as the scope of the present investigation. Besides, even in international emergency relief operations, the experiences in Iraq, Somalia, Haiti and Rwanda have proven that closer coordination among NGOs and the military can more effectively serve the goal of delivering assistance in complex humanitarian emergencies (Davidson *et al.*, 1996). As a result, there is much debate about the role of the military in a humanitarian context.

According to Chandes and Paché (2009), the participation of the military in humanitarian operations can be considered positive because there is no single organization with the ability or competence to solve every problem generated in an emergency situation. Pettit and Bersford (2005) also defend a humanitarian logistics framework combining military and NGO experience in cases of disaster relief and recovery. However, there are difficulties in establishing interpersonal working relationships between Military and NGOs (Tatham and Kovács, 2010). Because of the diffuse nature of the NGO community, the military often is confused when trying to figure out who is in charge, what organizational structure is present in-country or how the civilian chain of command functions (Davidson *et al.*, 1996). According to Byman (2001), military officials, particularly in the United States, also fear that by improving their capabilities they will be called on to carry out humanitarian missions rather

than being able to devote themselves to their primary mission: war-fighting. In the perspective of NGOs, the military footprint is too large and they are also concerned that the military might want to take charge and control non-governmental organizations. Thus, although NGOs are open with information concerning the needs of suffering people, they are often reluctant to share information on other areas with the military because they are afraid that the military seeks to collect information that goes well beyond the immediate crisis (Byman, 2001).

For that reason, the military should play a supporting role during humanitarian crises, helping relief agencies provide assistance rather than taking the lead. The Sphere Project (2011) recommends that any association with NGOs and the military should be in the service of, and led by, humanitarian agencies according to endorsed guidelines. The military should accomplish tasks unrelated to its core mission only when no civilian agency could do the job quickly enough or well enough under the circumstances, except during the first phases of complex contingency operations, while the situation remains unstable and civilian agencies are not yet fully able to carry out their responsibilities (Byman, 2001). Among the actors involved in humanitarian operations, military units are often among the first on the scene of disaster situation (Weeks, 2007). Besides, the assets most capable of being rapidly and effectively deployed in a disaster are often those held by military, so, in Australia, for instance, civil and military assets might be jointly deployed in response to a natural disaster (Oloruntoba, 2010). In this case, military forces are considered a valuable resource for relief operations, trained and disciplined to act as the international aid community prepares itself for action. Once the crisis is stabilized, the military can pass on its tasks to humanitarian organizations or UN agencies. Since relief agencies stay on the scene long after an intervention, they are ideal partners for taking over the humanitarian aspects of the military's mission (Byman, 2001).

The UN is generally the principal agency coordinating the international community's response, and as such assumes a preeminent role in integrating the activities of different actors supporting the operation (Davidson *et al.*, 1996). In the context of the US Department of Defense, Civil-Military Operations Centers (CMOC) are established to be an institutionalized way for the military and the relief community to coordinate procedures and priorities (Byman, 2001). The CMOC monitors military support throughout the area of operations, and respond to UN and NGOs logistic, security and/or technical support requirements. Although they share many characteristics, each humanitarian relief operation has unique characteristics and the CMOC structure will be tailored for each situation, providing liaison and coordination between the military capabilities and the needs of the relief agencies, validating NGO requests for military assistance and providing a conduit for information flow (Davidson *et al.*, 1996).

Experience in logistics also reinforces the use of militaries in humanitarian operations. Flexibility and agility required in disaster relief operations are conditions that stand out in the military supply chain. For Apte (2009), humanitarian logistics would benefit from military support for ensuring effectiveness, setting aside political and security reasons, because the structure for command and control, such as in the military, is critical in case of chaotic situations (war or disaster). Apte (2009) considers that the commonality of situation in war and disaster in conjunction with structure and resource acquisition in military logistics may help explain why military support during disasters is often more effective than other forms of aid, except for certain commercial organizations such as Wal-Mart.

Besides, according to Carroll and Neu (2009), the difficulties faced in humanitarian operations are not dissimilar to those routinely faced in military logistics operations. Military logistics is a discipline that encompasses the resources that are needed to keep the means of the military process (operation) going in order to achieve its desired outputs (objectives),

including the planning, management, tracking and control of these resources (Apte, 2009). Gattorna (2009), Tatham and Pettit (2010) point out commonalities between military and humanitarian logistics: both have dynamic and uncertain demand patterns, face difficulties due to degradation of the local physical infrastructure as well as to the absence of certain governmental functions, attend injured and traumatized victims and are in constant observation of the media. Demand patterns and demand locations change more frequently within the context of conflict and disaster than in commercial enterprises, so last mile distribution is necessarily dynamic and uncertain for military and humanitarian logistics (Apte, 2009). Military and humanitarian logistics also have significant commonalities regarding inventory management, because, as a result of instability and uncertainty, concerns about issues of fleet management, packing, routing, and delivery of supplies within specified time windows are compounded during times of disaster and conflict. As per funding, military mission normally dictates accomplishment despite the cost, so if the mission is necessary then the funds are made available, even though budget is still a consideration. Unfortunately, this may or may not happen in humanitarian logistics since acquisition of resources is dependent on donations (Apte, 2009).

For Pettit e Beresford (2005), the military must be capable to operate both in situations of conflicts or disasters, having to adapt to the existing conditions at the given moment, due to the advantages that their presence brings to complex emergency relief operations. The military have unique capabilities that might be applied in humanitarian operations. Combat units, for example, are designed for mobility and quick response, characteristics that allow military organizations to swiftly bring communications equipment and supplies to the disaster area (Weeks, 2007). Other capabilities of the military applied on humanitarian operations are: sea and aerial port operations and openings, logistics for high-threat regions, bulk water

production and distribution, a complete strategic airlift package, self-supporting logistics capability and oversized or outsized lift delivery (Davidson *et al.*, 1996). However, NGOs have unique capabilities as well. Because they are often in-country for many years, in international operations, relief agencies have the advantage to understand the local culture and the immediate needs of the population, also knowing local security and political situation better than other observers (Byman, 2001). For that reason, the partnership among humanitarian agencies and military as a great opportunity to alleviate human suffering and restore stability, since the military has an unique capacity to provide security, logistical support and fast planning and NGOs often provide financial resources, a more complete understanding of the local situation, experience in providing assistance and acts on the process of reconstruction. Nonetheless, as previously pointed out, there are difficulties in this relationship yet to overcome. Therefore, on the following section, we analyze lessons learned from international experience found in the literature.

3. International military experience in humanitarian logistics

Oloruntoba (2010) describes the emergency relief chain and overall relief effort of Cycle Larry in Australia, which is generally agreed to be one of the more effective in the history of emergency cyclone response in the country. In Australia, both domestic and international capabilities for natural disaster response, held respectively in each state and by the Australian Agency for International Development, can be augmented by the Australian military support through the Defense Aid to the Civil Community (DACC) program. Oloruntoba (2010) points out this program as an important part of Australian disaster plans, since it entails the use of flexible and quick military response strategies in collaboration with other civil response agencies and NGOs.

In the case of “Operation Larry Assist”, the military together with elements of the

State Emergency Service worked on search and rescue, evacuation, providing drinking water, food and shelter, clearing debris which blocked roads and endangered the population as well as preventing the breakdown of law and order, ensuring security and restoring the mobility of the population (Oloruntoba, 2010). The Defense Force also provided medical and support, transportation, supply and maintenance support. The immediate relief operation was mainly undertaken by the Defense Force (Oloruntoba, 2010). The military response strategies were collaborative with other civil government agencies and NGOs that managed disaster well beyond the initial crisis through to stabilization and reconstruction. According to Oloruntoba (2010), the participation of the Australian Defense Force was one of the key-success factors during the cyclone itself and its immediate aftermath. However, this success is due to the prior standing pre-cyclone plans and strategic planning, since the government actors and agencies, including the Defense Force, are all aware of their roles and responsibilities within the context of executing and standing plans and this enabled the unity of direction amongst responding government agencies.

Oloruntoba (2010) analyzes the joint response tactical plan called “Plan Ironbark”, which consisted of clear response triggers that detail the scenarios and how these units will respond, and under whose authority the forces will be deployed. This is a critical success factor that, in general, does not happen in emergency relief operations. Aspects of the Plan Ironbark also involved preparedness tactics, such as standardization of the used terminology with civil response agencies so that they understood each other clearly, allocation of roles and responsibilities as well as conducting exercises and simulated events (Oloruntoba, 2010). This type of knowledge, regarding each other’s role, culture and structure, is another critical success factor that usually is not applied in emergency relief operations.

Another feature of the operation pointed out by Oloruntoba (2010) as a key-success

factor is the employment of local military units, because it confers local knowledge and local networks (since soldiers and their families live in the region). Besides, due to Plan Ironbark, local military units were on stand-by ready to act before the cyclone struck. Therefore, local units are best suited to be employed to emergencies in the area. Moreover, Oloruntoba (2010) defends the creation of units used almost exclusively as disaster response arms of the military, such as happens in Australia, because these units are familiar with the terrain and the geotopography of the neighborhood and disaster areas. Pre-positioning of the military unit, relief supplies and resources in readiness for response in areas prone to natural disaster can contribute to shorten cycle times and increase relief chain responsiveness (Oloruntoba, 2010).

For Weeks (2007), the creation of a temporary central collection point to filter information was a significant element in the success of the 2005 Pakistan earthquake relief operation. Due to the large number of agencies involved in humanitarian operations, the large volume of information produced requires filtering, so communications channels will not be quickly overwhelmed. For instance, in Pakistan operation, the Combined Air Operations Center (CAOC) emerged solely to collect information on the current state of the situation and to coordinate the needs of the earthquake relief efforts and was extinct within 60 days, as the operation was then assimilated into the normal steady-state operations (Weeks, 2007). In order not to lose too much fidelity in the information provided to those on the scene following a disaster, physical proximity in which team members work is necessary. The CAOC team would meet every 12 hours between outgoing and oncoming shifts in order to pass along the significant events of the day (Weeks, 2007). However, Weeks (2007) states that the structure of this new and temporary organization must be similar to the affected firm because this allows employees to create a cognitive map more quickly and eliminate unnecessary searching and confusion when timely information is a top priority.

Weeks (2007) also points out that, when acting on humanitarian operations, both military and government organizations should reduce their paperwork and bureaucracy through the suspension of some requirements and procedures. For instance, in the 2005 Pakistan earthquake relief operation, a large amount of humanitarian supplies was moved based on phone calls and emails, something that would not happen during the course of normal military operations. This procedure has advantages, but it also removes many safeguards for efficiency. As an example, Weeks (2007) remarks that, during the 2005 Pakistan earthquake, planes that might typically fly only with a full cargo load aboard would sometimes make trips with less than a complete load. Although it is not the most efficient way to move cargo, efficiency may not be such a relevant aspect considering that lives are at stake.

4. Background of humanitarian logistics in Brazil

Disasters can be natural or anthropogenic. In the context of anthropogenic disasters, humanitarian logistics is more applicable in Brazil for possible nuclear accidents in the plants Angra I and II. Terrorist attacks, chemical attacks or refugee crises are not in the spotlight in Brazil (Nogueira *et al.*, 2008). With respect to natural disasters, the country does not have large magnitude earthquakes, tsunamis, typhoons or tornadoes. In 2004, occurred the first recorded hurricane on the Brazilian coast, Catarina, which damaged 53,000 buildings and left 2,200 homeless (Nogueira *et al.*, 2008). However, Brazil often suffers from droughts, floods and landslides: 58% of all natural disasters are floods and 11% are landslides (Thenório, 2011). Moreover, extreme precipitation events may become more frequent, causing floods and more severe landslides in the country (Nogueira *et al.*, 2009).

However, the concept of humanitarian logistics is still incipient in Brazil, with very few academic studies. The government neither invests solely on disaster prevention. In 2010, the Federal Government has invested 14 times more to remedy damage caused by rain than in

prevention (Campanato, 2011). Nevertheless, it can be observed the development of studies and planning for prevention and mitigation of disasters in the country, such as the National Alert System and Prevention of Natural Disasters Program. It is a project of the Ministry of Science and Technology that aims to reduce the number of deaths caused by floods and landslides. The first stage of this project is mapping 800 high-risk areas throughout the country. These maps will be input data to a software that will cross weather information (risk of rain, floods, winds etc.) with the most vulnerable regions to disasters (Thenório, 2011). Thus it will be possible to warn communities about the impending disasters. However, it is evident the importance of training so that people know how to act after receiving the alert. In Brazil, there is a lack of pre-event plans or preparedness tactics. After a disaster strikes, everyone and no one seem to be in charge, so military forces may not receive entirely clear missions and be compelled to improvise, or the mission may change in disconcerting ways.

5. Analysis of the military response to the floods in the fluminense mountain region

For this analysis, the research method used was qualitative, applying bibliographical research and case study techniques. Interviews were conducted with personnel who participated in the humanitarian operation response in the city of Teresópolis, Rio de Janeiro, Brazil. The interviews were analyzed using the content analysis technique. Categories were defined a priori according to the factors proposed by Martinez *et al.* (2010), based on the eleven UN clusters. These clusters were introduced by the United Nations at the end of 2006 as a classification of humanitarian activities (Oneresponse, 2011), used as a strategic tool to improve the effectiveness of humanitarian response by ensuring greater predictability, accountability and partnership. Martinez *et al.* (2010) selected five of these clusters related to the immediate response phase of a humanitarian operation, which were adopted as factors to assess the humanitarian operation in Haiti after the earthquake of 2010: (i) access and

logistics; (ii) health; (iii) water, sanitation and hygiene; (iv) food; and (v) shelters and non-food supplies.

5.1. Climate disaster in the Rio de Janeiro mountain region

The tragedy has directly affected 20 municipalities and 90,000 inhabitants. There were 30,000 homeless and displaced victims and 916 deaths caused by the floods, mudslides and landslides that occurred between 11 and 12 January 2011. This disaster was the largest in the country and the world's tenth worst slide in the last decade (O Exército, 2011). The city with more victims of the tragedy was Nova Friburgo, followed by Teresópolis, Petrópolis, Sumidouro, Sao Jose do Vale do Rio Preto and Bom Jardim. In Teresópolis, there were a total of 5,000 homeless and 6,000 displaced victims.

The main causes of this natural disaster were: local geology, irregular soil occupation (on slopes and floodplain areas) and high intensity rainfall concentrated in periods of 15 minutes. Nonetheless, such disasters historically occur in Rio de Janeiro State every year between November and April caused by these same reasons. However, there is also a history of low investments in disaster prevention and mitigation in Rio de Janeiro. In 2010, the amount invested (\$ 80 million) for reconstruction of areas affected by the rain was ten times the amount invested (\$ 8 million) for disaster prevention (Campanato, 2011).

5.2. Analysis of the humanitarian operation

The actors involved in the immediate response phase of the humanitarian operation for the flood disaster in the fluminense region were: the state government, local cities governments, the Civil Defense of Rio de Janeiro State, the National Security Force, Rio de Janeiro State Fire Department, Brazilian Army, Navy and Air Force, and support NGOs. In the first two days, these different stakeholders acted disjointed and without coordination through individual and anarchic actions. At times, there even was overlapping of efforts to act

in the same problem, causing poor efficiency. However, the guideline of the National Security Force was the collaboration among the different actors, under the coordination of local Crisis Management Centers, established by local governments. On the other hand, poor operations of the National Civil Defense System and the lack of experience of the local governments made it difficult for the Crisis Management Centers to mobilize and coordinate the different agencies, their material and human resources.

The participation of the military in this humanitarian operation took place by decision of Minister of Institutional Security. The mission of the Brazilian Army in the immediate response phase was to support the Civil Defense agencies of the affected towns, performing logistical tasks, such as: distribution of donations, transportation of refugees and evacuation of the wounded, water treatment and distribution in areas of difficult access, removal of debris (clearance pathways), distribution of bulk fuel (vehicles) and religion assistance.

This section analyzes the action of the Brazilian Army in the immediate response phase of the flood relief operation in the fluminense mountain region in January 2011. Initially, the involvement of the Brazilian Army started with the participation of the 25th Logistics Battalion (25th B Log), the 1st Artillery Division (AD/1) and the 32nd Motorized Infantry Battalion (32nd BIMtz), with the support of the Army Engineering, Health and Aviation troops. The 25th B Log was responsible for operations in Teresópolis, while AD/1 acted primarily in Nova Friburgo and 32nd BIMtz concentrated its efforts in Petropolis.

5.2.1. Access and logistics

Access to the affected region of Rio de Janeiro State takes place from roads BR 040, BR 116, BR 101 and RJ-116 (Figure 1). Some portions of these roads were blocked because of landslides, being released a few days after the flood, but several roads inside the city of Teresópolis were blocked due to falling barriers that isolated communities. However, one

week after the event, access to the main roads were free of debris and within two weeks access to 95% of all local roads were restored. One month after the disaster, access to all areas where there were victims had been restored.



Figure 1. Affected region of Rio de Janeiro State

The Brazilian Army had an important role in clearing road and pathways, using specialized vehicles and equipments. Such participation reinforces Oloruntoba's (2010) statement that the assets most capable of being rapidly and effectively deployed in a disaster are often those held by military. The Brazilian Army conducted these activities with the support of its engineering troops and also coordinating volunteering services provided by private civil engineering companies. After the disaster, assessment of infrastructure damage and reconstruction requirements required engineering skills. Army engineers assessed the damage to facilities necessary to conduct relief operations, such as runways and support structures. They were also able to assess the feasibility of building semi-improved helicopter landing areas on short notice. This action was essential to enable the distribution of donations.

After all, in the first seventy-two hours, the Fire Department was facing great difficulties to carry out search and rescue activities. Military engineers also launched bridges that enabled mobility. One bridge was launched on Grande River in Bom Jardim city, and another on the Paquequer River, allowing connection of isolated areas as well as the circulation of inter-city bus lines in these locations.

The main goal of the immediate response phase of a humanitarian operation is to save lives through rescue patrols and by the distribution of emergency supplies. In this context, access to the affected population is essential. At first, the Fire Department worked as a coordination center receiving calls with requests for help. However, in the first 72 hours after the disaster, the stakeholders had a hard time identifying where relief was necessary. In order to facilitate communication and requests for help, the telephone company Oi/Telemar allowed the use of public telephones without charging and also provided cell phones to relief agencies. Most relief requests were attended by air. Nevertheless, in the first 24 hours after the event, there were no conditions necessary to fly, creating greater need for clearing roads.

The Brazilian Army participated on search and rescue patrols, on the distribution of emergency supplies, transportation of homeless/displaced and on the evacuation of wounded victims. A large volume of donations was required to attend the increasing demands of the victims. The transport of donations from other regions of Brazil to Rio de Janeiro was performed by the Brazilian Air Force, which provided aircraft, trucks and trailers and also performed traffic control. The use of helicopters was essential for the distribution of emergency supplies and to access remote areas. Thus, air transportation was planned so that the same helicopters used in the distribution of supplies to victims in isolated areas were also used for evacuation and for transportation of victims. The Army had 42 vehicles and four helicopters operating in Teresópolis, but the military still faced a dilemma in

prioritizing needs for various requests of evacuation and supply distribution due to the restricted number of vehicles and human resources available. Therefore, a critical decision to be taken in immediate response operations refers to planning efficient use of available resources for transportation and rescue of injured and homeless.

One of the top questions that the military encountered was the dilemma in prioritizing needs for various supplies, especially because priorities change rapidly. For example, in the initial stages of the operation, delivering medical teams and supplies was a high priority, but as weeks passed the emergency medical needs diminished. According to Weeks (2007), in the heat of the moment, there isn't time to apply meticulous methodology such as classic project management techniques, so top leaders must provide timely direction regarding appropriate priorities, as they are likely to be the only individuals with enough knowledge to offer this critical 'big picture' guidance. Weeks (2007) point out that normal prioritization systems cannot handle the volume or complexity of needs that arise in an emergency situation, so hands-on guidance from top leadership is essential.

Another important role played by the military was the development of new mapping in the mountainous region immediately after the disaster, in order to show the best access to areas that were still isolated, facilitating thus the rescue of victims. This measure also facilitates the identification of inappropriate areas for new constructions. In this type of disaster, even pre-disaster images can provide details about which areas might be affected and provide critical information about the basic geography of the region.

5.2.2. Health

The Municipal Health Department was responsible for managing health resources applied in the immediate relief operation, coordinating the work of volunteers, NGOs (such as Médecins sans Frontières – MSF), public and private hospitals and the military. The military provided

health support making available medical, dental, X-ray, pathology, evacuation and psychological professionals that provided a range of health services to the affected populace on Military Combat Support Hospitals.

The Military Combat Support Hospitals have been a solution in assisting victims of disasters in Brazil, especially in cases of floods and landslides, such as the analyzed event. These hospitals were essential to reduce the waiting time for the victims in Teresópolis, given the partial destruction of local resources. They offered internal medicine, orthopedics, pediatrics, gynecology and dentistry services, and are equipped with operating rooms, X-rays, labs and beds for short periods of recovery. Aero medical evacuation was used in cases which it was necessary to transfer patients. In the first 72 hours after the disaster, 75% of the services provided by Military Combat Support Hospitals were clinical cases, 20% were orthopedic services and 5% were psychiatric cases. After physical trauma, fractures and injuries, most of the services provided involved victims with psychosomatic problems caused by emotional sequel.

The military also provided essential medical service in the control of leptospirosis, a disease to which the population is vulnerable in cases of floods and landsliding, and on the removal and burial of corpses. Besides, the Brazilian Army also provided religious assistance through the work of the military chaplain.

One of the top questions that the military encountered was the complexity in estimating the amount of critical medical supplies required by victims, since there are no surveys on the types of accidents and injuries most common in these disasters. In this specific operation, there were shortages in the supply of some drugs and on blood donation. Therefore, one of the main decisions related to the health services required in relief operations is the

allocation of scarce resources, such as doctors and medicine, in order to maximize the provision of health services.

5.2.3. Water, sanitation and hygiene

According to the International Red Cross, the daily demand for drinking water per person in cases of disasters ranges from four to five liters/person/day, including in this estimate consumption by hospitals and clinics (Martinez *et al.*, 2010). The total population of affected area is approximately 700,000 inhabitants, and 30,000 victims were homeless. Thus, it required a minimum of 150,000 liters of water daily to meet the needs of homeless/displaced victims by the disaster. In the specific case of Teresopolis, 11,000 victims were displaced or homeless, which would require about 45,000 liters of water daily.

Water is critical for survival, so it was treated as a priority in the first days after the disaster. Companies and the population of Rio de Janeiro donated large amounts of drinking water in response to requests from the media (television and radio). The Brazilian Army also participated in water treatment and distribution in areas of difficult access and, especially, for hospitals and health clinics, since there was contamination in the water supply system of several hospitals. However, restoring the water distribution system (as well as power and sewage) was under the responsibility of local utilities, which carried out the required work.

5.2.4. Food

The Brigade was the main logistics equipped unit that mass distributed food and water, as the unit was purpose-designed for longer term mass sustainment. Specifically, in the Army, 868 meals were served per day to feed the troops employed to assist in Teresópolis, besides the food distributed for affected population and volunteers.

Food distribution in cases of humanitarian operations is a network flow problem with multiple modes and multiple commodities, whose objective is to maximize the service

demand as time response is minimized (Martinez *et al.*, 2010). This problem becomes even more complex because some roads have their traffic blocked due to landslides or floods. On the other hand, a constant replenishment of food items was required. There was an immediate response from businesses and the population of Rio de Janeiro to provide food supplies, but facing problems of storage of these donations. Food items and other donations were stored in private distribution centers and warehouse or even on public schools and stadiums.

The main decisions to be made regarding the distribution of food are: (i) how to transport donations to the disaster area, (ii) where to storage them; and (iii) the amount and location of food distribution points.

5.2.5. Shelters and non-food items

The floods and landslides in the fluminense mountain region left 30,000 displaced or homeless victims that were initially sheltered in schools and warehouses. Sheltering plan was organized by the municipal authorities, which adopted the strategy of minimizing the number of sheltering sites, concentrating victims on fewer locations. Some victims were also sheltered in tents with capacity for ten people, similar to the ones used in the Haiti earthquake and the Indonesian tsunami (Lauriano, 2011). These tents were equipped with survival items, stoves, cutlery, pans, dishes, blankets, purifying and storing water.

Regarding non-food items, it could be observed an excess of donations of coats, pants, shirts and even mattresses, but there was a shortage of items such as underwear, towels, bed linen and gas cylinders (O Exército, 2011). However, as soon as the media announced this shortage, such supplies were soon received through donations. In the first 72 hours after the disaster, the scarcest resources were helicopters and ambulances.

The Brazilian Army acted on the preparation of packages with relief supplies as well as on supply distribution. Supply distribution was managed and controlled by the

Crisis Management Center, which received requests from the victims and then generated delivery orders for the Army. Due to the complexity of estimating the demand pattern on disaster situations, a constant replenishment of supplies was required, varying according to the evolution of events. There were also obstacles to transport the material, store it and distribute it. Therefore, the top decisions to be made, regarding this aspect of the humanitarian operation, are: a) forecasting the demand for shelter and non-food supplies, b) how to meet victims' demand, and c) how and where to shelter the homeless.

5.2.6. Summary of military involvement

In summary, Brazilian military involvement in the disaster relief operation at Rio de Janeiro State took place in the immediate response phase, more precisely, on the first fifteen days after the disaster. Responsibilities were then taken over by humanitarian NGOs or government agencies, during the reconstruction phase, such as recommended by Weeks (2007), Oloruntoba (2010) and The Sphere Project (2011).

Initially, Brazilian Army acted on the evacuation of wounded victims and transportation of homeless/displaced from risky areas, as well as on water and food distribution and on restoring access to the affected areas. Nonetheless, military involvement increased according to the demand and needs of the affected population. After an initial moment, Brazilian Army started acting on health support and on supply distribution. Finally, it supported activities related to sheltering and vaccination. Figure 2 summarizes in three stages the military activities in disaster. It is important to stress that all the activities have been developed to support procedures that were being performed by other governmental and nongovernmental institutions, mainly from the second stage on.

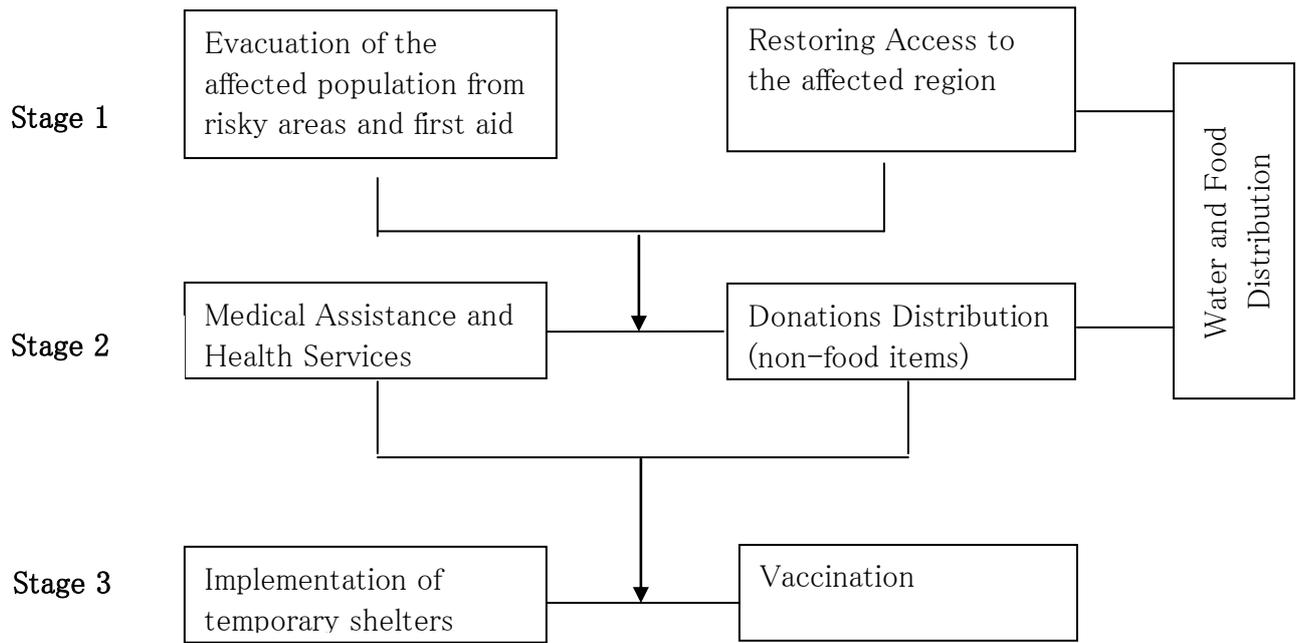


Figure 2. Summary of military response to the floods

6. Recommendations for Military Response to inland disasters in Brazil

The role of the military in an international humanitarian context has been a largely debated theme because it can threaten the principle of neutrality and the impartial image of NGOs. Nonetheless, these peculiarities do not apply for military participation in relief response operations to inland natural disasters, such as the analyzed case of floods in Brazil, because the military is not involved in war-fighting. Political or military agenda are not involved with military response to inland natural disasters and thus it would not compromise the impartial image, credibility and security of relief agencies or access to affected populations.

When a crisis is sudden and massive, such as natural disasters, relief agency capabilities are often not sufficient, hence rapid military support (often through airlift) may become essential, especially during the initial phase when delay in the delivery or relief might cost lives. In Brazil, as in other nations, the assets most capable of being rapidly used in disaster relief operations are often held by military. Besides, military troops specialized in

cross country mobility and equipped to transverse any terrain, such as cavalry units, can play a important role on the immediate response phase of humanitarian operations, observing and reporting relief requirements and disaster damage, as well as undertaking the reconnaissance of roads and infrastructure. For that reason, militaries should act on the immediate response phase of a humanitarian operation, but, as soon as the crisis becomes stable, humanitarian organizations can take over the operation, staying in the scene throughout the reconstruction. Nevertheless, military should play only a supporting role. Otherwise, it would complicate in the long-term the process of transferring responsibilities from the military to the NGOs.

Despite the existing differences in their organizational cultures and goals, the military and civilian agencies must work together to establish changes that will improve coordination and cooperation in humanitarian operations, thus, improving their success rates. In the specific case of floods in Brazil, it is important to establish measures to assure familiarity between the different actors involved in disaster relief operations, to improve information sharing and to support long-term planning. At a minimum, military leaders should ensure that key personnel are familiar with essential relief organizations to humanitarian operations, while these agencies should become more familiar with military's organization and capabilities. Brazilian military should host conferences, conduct exercises, provide briefings and offer courses at military educational institutes in order to improve overall awareness of relief agency capabilities and concerns. Even with these measures, some agencies will maintain a minimum dialogue to ensure operational efficiency (e.g. basic program information-sharing) while others may establish stronger links.

The Brazilian Government should develop a Basic Disaster Management Plan, like the one in New Zealand or the United States' National Response Framework, which would work as guide to how the country should conduct emergency relief responses, stating the principles,

arrangements and frameworks applied to the management of emergencies, as well as defining roles and responsibilities among all levels of government, nongovernmental organizations, and the private sector. This type of plan should define which stakeholders should act on different scenarios, whom they would respond to and under whose authority they would perform, defining preparedness tactics and standardization of terminology. Besides this general guide, local and regional governments should also work on developing local and regional disaster-preparation plans and shelter plans for critical areas. These contingency plans for emergency operations details possible scenarios and stakeholders' responsibilities, so they can contribute for a quick response of the military and its alignment with other civil response agencies and NGOs.

The participation of the Brazilian military in humanitarian operations depends on the decision of the President assisted by the Minister of Defense and the Institutional Security Office, what can cause delays on military involvement. In the case of the floods in Teresópolis, it took two days before the military started acting on the humanitarian operation. However, military response in disaster relief operations should be fast due to its importance to the immediate relief response. Therefore, Federal Government must establish clear response triggers that detail the scenarios and how military units will respond, and under whose authority.

In order to speed military response, Brazilian Army should also analyze the possibility of pre-positioning military units in critical areas, prone to floods and landslides disasters, such as in Australia. This decision can contribute to increase relief chain responsiveness and reduce lead times, because local military units already know the terrain and geography of the area, and they can be on stand-by even before the disaster strikes. It can also contribute for transfer of knowledge and experience in humanitarian operations. The probability of military response

in a disaster relief operation is high, but the personnel assigned often have limited experience in actual disaster environments due to frequent rotation of staff members, so lessons learned in one situation are often not applied to the next crisis (Weeks, 2007). As a result, pre-positioning military units in areas prone to natural disasters may contribute to create an organizational structure that stimulates the transfer of knowledge about the challenges of a humanitarian operation.

Moreover, Brazilian military should plan to establish, in case of disasters, a temporary structure to work as a connecting agency with NGOs and to stimulate information-sharing. Information-sharing, required to avoid duplication and to promote good practice in humanitarian operations, can be stimulated by the creation of a temporary central collection point to filter information, such as happened in 2005 Pakistan earthquake relief operation. The US Department of Defense establishes Civil-Military Operations Centers, also a temporary organization, to coordinate procedures and priorities between NGOs and the military and to provide information-sharing. Furthermore, it is important that Brazilian military keeps a public affairs office in this temporary agency to inform the media of the military activities, by providing personnel to handle the local media attention on the ground. This flow of information benefits the general public, contributes for the image of the institution and helps those on the ground to see their efforts are being noticed.

As suggested by Weeks (2007), the Brazilian Military should eliminate paperwork and bureaucracy, common to government organizations, during humanitarian operation in order to make its response more quick and flexible. Once in the humanitarian operation, the military should designate an individual to coordinate “force protection issues”. For instance, security presence may be necessary to ensure that local population does not get injured when trying to rush helicopters delivering supplies. During the operation, it is also important for the

Brazilian military to maintain accountability of those sent into the disaster area, since it is easy to lose track of those on the scene, and if another disaster were to strike, finding someone quickly becomes extremely difficult.

Finally, Brazilian military should develop a catalog of potential disaster-relief critical items and supplies, as well as establishing base emergency stockpiles of survival items for floods and landslides, because prices for local resources tend to be artificially inflated during disasters. Due to scarcity of supplies and because various relief organizations are bidding against each other for the same resource, prices tend to rise rapidly. A solution for this problem would be consolidate contracting (Weeks, 2007), as well as prior agreement with commercial sellers that might hold stocks of relief goods on behalf of emergency agencies just in case (Oloruntoba, 2010). Contracts might also be pre-established with commercial sellers from areas outside of the disaster affected zone for the acquisition of critical items. Brazilian military could implement these procedures to optimize its response to floods and landslides.

7. Conclusion

Even with the adoption of mitigation measures and contingency plans, disasters will still occur. Recent events such as tornadoes in the United States and the tsunami in Japan in 2011 are examples that even developed countries are vulnerable to the adverse impacts of natural disasters. Therefore, it is also necessary to plan for immediate response and recovery humanitarian operations.

Disaster prevention and mitigation planning associated with the immediate response and recovery planning would be effective to reduce the impact of floods and landslides in Rio de Janeiro. The emergency plan developed by Costa Rica, a country with similar topography to Rio de Janeiro, could be used as a reference model. In 2010, Costa Rica went through a

large volume of rain, but without a large number of casualties. The development of similar plans in Rio de Janeiro becomes essential, because, even if the possibility of a calamity is detected, there is no coordination of the stakeholders involved on the prevention and immediate response phases. Currently, the National Civil Defense is limited to helping the victims after the tragedy.

Initially, the paper brings a conceptual approach on humanitarian logistics. Then it examines the role of militaries in disaster relief operations and their relationship with NGOs, analyzing international successful cases of military experience in humanitarian logistics. Finally, the paper presents the immediate response phase of the humanitarian operation after the 2011 floods in the mountain region of Rio de Janeiro State (fluminense mountain region), analyzing military involvement in the event and suggesting new measures that Brazilian military could implement in order to increase their responsiveness in disaster relief operations.

Military support could help to ensure effectiveness for disaster relief operations in Brazil, since this area is still incipient in the country. Besides, military have unique capabilities and assets to be employed in this type of event. The military should take an important role on the immediate response phase of the operation, especially on the first days after the event strikes, when civilian agencies are not yet fully able to carry out their responsibilities and delays on rescue or supply distribution can cost lives. However, the Brazilian Government should simplify the decision making-process that triggers military involvement in response to natural disasters. It should establish clear response triggers that detail the scenarios and how military units will respond, and under whose authority, so military units could be among the first on the scene of disaster situation. Nonetheless, as disaster conditions start to stabilize, militaries should transfer the responsibilities for NGOs, since their core competence is and must remain to be war-fighting and national security.

According to Chandes and Paché (2009), it would be tempting, but dangerous and inefficient, to think that each natural disaster is unique, so it requires a customized response from which no general lesson will be learned for future events. However, beyond the objective differences among the various types of natural disasters, it is essential to determine the similarities among these interventions so standardized procedures can be developed. Thus, analyzing prior military experience, such as in this paper, contributes by shedding light on the noteworthy aspect of which procedures the military can establish in order to improve the relationship with NGOs and consequently provide a better service for the beneficiaries of emergency relief operations. This type of investigation is important especially for countries like Brazil, in which the field of Humanitarian Logistics is still incipient.

It is also important to stress that military and humanitarian logistics have many peculiarities in common, so new researches could analyze this similarities and point out which techniques and procedures from military logistics could be applied in a humanitarian context. Moreover, the paper investigated only the involvement of militaries in disaster relief operations and their relationship with humanitarian agencies. However, the private sector can also bring commercial efficiencies, complementary expertise and resources to humanitarian agencies. Therefore, collaboration between humanitarian agencies and private sector is also a necessity in humanitarian supply chain, especially in the last mile distribution (Apte, 2009), so more research pointing out the compatibility of these organizations is required.

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