STRENGTHENING OF DISASTER RISK MANAGEMENT STRATEGIES IN THE PERUVIAN RAINFOREST IN THE FACE OF DEBRIS FLOW THROUGH A VULNERABILITY APPROACH

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ABSTRACT

Disaster risk management (DRM) is a social process, which aims to prevent, reduce and periodically control disaster risk factors in society, taking into account both national and international policies, strategies and actions. In Latin America and the Caribbean, 25 countries aim to reduce risk, Peru is one of them with 1,535 provincial and local governments that have DRM instruments, however, in the Peruvian rainforest, there is a notable lack of these, meaning the population does not know what to do in an emergency situation. Of the multiple hazards to which Peru is exposed (i.e., earthquakes, mass movements, rainfall, etc.), 18% of these are debris, sludge and avalanche flows. Because of this, it is important to strengthen DRM strategies, specifically in the Peruvian rainforest, through an intercultural approach to reduce the level of social vulnerability to the debris flow. These strategies have to align with the Sendai Framework (2015–2030) and, at the same time, respond to the specific characteristics of each place due to the multicultural and multilingual nature of each sector. Therefore, this research proposes a holistic review for the improvement of vulnerability reduction strategies in social terms, with special emphasis on the intercultural dimension. In order to study the vulnerability factor, the conditions of exposure, fragility, and resilience were analysed, as well as urban centres, vital lines and services, poverty levels, socioeconomic fragility, and social organization levels. Finally, administrative decision-making, policy organization and implementation must respond to this cultural diversity and their capacities to cope with the adverse effects of disasters need to be strengthened.

Keywords: debris flow, disaster risk management, disaster risk strategies, vulnerability index, Peru.

1 INTRODUCTION

Strengthening disaster risk management (DRM) strategies in the Peruvian rainforest through an intercultural approach, regarding debris flow to reduce the level of social vulnerability, is a preponderant task considering the efforts that have been made in Latin America and the Caribbean during the last decades. In this way, the Risk Management Index for Latin America and the Caribbean (2020) has been developed, which allows understanding and evaluating the risk of disasters and humanitarian crises. In addition, it is also used for decision-making in prevention, preparation, monitoring, and response tasks. This information is relevant to determine, in the medium and long term, the effectiveness of the implemented strategies. This index is made up of the following dimensions: hazard and exposure, vulnerability, and lack of capacity [1]. The first dimension is determined by nature and cannot be reduced. The second is determined by the population and can be explained through multiple approaches (e.g., social, environmental, economic, etc.). Both dimensions interact with the lack of response capacity at the institutional and infrastructure level to make up this evaluation index that varies in a range from 0 to 10 in terms of risk [1]. Low and high values indicate a lower and higher level of risk, respectively. These indices facilitate the relative comparison of risk within the same country, as well as a comparison between countries. In this context, for the year 2020, Peru showed a level 6 according to this index, which is equivalent to a high risk [1].

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This research seeks to analyse the evolution process of strategies to reduce vulnerability due to debris flow implemented in the Peruvian rainforest in order to improve the conditions and livelihoods of the target population. Thus, in 2005, the Hyogo Framework for Action established a milestone in disaster reduction, whose general objective was to increase the resilience of nations and communities to disasters, as well as considerably reduce the loss of life and social, economic and environmental assets of communities and countries [2]. In this way, DRM came to occupy an important and priority place on the international agenda, in which governments had the responsibility to deal with disaster prevention, risk management, and vulnerabilities [2]. By 2015, progress was made thanks to its application, with advances in disaster risk reduction observed at the local, regional, national and global levels, thus demonstrating that DRM is a profitable investment in preventing future losses [2]. In this sense, considering the constant growth of disaster risk, the increase in the degree of exposure of people and goods, in combination with the lessons learned from past disasters, the need to strengthen disaster preparedness becomes clear. It is for this reason that it is necessary to adopt early measures to ensure an effective response and recovery at different levels of risk [3].

International mechanisms have contributed fundamentally to the development of risk reduction policies and strategies, whose corrective and prospective approach is centred on people. To direct these policies, governments must lead, regulate, coordinate DRM and interact directly with citizens who must be taken into account in their design and application in order to integrate disaster risk into their management practices [4]. Therefore, in 2014, Frontline Vision (VPL) through the project "Perspectives on the implementation of the Hyogo Framework for Action (MAH) in South America" sought to know the perception of the population vulnerable to disasters, in relation to DRM policies and their execution at the local level. To do this, they created spaces for dialogue and meetings between citizens, authorities and organizations present in the area. They concluded that, in recent years, the governments of Latin America have made significant progress in the institutional framework, design and implementation of national DRM policies. Parallel to this, there is also evidence of a weak institutional framework at the local level and the need to articulate the actions of the central government with local governments [5].

In the case of Peru, in 2010, the National Policy: Disaster Risk Management (PLANAGERD 2014–2021) was implemented, and in 2011 the regulatory framework was approved, which makes viable decentralized actions at the local level, under the protection of the Law No. 29664 and its regulations, transferring responsibility for action to local governments. For development planning and management, there is the National Disaster Risk Management System (SINAGERD) and for corrective management, there is Civil Defense, whose strategic objective is focused on integrating disaster risk into policies, plans, and sustainable development programs at all levels. A DRM capacity development policy was also promoted; however, there are still constant limitations regarding the allocation of financial resources and/or operational capacities. In this sense, knowledge on disaster risk reduction is made available to everyone, especially the most vulnerable and poor communities, to achieve the construction of resilient communities. In short, an institutional commitment has been achieved, but the achievements are not extensive or noticeable [6]. Along the same lines, in 2015 the Sendai Framework was implemented, which aims to strengthen disaster risk governance, considering regional, national and international platforms. One of its seven goals is to reduce the damage caused by disasters in vital infrastructure and the interruption of basic services, such as health and education facilities, building their resilience by 2030 [3].

In Peru, during 2019, 1,872 municipalities complied with reporting on DRM, of which approximately 80% reported that they have a DRM Unit or Civil Defense Office. From this information it was observed that 6% corresponds to the Junin region (region of interest belonging to the central rainforest of Peru). On the one hand, 1,428 municipalities reported that the Civil Defense office carried out prevention actions in the population and that 5.7% of these are from Junin. On the other hand, at the national level, 74 local governments did not carry out any action and three of them belong to Junin. Likewise, 736 took training courses in reactive risk management, of which 30 municipalities are from Junin. As far as drills are concerned, 1,236 executed drills in a coordinated manner with different institutions and evaluated the local emergency operations plan where 74 are from Junin. In relation to identifying the level of risk, 793 fulfilled this task and of these 43 are from Junin. Supervising compliance with safety standards in venues with public access was carried out by 572 municipalities, of which 26 belong to Junin. Finally, 684 properly marked security zones in high-risk areas and 28 belong to Junin [7]. That said, by 2020, the Junin region had nine provincial governments, 109 district governments, and 145 small communities. Of these, 102 municipalities have risk management instruments. The problem lies in those municipalities that do not comply and do not have these instruments, so the population does not know how to respond to the dangers, risks and vulnerabilities when disaster situations occur [8]. It is important to emphasize that Junin is one of the regions that is most affected by landslides during the winter seasons, such is the case of the María Pía streams that affects Pampa del Carmen settlement, which is the case study considered for the development of this research.

It can be deduced, then, that the purpose of this evaluation is to strengthen the current strategies to reduce the level of vulnerability based on the gaps evidenced as a result of recent events (e.g., linguistic, economic, origin, resilience, etc.) raised in Peruvian territory. Finally, this study proposes some recommendations that will help a more efficient management of resources and people.

2 BACKGROUND AND CASE STUDY INFORMATION

In recent years, Peru has recurrently suffered the impacts generated by the occurrence of debris flow, especially in the northern and central regions, due to the fact that it is located on medium and high slopes, rivers and streams [9]. Debris flow emergency records are approximately 1,529 from 2003 to 2018. Fig. 1 shows the frequencies recorded during that time interval. It can be seen that during 2017, the highest record was 570 incidents and the lowest record was in 2011 with 45 events [10]. Likewise, the impact generated in society is 439,636 people affected and 5,243 homes destroyed, with 2017 being the year with the most reported cases, registering 115,431 people affected and 2,365 homes destroyed [10].

2.1 General characteristics of the Junin region: Central rainforest

The exploratory analysis of this research is based on the Chanchamayo province of the Junin region, located in the central rainforest of Peru, which is geographically located at an altitude of 775 m above sea level, with a south latitude of 11°03'21" and west longitude of 75°19'45" [11]. It has temperate and humid climates with temperatures ranging between 23°C to 32°C [12]. Junin has a population of 1,246,038 people and the district of Chanchamayo has 27,790 people, approximately [13]. Regarding the economic sector, 41.8% of the population is dedicated to agriculture and fishing, with mining being the economic activities with the lowest active population with 2.2% [11]. Likewise, in relation to access to basic services, certain gaps are evident where 7.2% of the population does not have potable resources, 35.7%

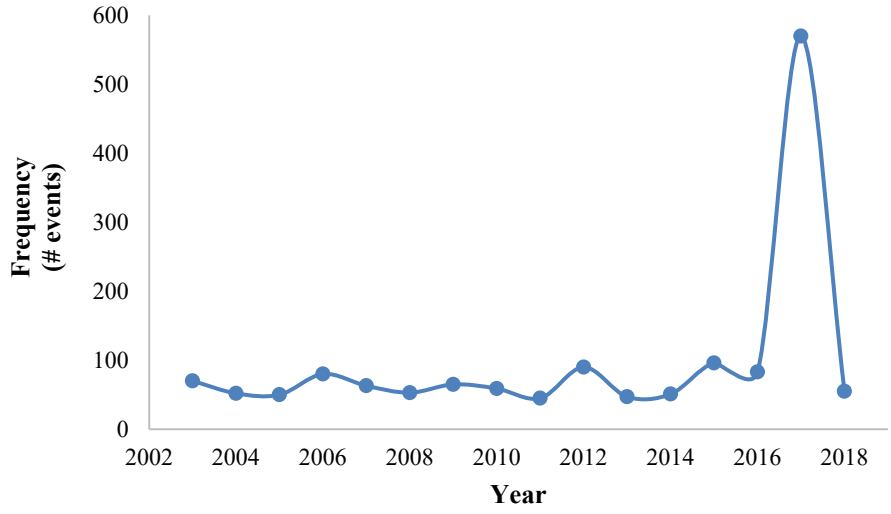

Figure 1: Occurrence of debris flows in Peru during the last 20 years.

does not have hygienic services, 8.4% does not have electricity and, approximately, 2.2% of this population does not have household garbage collection services, among other deficiencies in the management of their capacities [14]. In addition, there are sectors located near streams where accessibility to basic services is exponentially difficult [15].

2.2 Representative events that occurred in Peru (2000–2021)

2.2.1 La Merced

In the Pampa del Carmen sector, La Merced district, on 23 August 2003, a debris flow originated due to heavy rainfall that caused the activation of the María Pía stream, affecting 300 homes, 200 m of road, among other infrastructures [16]. In the same way, on 22 January 2007 there were rains for 9 hours that reached up to 173.7 mm, causing the streams to produce debris flows [17], thus generating 1,758 people affected, 283 houses destroyed, 213 houses affected [18]. On the other hand, considering that the area is influenced by tropical, humid and rainy weather that cause massive landslides [19], on 21 February 2021, a landslide occurred in the district of La Merced, province of Chanchamayo [20]. As a result of this incident, it was reported that 60% of the population (i.e., 250 people affected) were left without drinking water service, 27 houses destroyed, 108 houses affected, causing 83 homeless people [21]. Additionally, that same day the authorities carried out a damage assessment and moved heavy machinery for debris removal and cleaning work. Also, the municipal government personnel and the regional government provided help to the affected families.

2.2.2 Pataz

In the district of Parcoy, province of Pataz, on 12 April 2009, the first case of landslide was recorded near a stream due to heavy rains, land with steep slopes, and increasing deforestation in the area. The result was nine deaths, 150 people affected and five houses destroyed [22].

Likewise, on 15 March 2022, a debris flow slide occurred due to increased rainfall and poor housing distribution in a steep area. There was a mass movement that caused damage to life, health and housing, where there were 53 victims, eight destroyed homes, 12 uninhabitable homes, 13 affected homes, a business establishment destroyed and 100 m of adduction line destroyed [23]. In addition, on that day, the authorities carried out their first search 11 hours after the landslide occurred with the help of the National Police. On the other hand, the Municipality of Parcoy moved heavy machinery and the Regional Government provided search support and specialized rescuers. On 22 March, the MINSA provided psychological help to 12 residents for the loss of their relatives and implemented a refuge area [23].

2.2.3 Santa Ana

On 16 February 2021, intense rainfall occurred that caused a mudslide, damaging homes, institutions, crops, roads and, above all, life and health in the city of Quillabamba and the Chaupimayo B sector, in the district of Santa Ana, province of La Convencion, in the department of Cusco [24]. This was due to the fact that the Chaupimayo stream was activated as a result of the rains, causing landslides where the flow travelled around 7.8 km. Likewise, this fact caused the death of four people and the disappearance of five people. Also, ten homes were affected, one educational institution destroyed, one educational institution uninhabitable, 0.3 km of highway affected and two pedestrian bridges destroyed [24]. After this incident, the authorities provided aid to the affected people, where food was offered to the victims. A temporary shelter was also installed and, later, heavy machinery was assigned for clean-up work [24].

Fig. 2 shows the main ravages of the events described above, while Table 1 identifies the main characteristics of the Junin region in the central Peruvian rainforest. These social, economic and environmental characteristics serve as a reference to establish a possible baseline for the design, planning and implementation of strategies to reduce vulnerabilities when facing debris flow.

3 ANALYSIS OF THE IMPLEMENTATION OF STRATEGIES TO REDUCE VULNERABILITIES AGAINST DEBRIS FLOW

The application and evolution of strategies to reduce vulnerability due to debris flow implemented in the central rainforest in order to improve the conditions and livelihoods of the population from 2005 to 2022, leads us to analyse the policies, plans and strategies within the Hyogo Framework for Action 2005–2015, which is based on the strategic and systematic approach to disaster vulnerability reduction [2] and the Sendai Framework for Disaster Risk Reduction 2015–2030, which aims to prevent new and existing risks by integrating economic, structural, legal, cultural, educational, environmental and technological measures [3]. Both are DRM instruments to be applied in all UN member countries in order to build the resilience of nations and communities to disasters [3].

3.1 Analysis of DRM strategies in the face of the PLANAGERD incursion

In Peru, there are sectors where poverty and extreme poverty coexist, which, along with their low resilience, magnify the impact generated by debris flows on the population and housing, making evident the need to improve DRM strategies [26]. In 2012, the Ministry of the Environment warned –through the physical vulnerability map– that 46% of the national territory is in conditions of high to very high vulnerability [27] and that 36.2% of the national population is using and occupying this space in order to take preventive actions and safeguard

Figure 2: Evidence of destruction due to debris flow in La Merced, Pataz and Santa Ana, respectively [20], [23], [24].

Table 1: Social, economic and environmental characteristics of the sector of interest.

Dimension	Description in the sector	Source
Social	• There are gaps in the services of drinking water, electricity and hygienic services • Excess of family members residing in a dwelling • Low percentage of professionals	[11] [25]
Economic	• Income is mostly based on agriculture • They have houses with predominant material of bricks, adobe, quincha, etc. • The largest economically active population is engaged in agricultural work	[11] [19]
Environmental	• Presents humid climate with high rainfall • Temperatures around 32°C • Low resistance soils • Location close to streams	[12]

the integrity of the occupants [26]. For 2013, in the Junin region, the number of vulnerable population rose to 810,236. For 2016, 810,770, and for 2021, 896,422. These data allow us to understand the need to incorporate the PLANAGERD 2014–2021 as a policy instrument to apply DRM strategies aligned with the strategic objectives of the MAH 2005–2015 and State policies No. 32 "Disaster Risk Management" and No. 34 "Territorial Planning and Management" [26].

Effective disaster risk management is conducive to sustainable development. Countries that have implemented such strategies have improved their disaster risk management capacities. Overall, the Hyogo Framework for Action has been an important instrument for raising public and institutional awareness to generate political commitment and to focus and galvanize action by a wide range of actors at all levels [26]. Likewise, oriented to the strategic processes regulated in Law No. 29664, which are: estimation, prevention, reduction, preparation, response, rehabilitation, reconstruction, institutionality and culture of prevention as DRM strategies [28]. Thus, in order to incorporate an efficient DRM and achieve a safe and resilient society, the different levels of government make use of the following instruments: (a) The Policy and the PLANAGERD, which establish the strategic lines, the objectives and the necessary actions to implement the SINAGERD Law; (b) The financial management strategy for disaster risk by the Ministry of Economy and Finance, whose purpose is to ensure adequate financial capacity in DRM processes; (c) The mechanisms for coordination, decision, communication and information management, which promote inclusive spaces where it is sought that public and private entities and organized civil society participate, coordinate, articulate and integrate proposals to raise awareness and generate political and institutionalize disaster risk prevention and reduction; (d) the National Information System for Disaster Risk Management; and (e) the National Radio for Civil and Environment Defense (Communication system for DRM) [28].

Within the strategic objectives of PLANAGERD, it is pointed out that it is essential to strengthen the participation of the population and organized society for the development of a culture of prevention. For this, it is established to promote the incorporation of DRM in basic and higher education, under the responsibility of regional and local governments, universities, social organizations and private entities; develop community education programs in DRM aimed at the urban and rural population, incorporating the rights approach and interculturality, and finally promote good practices in DRM in the urban and rural population, respecting cultural diversity and involving the media [26].

3.2 Capacity: Response relationship with the sustainable development goals

Evidence of the evolution that has occurred in the Peruvian rainforest is that, in 2020, 75.3% of regional and local governments organized working groups for DRM made up of officials and authorities, led by the highest executive authority. Of this, 96.9% installed the work group, 95.1% appointed the technical secretary of the work group, 65.6% have an annual work plan and 56.6% have internal regulations for functioning. With these data, we can conclude that one of the priorities of the Sendai Framework is being worked on: strengthening disaster risk governance. However, there is still a gap to close with 24.7% of municipalities that reported not having constituted DRM working groups [29].

Regarding investing in disaster risk reduction, according to the Sendai Framework, it is materialized in our country in the Results-Based Budgeting Program No. 068 "Reduction of Vulnerability and Attention to Disaster Emergencies" [30]. This program has the specific result of reducing the vulnerability of the population and their livelihoods in the event of hazards. In 2019, 58% of provincial and district municipalities carried out activities and/or

investment projects for this purpose. Of this total, 59.1% carried out actions aimed at avoiding the generation of new risks, 50.3% carried out actions to reduce vulnerability and existing risks, 43.2% developed actions in order to seek, execute and rehabilitate the areas affected by a disaster, 26.2% estimated the risk levels and 21.7% carried out actions for reconstruction [29].

4 DISCUSSION

Considering that the strengthening of the strategies arises as a product of the reflexive and practical analysis of the differences of each one of the peoples [31], the establishment of DRM mechanisms and strategies evidenced in recent events for the recovery, rehabilitation and reconstruction phase are a good sign of progress. However, there are still social gaps that increase the negative impacts. We believe that the strengthening of these strategies should be carried out taking into account the characteristics of the case study and promoting citizen participation. In short, recovery processes should take into account the characteristics of the territory, lifestyles, and respect for traditions and customs. On the other hand, economic and social rehabilitation and recovery would only be achieved with the participation of the beneficiaries and it would be key to know this human group and its dynamics in order to formulate and apply the corresponding policies.

On the other hand, in the process of strengthening strategies, the National Policy for Disaster Risk Management to 2050, approved by DS. No. 038-2021-PCM, suggests that meeting its strategic objectives will depend mainly on the establishment of tools that allow universal access to information and knowledge available on DRM [32]. Thus, according to the analysis conducted on Municipal Management between 2008 and 2014, there was an 8.8% increase in the number of municipalities that reported having technical instruments for Civil Defense [33]. With the gradual implementation of these instruments, the region is more aware of the level of exposure to debris flows, so much so that in 2010, the National Water Authority, through the Local Water Authority, launched the prevention plan for natural phenomena such as floods, landslides, landslides and droughts, thus promoting a series of structural measures in the sector (e.g., construction of 200 ml of gabions and reforestation of 1 ha) [34]. Similarly, in 2015, there was an increase of 9.8% in the number of municipalities that reported having disaster risk management instruments [35] and the DRM working group of the Municipality of Chanchamayo was formed in compliance with Law No. 29664 and its Regulations [36]. Finally, in the following years, the level of awareness increased [37], leading to the implementation of related instruments in the pending municipalities [38].

In regulations terms, in 2021 the Plan for Prevention and Risk Reduction in the face of the rainy season in the district of Chanchamayo 2021–2022 was approved, the purpose of which was to carry out intervention activities, since in recent years' natural disasters have occurred, with heavy damage and losses caused by heavy rains, landslides, rock falls, flooding in different sectors of the population due to overflowing rivers. This plan seeks to guarantee and implement activities for the clearing and channelling of rivers and drainage of rainwater channels in the province of Chanchamayo [39].

5 CONCLUSION

To summarize, DRM as a social process has the purpose of periodically preventing, reducing and controlling disaster risk factors by applying national and international policies, strategies and actions. For this, provincial and local governments need to have DRM instruments, mainly those located in the Peruvian rainforest. And for this reason, being a multilingual and multicultural society, these strategies require respect for an intercultural approach to reduce the level of social vulnerability, mainly in the face of debris flow. Likewise, this new

approach would be complemented by the current strategies applied in central, provincial and local governments that are aligned with MAH 2005–2015 and the Sendai Framework (2015–2030). Within this intercultural approach suggested to strengthen DRM strategies, the cultural elements that are feasible to identify from the daily practices of the inhabitants should be considered, since they would constitute pillars, going from being a generic instrumentation to a risk social management, also a management that responds to the characteristics of the territory and society. Key aspects such as language – which was often an obstacle in communication processes – will be especially relevant when you want to convey guidelines, ideas or proposals. Respect for territory and culture will facilitate the implementation of DRM strategies. In this sense, a coordinated and collaborative work will be possible to carry out for the improvement of conditions and livelihoods of the affected population.

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