Revista Multidisciplinaria Perspectivas Investigativas
Multidisciplinary Journal Investigative Perspectives
Vol. 6(4), 18-26, 2026
https://doi.org/10.62574/rmpi.v6i4.524

Social sciences and algorethics as disciplines that help populations affected by earthquakes

Ciencias sociales y algorética como disciplinas coadyuvantes a las poblaciones víctimas de terremotos

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ABSTRACT

Earthquakes hit hardest the populations with fewer resources, since vulnerability is socially built before the quake and artificial intelligence can reproduce those inequalities. The study therefore set out to analyse social sciences and algorethics as disciplines that help the populations affected by the 2026 earthquakes in Venezuela. A qualitative systematic review with a hermeneutic-analytical method was used, taking as corpus 25 peer-reviewed and magisterial sources (2015-2026), examined through content analysis in four axes. The results showed that social sciences explain the vulnerability and social capital that sustain recovery, while algorethics steers the use of data and algorithms towards the dignity of those affected. It was concluded that both disciplines complement each other when affected communities take part in designing and overseeing the tools.

Descriptors: earthquakes; social sciences; artificial intelligence; ethics; humanitarian assistance. (Source: UNESCO Thesaurus).

RESUMEN

Los terremotos golpean con mayor dureza a las poblaciones con menos recursos, por cuanto la vulnerabilidad se construye socialmente antes del sismo y la inteligencia artificial puede reproducir esas desigualdades. Es así que el estudio se planteó como objetivo analizar las ciencias sociales y la algorética como disciplinas coadyuvantes a las poblaciones víctimas de los terremotos ocurridos en Venezuela en 2026. En este sentido se empleó una revisión sistemática cualitativa con método hermenéutico-analítico, teniéndose como corpus 25 fuentes arbitradas y magisteriales (2015-2026), examinadas mediante análisis de contenido en cuatro ejes. Entre los resultados se obtuvo que las ciencias sociales explican la vulnerabilidad y el capital social que sostienen la recuperación, mientras la algorética orienta el uso de datos y algoritmos hacia la dignidad de los afectados. Entre las conclusiones se estableció que ambas disciplinas se complementan cuando las comunidades afectadas participan en el diseño y control de las herramientas.

Descriptores: terremoto; ciencias sociales; inteligencia artificial; ética; ayuda humanitaria. (Fuente: Tesauro UNESCO).

Received: 6/7/2026. Reviewed: 12/7/2026. Accepted: 9/9/2026. Published: 1/10/2026.

Research Articles Section

INTRODUCTION

On 24 June 2026, a public holiday in Venezuela, two earthquakes of magnitude 7.2 and 7.5 shook the north of the country, west of Caracas, in a sequence that the U.S. Geological Survey (USGS, 2026) judged capable of triggering landslides significant in number and extent, as was indeed observed in Catia La Mar, Playa Grande and the coastal mountains running from La Guaira to Naiguatá. The same agency warned that the weakened slopes could send debris flows down on Naiguatá, Caraballeda and Macuto for several years, towns already struck by the 1999 mudslides, so that for many families in La Guaira the quake reopened a wound that collective memory had not yet closed.

What happened in Venezuela confirms something that seismology alone does not explain, and which Bravo (2017) showed for the magnitude 7.8 earthquake that hit the province of Manabí, Ecuador, on 16 April 2016, namely that all inhabitants face the same natural hazard but not the same vulnerability, since informal settlements, peasant families without land titles and those who ended up in shelters suffered very different damage from that of insured owners or the tourist developments along the Ruta del Sol, so the earthquake was also a social event, shaped by earlier political and economic decisions. Moretta-Macías (2019), for her part, studied the so-called Ground Zero of Portoviejo through three focus groups of eight people and found that moving families to places far from their work, as in the Guabito resettlement, produced segregation and more poverty, even though residents showed a strong attachment to the historic centre.

Along these lines, the literature on social capital offers a clue that reconstruction policies tend to overlook, one that Aldrich & Meyer (2015) sum up by noting that disaster research and management still look mainly at physical infrastructure, at levees and buildings, when what matters most for survival and recovery are social networks and ties between neighbours, which is why they urge governments and non-profit organisations to invest in the social infrastructure of neighbourhoods. Seen this way, the earthquake stops being an instant and becomes a process that begins long before the ground moves and goes on for years afterwards.

Artificial intelligence (AI) has also entered this process in full, and Sun et al. (2020), in a review published in *Natural Hazards*, sorted its applications according to the four phases of disaster management, mitigation, preparedness, response and recovery, and found that most of them concentrate on response, while Mousavi & Beroza (2023) describe how machine learning has made it possible to build earthquake catalogues far more complete than those obtained with traditional methods. Beduschi (2022), however, warns in the *International Review of the Red Cross* that poor-quality data, algorithmic bias and the difficulty of obtaining free consent in the middle of a crisis can turn a useful tool into a source of harm for people who have already lost almost everything.

This raises the question that guides the present work: what do social sciences and algorethics, each from its own ground, offer the people who survived the earthquakes in La Guaira, Yaracuy and Caracas? Villalba (2020) proposes algor-ethics as a bridge for inscribing the principles of Catholic social teaching into digital technologies while keeping the person at the centre, and Gamboa-Bernal (2024) calls for it from bioethics in the face of the risk of an algor-cracy, that is, a digital era governed by algorithms. Based on the above, the aim of this research is to analyse social sciences and algorethics as disciplines that help the populations affected by the 2026 earthquakes in Venezuela.

METHOD

The methodological procedure followed in the review is described below:

To this end, the methodology is qualitative, with a systematic literature review design and the hermeneutic-analytical method of the reflection article, which made it possible to examine a bounded corpus of 25 sources in order to interpret how social sciences and algorethics can assist the populations affected by the 2026 Venezuelan earthquakes. The phases of identification, screening, eligibility and inclusion were followed, with the criteria summarised in Table 1, so that every selection decision was recorded.

Table 1. *Protocol of the systematic review*.

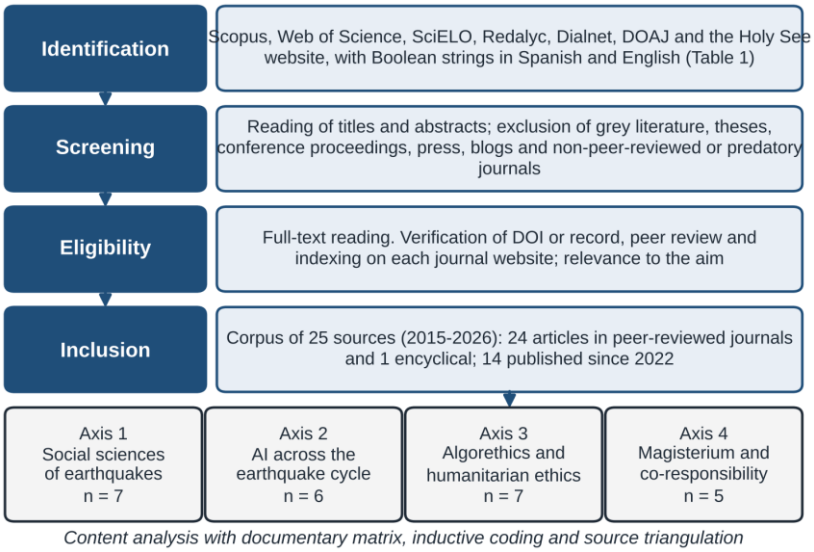
Element	Description
Approach and design	Qualitative; systematic literature review with a hermeneutic-analytical method
Databases and repositories	Scopus, Web of Science, SciELO, Redalyc, Dialnet and DOAJ; official website of the Holy See
Search strings	("terremoto" OR "sismo" OR "earthquake" OR "disaster") AND ("ciencias sociales" OR "social capital" OR "inteligencia artificial" OR "artificial intelligence" OR "humanitarian" OR "algorética" OR "algor-ethics")
Period	2015-2026
Language	Spanish and English, or an abstract in either
Inclusion criteria	Articles in peer-reviewed journals with a DOI or verifiable record; official magisterial documents; relevance to the aim
Exclusion criteria	Grey literature, theses, conference proceedings, press, blogs, non-peer-reviewed or predatory journals and duplicate records
Analysis	Content analysis with a documentary matrix, inductive coding by axes and source triangulation

Note: developed in-house.

As for identification, sources were located in Scopus, Web of Science, SciELO, Redalyc, Dialnet and DOAJ, and the magisterial documents on the official website of the Holy See, combining in Spanish and English the descriptors for earthquake and disaster with those for social sciences, artificial intelligence, humanitarian assistance and algorethics. During screening, grey literature, theses, conference proceedings, press and non-peer-reviewed journals were discarded, and at the eligibility stage the DOI or record, peer review and indexing were checked on each journal's website, a process shown in Figure 1.

The corpus thus came to include 24 articles in peer-reviewed journals and the encyclical *Magnifica humanitas*, while the note *Antiqua et nova* was included through its publication in the journal *Vida y Ética*, and the USGS (2026) report on the Venezuelan seismic sequence was used outside the corpus as official contextual data. Regarding currency, 14 of the 25 sources in the corpus date from 2022 onwards, and among the older ones field studies on Ecuador 2016 and Mexico 2017 were kept, since they allow what happened in Venezuela to be read by comparison, together with reference works such as that of Aldrich & Meyer (2015).

Figure 1. *Phases of the systematic review and composition of the corpus*.



Note: developed in-house.

For the analysis, content analysis was applied to a documentary matrix whose inductive coding grouped the sources into the four axes in Table 2, and the final proposal on how the two disciplines fit together is flagged in the text as an inference of the author.

With regard to the ontological bond with the object of study, it is stated that the author is a lawyer, provides community care through the Catholic Church and is pursuing postdoctoral studies in

Social Sciences at the Universidad Central de Venezuela, a position that brings her close to the concrete suffering of the Venezuelan families who lost their homes in 2026 and, at the same time, to the language of rights in which they voice their claims. Three safeguards were therefore taken, namely contrasting Church documents with secular literature from the social sciences and engineering, paraphrasing so that every idea can be traced to its source, and distinguishing what the reviewed authors state from what is put forward as her own contribution. Finally, since this is a documentary study, no people or personal data were involved, and authorship of the works was respected by citing them according to APA standards.

REFLECTION

The four axes that emerged from the analysis are presented below, summarised in Table 2, followed by the way social sciences and algorethics fit together as a synthesis of the reflection.

Table 2. *Axes of analysis of the corpus*.

Axis	Sources	Analytical core
1. Social sciences of earthquakes (n = 7)	Aldrich & Meyer (2015); Bravo (2017); Mora et al. (2018); Salgado-Andrade (2018); Moretta-Macías (2019); Loeza-Reyes & Campos-Gómez (2022); Özmaya et al. (2025)	Socially built vulnerability, social capital, citizen organisation and emotional health in Ecuador 2016, Mexico 2017 and Türkiye 2023
2. AI across the earthquake cycle (n = 6)	Imran et al. (2015); Martínez-Viveros (2018); Sun et al. (2020); Linardos et al. (2022); Mousavi & Beroza (2023); Haykal et al. (2025)	Tools for prediction, detection, damage mapping and humanitarian care, with their limits
3. Algorethics and humanitarian ethics (n = 7)	Floridi et al. (2018); Villalba (2020); Coppi et al. (2021); Beduschi (2022); Gamboa-Bernal (2024); Carreño-Vélez (2025); Peirats-Navarro & Arteaga (2026)	Explicability, data protection, do no harm and the human reserve of decision
4. Magisterium and co-responsibility (n = 5)	Labrecque (2022); Pegoraro & Curzel (2023); Dicasterio para la Doctrina de la Fe & Dicasterio para la Cultura y la Educación (2025); Leo XIV (2026); Torres-Chavarría & Franco-Fernández (2026)	Dignity of the victim, subsidiarity and inclusion of minority cultures and languages

Note: developed in-house from the reviewed corpus.

What social sciences teach about earthquakes

Looking at the first axis, what stands out is how much the social sciences have documented about what people go through before, during and after an earthquake, and the Mexican case shows it well, since Mora et al. (2018) recount the experience of Documenta Desde Abajo 19S, in which some 45 brigades with more than 120 students and lecturers visited shelters and camps for six to eight weeks after the earthquake of 19 September 2017 and gathered more than 200 records in 43 sites across nine boroughs, all in order to document human rights violations. The authors also acknowledge that they had to build their categories from what the people affected told them, as happened with the housing category, and that at times they published preliminary findings before data collection ended because political urgency required it.

Similarly, Loeza-Reyes & Campos-Gómez (2022) interviewed 16 young people aged 15 to 29 who joined humanitarian aid efforts in Mexico City and found that many were already active in organisations before the quake, that they were moved by compassion, indignation and fear, and that the slowness of the authorities and abuses with aid deepened their distrust of institutions. From the analysis of digital discourse, Salgado-Andrade (2018) examined 139 hashtags and topics that trended on Twitter between 20 and 26 September 2017 and showed that the platform served to organise donations, verify information through initiatives such as #Verificado19S and connect engineers who were checking cracks, although it also spread false news such as the story of the non-existent girl Frida Sofía.

Another aspect that needs review is the psychological one, because recovery does not end on the day a house is handed over, as Özmaya et al. (2025) show after surveying 1,406 people affected by the February 2023 earthquake in Kahramanmaraş, Türkiye, and finding that greater resilience is associated with less trauma and that life engagement mediates between the two, a result that suggests planning post-disaster interventions that go beyond material needs. With all this in view, vulnerability, the social capital described by Aldrich & Meyer (2015) and emotional health turn out to be one fabric, and any technological tool enters that fabric without being able to

ignore it. Applied to La Guaira, these lessons suggest, as an inference of the author, that reconstruction should not move families away from their sources of work, as happened with the Guabito resettlement in Portoviejo, and that university and parish brigades in Caracas can document the damage with the same action-research logic tried out in Mexico City.

Artificial intelligence across the earthquake cycle

Turning to the second axis, the tools gathered in the corpus already operate in almost every phase of a disaster, as can be seen in the review by Linardos et al. (2022), which brought together machine learning and deep learning studies published since 2017 and grouped them into hazard prediction, risk and vulnerability assessment, detection, early warning, monitoring, damage assessment and post-disaster response. Years earlier, Imran et al. (2015) had reviewed methods for processing the messages people post on social media during mass emergencies, a source that the Mexican experience of 2017 proved to be both valuable and unreliable.

In Latin America, Martínez-Viveros (2018) presents three CentroGeo projects carried out after the 2017 earthquakes, among them the use of Sentinel-1 radar images that recorded vertical ground displacements of up to about 25 cm at some points in Mexico City, three-dimensional modelling of buildings with lidar to estimate the vulnerability of small areas, and a collective mapping platform that lets residents report problems and resources almost in real time. The author herself describes the radar results as provisional and in need of field validation, a caution worth carrying over to any reading of such data. Something similar occurred in Venezuela with the high-resolution satellite images through which the USGS (2026) identified landslides along the coast of La Guaira and communities possibly cut off by the blocked coastal road between Catia La Mar and Puerto Cruz, results that the agency itself called preliminary and incomplete because cloud cover and missing imagery prevented some areas from being reviewed.

In the health field, Haykal et al. (2025) review applications of AI in humanitarian healthcare, such as early warning systems, chatbots for displaced people and telemedicine, while acknowledging that data privacy, bias and unequal access remain unresolved. This suggests that technology is moving faster than the rules for using it, and that in the coastal towns of La Guaira or the barrios of Caracas a tool designed for another context may leave out precisely those who most need help.

Algorethics and the ethics of humanitarian aid

Regarding the third axis, algorethics appears as the discipline that helps decide when and how to use these tools, and for this purpose Floridi et al. (2018) offered, within the AI4People framework, five principles, beneficence, non-maleficence, autonomy, justice and explicability, which humanitarian aid puts to an especially hard test. Coppi et al. (2021) see it that way, warning that algorithmic opacity can break the link between a crisis and the assistance each person receives, in tension with the principles of humanity, neutrality, impartiality and independence, which is why they propose explicability as an ethical requirement and call for auditable standards before new systems are tested on vulnerable populations.

Taking a more operational approach, Beduschi (2022) recommends privacy by design, data minimisation, impact assessments and mechanisms that allow people to challenge automated decisions, and concludes that, under the do-no-harm principle, AI should only be used when it adds value in a specific context. Peirats-Navarro & Arteaga (2026) provide a theological grounding for that caution by reserving the command of action (*imperium*) to the person and leaving AI a legitimate role in deliberation (*consilium*), a distinction that becomes clear in an emergency, where a model may suggest which neighbourhood rescue teams should reach first, but the decision and its responsibility lie with whoever is coordinating.

In the Venezuelan legal field, Carreño-Vélez (2025) put forward an onto-epistemic and humanising algorethics for citizen security based on interviews with police managers in Caracas, and found that the participation model of Baruta, supported by technological means and real-time communication, contrasted with weaknesses in the most vulnerable communities. Herein lies an intrinsic challenge for earthquake management, since the Caracas experience suggests that technology pays off where community organisation already exists, which is in keeping with what Aldrich & Meyer (2015) argue about social capital. In a setting such as Venezuela in 2026, where the figures for victims and missing persons have been the subject of public debate, the demands for explicability made by Coppi et al. (2021) and for accountability made by Beduschi (2022) take

on a practical meaning, since the records and algorithms that order search and aid should be open to review by the families themselves.

The Magisterium and co-responsibility towards the victim

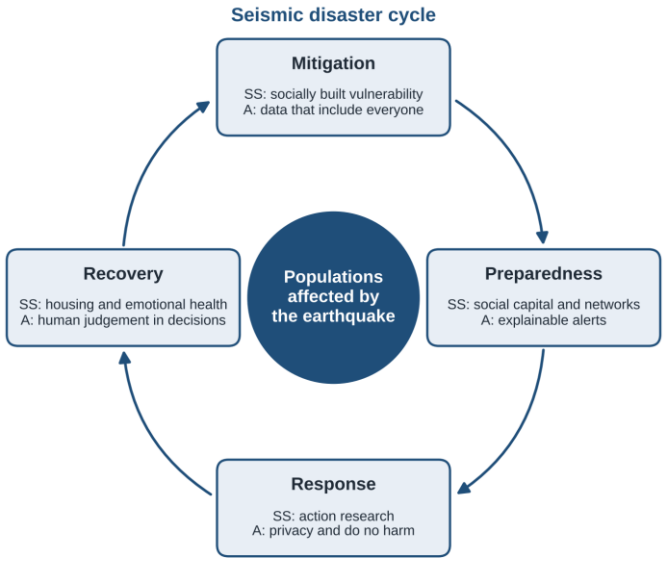
As for the fourth axis, the Magisterium of the Catholic Church offers criteria that, read from the shelters of La Guaira and Yaracuy, match what the social sciences have found, as can be seen in Labrecque's (2022) reading, which links the *Rome Call for AI Ethics* with integral ecology and with the critique of the technocratic paradigm in *Laudato si'*, and highlights the sense of responsibility shared among industry, government and Church that its signing expressed. According to Pegoraro & Curzel (2023), the call was signed in Rome on 28 February 2020 and asked for human dignity, justice, sociability and subsidiarity to be built into AI applications. Later on, the note *Antiqua et nova* asked that the ends and means of each system be assessed according to human dignity and the common good (Dicasterio para la Doctrina de la Fe & Dicasterio para la Cultura y la Educación, 2025), a criterion that in an emergency forces one to ask whom each algorithm serves.

Leo XIV (2026), for his part, recalls in *Magnifica humanitas* that "the value of the person does not depend on what he or she does or produces" (n. 51, own translation), a statement that carries particular weight for someone who has lost everything in Catia La Mar or Naiguatá and can no longer produce anything, and that guides the community care that parishes provide to those families. Torres-Chavarría & Franco-Fernández (2026) also warn that AI can exclude minority cultures and languages, as shown by the example of the Quechua language of Pomabamba, in Peru, which the systems do not recognise, an exclusion that in an emergency turns into alerts and forms that some communities cannot understand.

Social sciences and algorethics as supporting disciplines

From the dialogue among the four axes, it is proposed as an inference of the author that both disciplines complement each other throughout the disaster cycle described by Sun et al. (2020), as represented in Figure 2. In mitigation and preparedness, the social sciences identify who is vulnerable and why, as Bravo (2017) did in Manabí and as urgently needs to be done on the slopes of La Guaira that the USGS (2026) flagged as at risk of debris flows, while algorethics demands that risk models be fed with data that include those populations. During the response, the action research of Mora et al. (2018) and the citizen verification described by Salgado-Andrade (2018) provide situated information, and algorethics, following Coppi et al. (2021) and Beduschi (2022), sees to it that its automated processing is explainable and does not expose those affected.

Figure 2. *Social sciences and algorethics across the seismic disaster cycle*.



Note: developed in-house from the reviewed corpus.

Finally, in recovery, the resettlement studied by Moretta-Macías (2019) in Portoviejo and the trauma measured by Özmaya et al. (2025) in Kahramanmaraş show that decisions on housing and psychosocial care cannot be handed over to an efficiency calculation, so that the human reserve of prudential judgement takes on its most concrete meaning here. For this to happen, someone has to train lawyers, engineers, civil servants and pastoral workers in these two disciplines, a task for which universities, Church communities and the State share responsibility, in keeping with the subsidiarity called for by Pegoraro & Curzel (2023) and with algor-ethics as the bridge proposed by Villalba (2020).

CONCLUSIONS

In short, the aim of analysing social sciences and algorethics as disciplines that help the populations affected by the 2026 earthquakes in Venezuela was met by reading the seismic sequence of 24 June in the light of studies on Ecuador 2016, Mexico 2017 and Türkiye 2023, of the literature on AI applied to disasters and of the recent Magisterium. It was established that the social sciences explain why the same earthquake causes unequal damage, show the weight of social capital, youth organisation and emotional health in recovery, and provide action-research methods that are useful in the middle of an emergency. Algorethics, in turn, offers criteria for using AI in early warning, damage mapping and humanitarian care without violating the privacy or dignity of those affected, reserving to the person the judgement on decisions that put lives at stake. It is concluded that both disciplines complement each other when communities take part in designing and overseeing the tools, which is a contribution to the reconstruction of La Guaira, Yaracuy and Caracas and to disaster management in Latin America.

FINANCING

Non-monetary.

CONFLICT OF INTEREST

The author declares that she has no conflict of interest with any individuals or institutions related to this research.

ACKNOWLEDGMENTS

The author thanks the Universidad Central de Venezuela for the support provided in the framework of her postdoctoral studies in Social Sciences.

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