

Community resilience in Asunción Ixtaltepec, Oaxaca

Resiliencia comunitaria en Asunción Ixtaltepec, Oaxaca

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Abstract

Oaxaca is located in an area where five tectonic plates meet: Caribbean, Pacific, North American, Rivera and Cocos (SSN, 2017), which makes it highly vulnerable to natural hazards such as earthquakes. The most recent earthquake was last September 7, 2017 at 23:49:17 hrs, with a magnitude of (8.2) degrees on the Richter scale, epicenter 133 km southwest of Pijijiapan, Chiapas (SSN, 2017), leaving a balance of 99 victims, of which 82 were in Oaxaca. The objective of this research was to identify the level of community resilience in Asunción Ixtaltepec, Oax. The techniques used were: participant observation, surveys, focus groups and semi-structured interviews. The instrument used was a questionnaire based on the one developed by GOAL, an association characterized by "disaster risk management, early warning systems, market systems, measurement and applicability of resilience." (GOAL, 2016). As a result, five pillars of community resilience were identified: cohesive social structure; governmental honesty; cultural identity; collective self-esteem and social humor, proposed by Suárez (1993) apud Uriarte (2014), in addition, the community resilience radar was elaborated.

Resumen

Oaxaca se ubica en un área donde se encuentran cinco placas tectónicas: Caribe, Pacífico, Norteamérica, Rivera y Cocos (SSN, 2017), lo que la vuelve un territorio altamente vulnerable a los riesgos naturales como los sismos. El sismo más reciente fue el del pasado siete de septiembre del 2017 a las 23:49:17 hrs, con una magnitud de (8.2) grados en la escala de Richter, epicentro a 133 km al suroeste de Pijijiapan, Chiapas (SSN, 2017), dejando un saldo de 99 víctimas, de las cuales 82 fueron en Oaxaca. El objetivo de esta investigación fue identificar el nivel de resiliencia comunitaria en Asunción Ixtaltepec, Oax. Las técnicas que se utilizaron fueron: observación participante, encuestas, grupos de enfoque y entrevistas semiestructuradas. El instrumento que se utilizó fue un cuestionario basado en el elaborado por GOAL, Asociación caracterizada por la "gestión de riesgo ante desastres, sistemas de alerta temprana, sistemas de mercado, medición y aplicabilidad de resiliencia". (GOAL, 2016). Como resultado se identificaron cinco pilares de la resiliencia comunitaria: estructura social cohesionada; honestidad gubernamental; identidad cultural; autoestima colectiva y humor social, que propone Suárez (1993) apud Uriarte (2014), además se elaboró el radar de resiliencia comunitaria.

Resilience, Vulnerable, Territory

Resiliencia, Vulnerable, Territorio

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Introduction

Human beings live immersed in various risks that occur in daily life, but specifically the risks caused by natural phenomena come to damage a society depending on a certain level of vulnerability, which without adequate preparation to mitigate the negative effects, becomes vulnerable to suffer greater damage.

These natural phenomena are considered as hazards and are often referred to as threats, and since they come from nature, they are called natural hazards. The effects of natural hazards represent economic, material and human losses. In other words, the hazard is considered a risk factor. In this way, it is said that the level of risk will depend on the community organisation, if there are resistant structures and mitigation plans. Novelo, (2020).

In this action, communities are severely affected by not being prepared to face and overcome adversity. This results in a disaster, generated by the interaction of a natural phenomenon (earthquake) and the prevailing levels of vulnerability of the community. This causes a rupture in development, generating that the planned and sustainable process of the community in search of quality of life and well-being is affected, due to losses that cause paralysis in daily activities and livelihoods.

(Lavell, 2007, 2020) apud Canese et al., (2022) point out that disasters are not the direct result of a natural event alone, but that a series of interrelated factors must be considered, such as social inequalities, citizen behaviour, territorial, economic and social exclusion, as well as the interaction of environmental conditions.

In this sense, Mexico has been no exception in being exposed to risks, as different types of natural disasters have been recorded over time, generating diverse damages, and unlike other natural phenomena, earthquakes or earthquakes silently threaten our peace of mind, since it is impossible to predict them.

In the Mexican Republic, Oaxaca is located in an area where five tectonic plates meet: Caribbean, Pacific, North American, Rivera and Cocos (the last two are subducting, submerging). These plates form a tectonic system and the boundaries between them are active seismic zones due to their interaction.

The Cocos plate is specifically the one that shows an eastward movement at an average displacement of seven centimetres per year, which generates a plate collision (SSN, 2017).

For this reason, Oaxaca is vulnerable to earthquakes and tremors. As it is located within the aforementioned plates, there have been earthquakes with magnitudes greater than eight on the Richter scale, of which there are records since 1700 to date. The most recent earthquake greater than seven degrees was the one on 7 September 2017 at 23:49:17 hrs, with a magnitude of 8.2 on the Richter scale, epicentre 133 kms southwest of Pijijiapan, Chiapas, leaving a toll of 99 victims, of which 82 were in Oaxaca. (SSN, 2017).

In the state of Oaxaca this earthquake left thousands of families devastated, mainly in the region of the Isthmus of Tehuantepec, affecting houses, schools, hospitals, health centres, churches, municipal palaces and markets, in addition to having a large number of victims due to the magnitude of the earthquake.

Baas mentions that "Unplanned urbanisation, environmental degradation and inadequate land-use planning are key factors that contribute to the increase in natural hazards, loss of life and assets when these hazards become disasters" (Baas, 2009: 22). Such is the case of Asunción Ixtaltepec in the Isthmus Region, where there is no planned urbanisation, so land use planning has not been controlled either.

Situations after the natural disaster (earthquake)

The lives of the people affected by the 2017 earthquake took a radical turn with a total of 180,000 people considered as victims (Velásquez, 2017). People who were left without patrimony, major structural affectations, family losses, traumas and fears, causing social dislocation.

After the disaster, what is sought is to recover the capacity of the social system and institutions to be able to face the adversities that have arisen and those that will arise on the road to resilience in order to reorganise (Uriarte, 2010). As well as the creation of action plans identifying the risks and dangers to which they are exposed and not waiting for another natural hazard to happen before acting.

The United Nations International Strategy for Disaster Reduction (UNISDR, 2010) states once again that the greatest damage occurs in places where poverty is prevalent, stating that: "85% of people exposed to earthquakes, cyclones, floods and droughts live in developing countries" and Mexico is among the countries with these characteristics.

In Mexico, in 2020, according to data from CONEVAL (2020), the 15 municipalities with the highest percentage of extreme poverty (98.5% or more) were located in Oaxaca (8), Chiapas (6) and Guerrero (1). These three municipalities are the municipalities with the highest percentages of poverty, while those with the lowest percentages of poverty are Nuevo León, CDMX, Sonora, Chihuahua and Coahuila (CONEVAL, 2020).

Due to the COVID-19 pandemic, poverty rose to levels that had not been recorded in 20 years. According to ECLAC data (2020), it is estimated that the total poor population reached 209 million by the end of 2020, adding 22 million more than in 2019.

Taking into account these factors for the case of Oaxaca: the high-risk geographical location, poverty in part of the population, vulnerability, limited access to information and poor territorial planning, among others, it becomes more important to develop resilience in the communities affected by earthquakes.

Disaster-risk countries, vulnerable, with increased hazards and exposure

The INFORM-LAC study (Risk Management Index for Latin America and the Caribbean) of UNICEF conducted for the years 2017, 2018 and 2020, shows little significant change over time and has been developed with the purpose of knowing the particular conditions of the countries in the region (33 countries) and to obtain a better comparison of the levels of risk among them (United Nations et al., 2020).

This report mentions the countries with a tendency to suffer greater risks from disasters and humanitarian crises and Mexico has a score of 6.0 (in 2018 it was at 6.2), the highest score is for Haiti with 8.5; Guatemala 8.2; Honduras 8.1; Venezuela 7.2; Colombia 7.0; El Salvador 6.7; Nicaragua 6.6; Peru, Bolivia and Mexico with 6.0 (United Nations et al., 2020).

Similarly, the report includes the countries with the highest values for vulnerability, which measures people's susceptibility to hazards. It takes into account the capacity of socio-economic systems and looks at the strengths of communities, families and individuals. In this way, it was based on socio-economic vulnerability and the vulnerable population in each country, with Mexico scoring 6.5 in ninth position (United Nations et al., 2020).

They also list the lack of coping capacity in the face of scarce resources available to cope with damage resulting from disaster or adverse events. The lack of institutional, infrastructure and systems capacity is also measured.

In both infrastructure and institutional capacity, Mexico disappeared from the list, ranking 10th in 2018 with a score of 6.5.

A very important element that makes Mexico vulnerable is its exposure to natural hazards; in 2018 it was in first place with a score of 8.3 and is currently in fourth place, as shown below:

Exposure to natural hazards					
Haiti	8.1	Colombia	7.4	Venezuela	7.0
Honduras	8.0	Dominican Republic	7.4	Cuba	6.6
Guatemala	7.9	Ecuador	7.3	Panama	6.5
Mexico	7.9	El Salvador	7.3	Jamaica	6.4
Nicaragua	7.7	Peru	7.2	Belize	6.2

Table 1 Exposure to natural hazards

Source: INFORM-LAC, Risk Management Index for Latin America and the Caribbean, United Nations, 2020.

This shows the final table for all dimensions of the countries with the highest values for risk, hazard and exposure, vulnerability and lack of coping capacity.

Country	Risk INFORM-LAC	Hazard and exposure	Vulnerability	Lack of coping capacity
LEVEL OF RISK VERY HIGH				
Guatemala	8.2	8.3	8.6	7.6
Haiti	8.5	8.0	8.4	9.0
Honduras	8.1	8.4	8.0	7.9
HIGH RISK LEVEL				
Bolivia	6.0	5.2	6.2	6.8
Colombia	7.0	8.1	7.1	6.0
El Salvador	6.7	8.1	5.1	7.2
Mexico	6.0	8.4	5.8	4.5
Nicaragua	6.6	8.0	5.7	6.3
Peru	6.0	6.1	6.3	5.5
Venezuela	7.2	8.3	6.5	6.9

Table 2 INFORM-LAC index, Risk Management Index for Latin America and the Caribbean

Source: United Nations INFORM-LAC study, 2020.

The table shows a close relationship between the risk index and the hazard and exposure index for both human and natural hazards. With regard to vulnerability, it is shown that the countries with a very high level are two Central American countries and one Caribbean country, while the others are at a high level of risk. In terms of coping capacity, Mexico has a score of 4.5.

The case of Mexico maintains a high level of risk, very high in terms of danger and exposure, medium in terms of vulnerability and lack of coping capacity. This means that in the face of a disaster, the state responds, albeit in a limited way, but with the resources it has, it attends to cases with higher levels of emergency, which means that vulnerability levels do not rise as much, but being in the medium level of vulnerability does not mean that it is not affected by levels of poverty, social backwardness, education, health centres, etc.

However, in terms of the risk and dangers to which Mexico is exposed, these are high and very high respectively. It is worth mentioning again that due to its geographic location, Mexico is highly seismic, in addition to other natural hazards such as hydrological, atmospheric, volcanic, as well as anthropogenic hazards to which it is exposed, making it one of the countries with the highest levels of exposure to natural hazards.

Within the country, the states that register a very high level of danger are Oaxaca, Guerrero and Chiapas (Atienza, 2015).

After the earthquake of 7 September 2017 with a magnitude of 8.2 Richter in which there was serious material damage and deaths, the affected communities had a response capacity according to the level of resilience that had been generated until then.

Authors such as Rutter (1992), Werner (1995) and Garmezy (1991), affirm that resilience is a process in which the capacity to face adversity is acquired, because one is not born with it, one develops the power to adapt and recover after an unhealthy or stressful event, but it will also depend on the internal and external factors that intervene.

In summary, resilience comprises the process of coping with adverse situations that are an opportunity for growth and development of both coping and protective skills for future situations.

In order to understand the level of community resilience, the five pillars of community resilience are identified: cohesive social structure; governmental honesty; cultural identity; collective self-esteem; and social humour, as proposed by Suárez (1993) apud Uriarte (2014). The Sendai Framework for Action 2015-2030 (UNISDR., 2010) also proposed four priorities for action that have been a methodological guide in various research, these priorities are: understanding disaster risk; strengthening disaster risk governance; investing in disaster risk reduction; and increasing disaster preparedness for effective response and to "build back better" in the areas of recovery, rehabilitation and reconstruction.

The effects of earthquakes on the individual-family-community are concentrated in various types of damage, for example, Palomares and Campos (2018) focus on traumatic experiences after living through a major earthquake. About one person in ten develops a psychiatric disorder afterwards. This damage will depend on whether they were in the most affected area, if they had some direct consequence or if they were already suffering from something. Among the disorders they develop are depression, post-traumatic stress disorder, anxiety, nicotine dependence, alcohol or drug abuse.

According to UNICEF (2018), children and adolescents suffer the greatest damage, as their daily activities are significantly interrupted and these changes affect their physical, cognitive and socio-emotional development (in situations of poverty this damage increases). Physical health can be directly affected by death, injury, maiming or illness due to reduced access to basic services such as water. In terms of economic damage, it was mentioned that the negative consequences are estimated to be divided into direct and indirect effects. The former refer to partial or total damage to property that may or may not be recoverable, while the indirect effects are the result of a decrease in household and/or business income due to a drop in productivity, etc.

Material damage ranges from a partially damaged house to homes destroyed and in rubble, as well as damage to churches, schools and public infrastructure, roads, etc.

The Economic Commission for Latin America and the Caribbean (ECLAC, 2020) states that a disaster implies setbacks in the economic and social progress that has been achieved in the place where the crisis occurs for years. The severity of this will depend on the capacity of each country to detect and transform its vulnerabilities.

Research study area

The Isthmus of Tehuantepec Region is one of the eight regions of the state of Oaxaca; to the north it borders the southern part of the state of Veracruz; to the south it borders the Pacific Ocean; to the east it borders the Sierra Sur Region of the state of Oaxaca; to the west it borders the state of Chiapas; it encompasses two districts: Juchitán and Tehuantepec.



Figure 1 Macro-localisation of the Isthmus region in the state of Oaxaca

Source: Own elaboration based on the National Institute of Statistics, Geography and Informatics, 2019

The Isthmus region is located on the coastal plain of the Pacific Ocean and, according to the classification for the seismic regions of Mexico made by the Federal Electricity Commission, it is located in the seismic region type D. This is explained in the Risk Atlas published by ERN, Ingenieros Consultores (2011), a classification presented by the Federal Electricity Commission (CFE) and the National Centre for Disaster Prevention (CENAPRED): "this region is characterised because ground accelerations usually exceed 70% of the acceleration of gravity and because in it, the number of epicentres registered by the National Seismological Service Network is much higher with respect to zones A, B, and C".

Compared to zone A where there are no historical records of earthquakes, there are no records of earthquakes in the last 80 years and the highest ground accelerations do not exceed 10% due to tremors.

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It is also important to mention that Oaxaca is located in the "Pacific Ring of Fire" or also known as the "Ring of Fire", which is associated with the formation of large mountain ranges. This ring of fire links 328 of the 540 volcanoes on our planet (Valenzuela Wong, 2019).



Figure 2 Seismic regionalisation of Mexico

Source: Federal Electricity Commission, 2018

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Figure 3 Ring of Fire

Source: Science UNAM, 2018

The region of the Isthmus of Tehuantepec, located in the state of Oaxaca, is geographically located on a zone of interaction of three tectonic plates: the Cocos plate, the Caribbean plate and the North American plate, which provide considerable elements and evidence of constant seismic movement.

In this same sense, in addition to the movement caused by the tectonic plates, geological faults are some of the evidence produced on the surface by the same plate dynamics, which can produce earthquakes of low to very high intensity.



Figure 4 Tectonic plates of Mexico
Source: Los sismos una amenaza cotidiana. Atienza, 2015

Taking into consideration the above, the following table issued by SEDATU (2017), shows the total damage to housing by municipality, caused by the earthquake of 7 September 2017 in Oaxaca.

Id	Municipality	Dwellings	51	San Miguel Tlaxiaco	2
1	Asunción Cuvotepeil	3	52	San Nicolás Hidalgo	27
2	Asunción Ixtaltepec	2,974	53	San Pedro Comitancillo	604
3	Calihualá	13	54	San Pedro Huamelula	1,487
4	Chahuites	1,078	55	San Pedro Huilotepec	383
5	Ciudad Ixtepec	4,130	56	San Pedro Mártir Yucuxaco	10
6	Cosoltepec	4	57	San Pedro Nopala	13
7	El Barrio De La Soledad	151	58	San Pedro Tapanatepec	2,611
8	El Espinal	1,106	59	San Pedro Y San Pablo Teposcolula	2
9	Fresnillo De Trujano	20	60	San Pedro Y San Pablo Tequixtepec	6
10	Guadalupe De Ramírez	5	61	San Sebastián Nicananduta	2
11	Guevea De Humboldt	929	62	San Sebastián Tecomaxtlahuaca	5
12	Heroica Ciudad De Huajuapam De León	452	63	San Simón Zahuatlán	4
13	Heroica Ciudad De Juchitán De Zaragoza	15,087	64	Santa Catarina Zapotitlán	1
14	Ixpantepec Nieves	12	65	Santa Cruz De Bravo	13
15	Magdalena Tequisistlán	296	66	Santa Cruz Tacache De Mina	88
16	Magdalena Tlaxiaco	106	67	Santa María Camotlán	3
17	Mariscala De Juárez	107	68	Santa María Chimalapa	398
18	Matías Romero	459	69	Santa María Guienagati	285
19	Reforma De Pineda	1,120	70	Santa María Jalapa Del Marqués	1,114
20	Salina Cruz	997	71	Santa María Mixtequilla	604
21	San Agustín Atenango	4	72	Santa María Petapa	684
22	San Andrés Dincuiti	6	73	Santa María Tototapilla	85
23	San Andrés Lagunas	2	74	Santa María Xadani	1,450
24	San Andrés Tepetlapan	3	75	Santiago Astata	498
25	San Antonio Monte Verde	16	76	Santiago Ayuquihilla	4
26	San Antonio Acutla	2	77	Santiago Cacaloxtotec	3
27	San Blas Atempa	1,282	78	Santiago Chazumba	4
28	San Dionisio Del Mar	1,548	79	Santiago Del Río	9
29	San Francisco Del Mar	2,194	81	Santiago Ihuatlán Plumas	6
30	San Francisco Ixhuatlán	2,658	82	Santiago Lachiguri	784
31	San Francisco Teopan	1	83	Santiago Laollaga	295
32	San Francisco Tlapancingo	5	84	Santiago Miltepec	1,603

33	San Jerónimo Silacayoapilla	20	85	Santiago Tamazola	15
34	San Jorge Nuchita	9	86	Santo Domingo Chihuitán	215
35	San José Ayuquila	16	87	Santo Domingo Ingenio	1,010
38	San Juan Bautista Tlachichilco	1,070	88	Santo Domingo Petapa	1,090
39	San Juan Mixtepec	6	89	Santo Domingo Tehuantepec	4,321
40	San Juan Numí	16	90	Santo Domingo Tonalá	149
41	San Marcos Arteaga	4	91	Santo Domingo Yodohino	2
42	San Martín Peras	3	92	Santo Domingo Zanatepec	1,578
43	San Martín Zacatepec	3	93	Santos Reyes Tepejillo	2
44	San Mateo Del Mar	1,788	94	Santos Reyes Yucuná	1
45	San Mateo Nejápam	4	95	Silacayoapam	41
46	San Mateo Tlapitepec	7	96	Teotongo	3
47	San Miguel Ahuehuetitlán	17	97	Tlaxiaco Plumas	4
48	San Miguel Amatitlán	32	98	Unión Hidalgo	2,811
49	San Miguel Chimalapa	646	99	Villa De Tamazulápam	13
50	San Miguel Tenango	105	100	Zapotitlán Lagunas	132

Table 3 Damaged housing by municipality in the state of Oaxaca
Source: Secretaría de Desarrollo Agrario Territorial y Urbano SEDATU, 2017

Based on the above, the municipality of Asunción Ixtaltepec was selected for the development of the research since the houses damaged by the earthquake represented 64% of the total.

Asunción Ixtaltepec

Bordering

Asunción Ixtaltepec is bordered to the north by the municipalities of: El Barrio de la Soledad and Santa María Chimalapa; to the east with the municipalities of Santa María Chimalapa, San Miguel Chimalapa and the Heroic City of Juchitán de Zaragoza; to the south with the municipalities of the Heroic City of Juchitán de Zaragoza, El Espinal, San Blas Atempa and San Pedro Comitancillo; to the west with the municipalities of San Pedro Comitancillo, Magdalena Tlaxiaco, Ciudad Ixtepec and El Barrio de la Soledad.

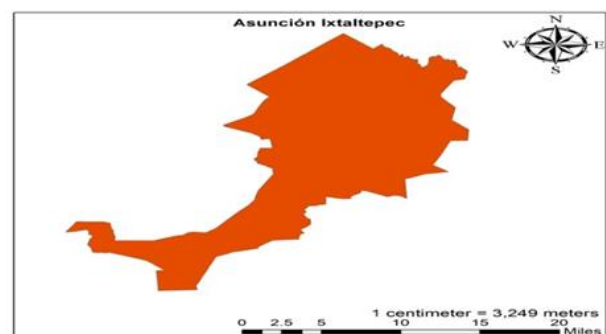


Figure 5 Asunción Ixtaltepec
Source: Own elaboration, ArcGis 2019

The total surface area of the municipality is 659.28 km², which represents 3.3% of the total surface area of the Isthmus region (19,977 km²), occupying 0.71% of the surface area of the state of Oaxaca (93,757 km²).

Forms of organisation and governance structure

Asunción Ixtaltepec is a municipality that is politically formed by political parties, the organisational structure is by town council, elected by a majority of the population in party elections, generally consisting of the Municipal President, Syndics and Councillors.

Characteristics of the population

The following data were consulted in CONEVAL's 2015 municipal poverty measurement report. The total population of Asunción Ixtaltepec is 15,105 people, occupying 0.37% of the state level (4,019,821), of which 7,620 are women and 7,485 are men.

Indigenous and language-speaking population

The total population of indigenous origin is 10,995, which represents 72.8% of the total population in the municipality of Asunción Ixtaltepec.

The population aged five years and over is 14,078, of which 6,600 speak an indigenous language, representing 46.9%; 6,385 speak Spanish in addition to their mother tongue, i.e. only 129 people do not speak Spanish.

Regarding the social situation, the following data were obtained

Social situation	Total
In poverty	6,946
In extreme poverty	1,503
Non-vulnerable - non-poor	2,588
Vulnerable income	817

Table 4 Social situation

Source: INEGI; *Social deprivation and economic well-being 2015*

The degree of social backwardness in this municipality is very low, compared to the state level, which is classified as very high. Even though there are two priority attention zones (ZAP). There are 4,631 homes, of which 2,974 were affected by the earthquake. In terms of quality and basic services in housing, the following data were obtained:

Quality and space in housing	%
With earthen floors	1.8
With roof of flimsy material	0.1
With walls of flimsy material	1.5
Overcrowded	4.0
Basic services in the dwelling	
No piped water	4.2
No drainage	3.4
No electricity	1.1

Table 5 Quality and basic services in housing

Source: INEGI; *Social deprivation and economic well-being 2015*

Finally, data related to the needs of the community according to SISPLADE (2020) are presented, which show that more than 50% of the population has income below the welfare line; there is a 40% lack of access to basic housing services and 63% of the population lacks access to social security. These are important aspects that increase the vulnerability of the municipality's population.



Figure 6 Needs of Asunción Ixtaltepec

Source: SISPLADE, 2020

Theoretical research model

This study was carried out using the social theory of risk developed by Ulrich Beck in 1986 as the basis and principle of risk theory, followed by Claudia E. Natenzon (1995), as well as the theory of disasters as a social phenomenon Maskrey (1993) and complemented by the theory of community action (Zambrano and Berroeta, 2012) and community resilience in which there are several authors (Arciniaga, 2010); (Uriarte, 2005; GOAL, 2015; Suárez Ojeda, 1993). In this way, the theoretical proposal is summarised in the following research model.

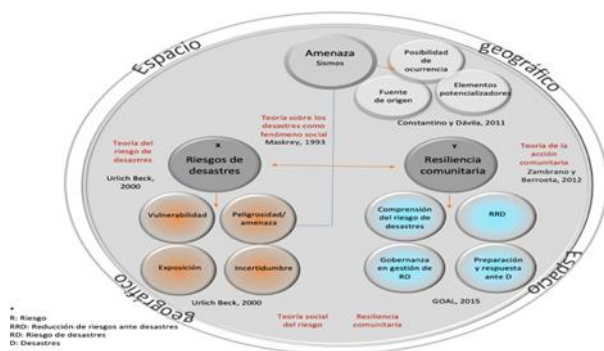


Figure 7 Explanatory model

Source: Own elaboration

This model shows that the factors that influence community resilience are supported by the theory of community action and community resilience, identifying five pillars: cohesive social structure, government honesty, cultural identity, collective self-esteem and social humour.

The five pillars range from how the community is structured, the identity they share together through beliefs and ways of life, to the governmental side of decision-making and how this is shared with the community.

It also mentions the seven anti-pillars of community resilience, i.e. those factors that limit the capacity to respond and recover. These pillars are: poverty, cultural poverty, moral poverty, political poverty, economic dependency, social isolation and stigmatisation of victims.

In terms of disaster risk factors, the social theory of risk and the theory of disasters as social phenomena were used, in which vulnerability, exposure, danger and threat, as well as uncertainty are highlighted. The main characteristic of vulnerability is that it is the main factor for the existence of a disaster, resulting from a combination of hazards and the danger to which the community is exposed.

As confirmed in their studies by Kates (1970) and Rubiano (2009) apud Canese et al., (2022), the contribution of the Social Sciences to disaster management studies has made it possible to understand the social and cultural problems that accompany disasters, in order to guide the management, action, participation and education of citizens.

In this sense, Casarrubia (2020) apud Canese et al., (2022), states that risk management has been approached from a macro approach, where the local dimension and citizen participation are not considered. Agreeing with Casarrubia, Durán Vargas points out that local management is an "option for direct action on the most concrete conditions of insecurity in communities and that it acts on the capacities and resilience that the history and social reality of the community builds".

Methodological design

The method of this research is qualitative, focused on understanding and deepening community resilience to earthquakes in the study community, relating the perspective of the inhabitants in their natural environment and context with the theoretical part (Hernández et al., 2014).

The design is action research, which helped to identify how to solve problems in the face of earthquake exposure and the path towards community resilience, as well as to improve and design DRR practices, with the main purpose of providing lines of action to guide decision-making for prevention, coping and coping.

Through this research design, the aim is to foster interest in change in the communities, to transform the current situation into a desired situation, and to make the inhabitants aware of their role in this transformation process.

According to Hernández et al. (2014), action research focuses on local and individual practices, proposes to elaborate and follow actions, and above all, one characteristic is that the research is accompanied, i.e. the researcher and one or more members of the community jointly create links to reach the objective.

At the same time, Ander-Egg (2003) suggests that there should be an intervention that creates mutual knowledge, always researching topics of common interest, not just a topic of personal interest. In this case, community resilience is a topic that both major authorities and civil protection and society have been interested in studies of this type, especially because it is a relevant topic due to the nature of its origin and the damage it has suffered, reasons that are set out in the justification.

In this sense, the essential phases of action research design listed by Stringer (1999) are firstly to observe, think and act. In the first one, the aim is to analyse, then interpret and finally propose strategies to solve problems in order to create improvements (apud Hernández et al., 2010).

It is considered that the scope of this research was descriptive and explanatory, with the former looking for specific characteristics and profiles of the communities in terms of community resilience (Hernández et al., 2010).

The explanatory scope is based on the problem, the aim is to explain the causes of the problem, to try to establish the causes of the problem, in this case, to find out the level of community resilience.

The techniques used were participant observation, surveys, focus groups and semi-structured interviews.

Authors such as Pascuas (2022) propose a methodology for managing the ecosystem resilience of natural areas that can serve as a basis for decision-makers and for those who design public policies on the subject.

What is important about this methodology is that it focuses not only on the ecological aspects, but also on the legal and socio-cultural aspects of each territory, and it is hoped that the application of this methodology will strengthen the resilience of ecological areas. This methodological process can be useful in research on community resilience (Pascuas, 2022).

Instrument for the collection of information

The instrument used was a questionnaire which is mainly based on the one developed by GOAL, an Association founded in Ireland in 1977 and which has been operating in Honduras for 21 years, characterised by the management of "disaster risk management, early warning systems, market systems, resilience measurement and applicability". (GOAL, 2015).

GOAL's perspective, and that of other authors, has been guided by the Sendai Framework for Action 2015-2030, developing a survey that is underpinned by extensive research by John Twigg. This partnership has applied it in 11 countries mostly in Africa and only in one country in Asia and two in Latin America.

In the same context, the ARC-D tool (named after GOAL) consists of two parts, part A is a description of the community context, while part B is assessed through 30 questions.

Due to the flexibility of the tool, which can be adapted to any type of hazard and local context, it has been complemented with the "Minimum indicators for building the resilience of municipalities" of CONRED (2015), in which essential aspects are taken.

In order to apply the questionnaire and identify the level of community resilience, two focus groups were carried out in which 15 people from the community were required in each one to provide the information. Balance is sought between participants, men and women, people from the community with different activities, different ages, with disabilities, etc.

Results

The pillars and anti-pillars are elements that allow us to identify the existence of community resilience in the communities, in each community there is a different way of responding to disaster situations. According to the pillars and anti-pillars of Suárez (1993) apud Uriarte (2014), the following was obtained:



Figure 8 The Five Pillars of Community Resilience in Asunción Ixtaltepec

Source: Own elaboration based on the community resilience perspective and fieldwork 2019- 2022.

The analysis of the community resilience radar in Asunción Ixtaltepec to determine the level of resilience identified that among the 16 indicators of community resilience, the participatory community risk assessment, the early warning system and leadership in the coordination of preparedness, response and recovery presented the lowest values and therefore are the ones that contribute to vulnerability. In contrast, those with the highest values are women's participation and security, peace and conflict mitigation mechanisms with the highest values, contributing to equity in participation and social cohesion and conflict prevention, respectively.

And of the 14 disaster risk indicators, higher values can be noted than for community resilience. The highest is water supply and access to water, with this indicator having the best overall score. Among the lowest values are sustainable housing, environmental management, business linkages, insurance, emergency operation capacity and knowledge of rights and entitlements.

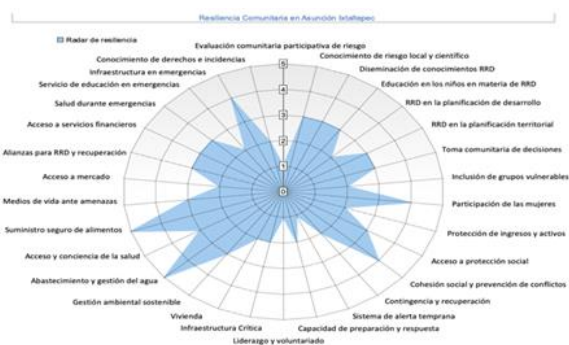


Figure 9 Community Resilience in Asunción Ixtaltepec
Source: Own elaboration

Finally, the results of Section B of the ARC-D tool are presented, which presents the results of the 30 questions posed in relation to the categories of community resilience, with the objective of establishing the level of community resilience in the municipality of Asunción Ixtaltepec.

Category 1: Participatory Community Risk Assessment		Key Question 1: Has the community conducted a participatory risk assessment?	Asunción Ixtaltepec
Level description		Characteristics of resilience	05
1	Little awareness/motivation and no action.	A structured, participatory risk assessment has never been conducted in the community. Or, if it has been done, the assessment is outdated or not in use and community members do not know about its findings.	x

Component 2: Local and scientific local and scientific knowledge		Key question 2: Does the community combine local knowledge/perception of risk with scientific knowledge, data and risk assessments?	Asunción Ixtaltepec
Description of levels		Characteristics of resilience	05
3	Awareness and long-term actions, but no strategy and not all aspects of the problem are addressed.	The community combines local knowledge/perceptions of risk with a degree of scientific analysis/data, but this can only address some aspects of the necessary disaster risk awareness.	x

Component 3: Dissemination of DRR knowledge		Key question 3: Have community members been exposed to or participated in DRR and recovery awareness-raising events (campaigns, debates and trainings) and have these resulted in an improvement in their knowledge and practices?	Asunción Ixtaltepec
Description of levels		Characteristics of resilience	05
3	Awareness and long-term actions, but no strategy and not all aspects of the problem are addressed.	Some community members have been exposed to or participated in DRR/recovery awareness-raising events. These have resulted in some improved knowledge and practices.	x

Component 4: DRR education for children		Key question 4: Are DRR and recovery knowledge and capacities being passed on to children formally, through local schools, and informally, through oral tradition from one generation to the next?	Asunción Ixtaltepec
Description of levels		Characteristics of resilience	05
3	Awareness and long-term actions, but no strategy and not all aspects of the problem are addressed.	Some DRR knowledge and skills are being passed on through both oral tradition and local schooling, however local teachers have not been formally trained in DRR and recovery.	x

Component 5: DRR in Development Planning		Key Question 5: Is DRR seen by the community as an integral part of plans and actions to achieve broader community objectives (e.g. poverty alleviation, quality of life)?	Asunción Ixtaltepec
Level description		Characteristics of resilience	05
2	Some awareness / motivation and limited, fragmented and short-term actions.	The community sees the importance of DRR in achieving broader community objectives, but has not documented DRR actions in their local development plans (or there are DRR actions documented in the local development plan, but this is not used or is outdated).	x

Component 6: DRR in spatial planning		Key Question 6: Does community decision-making on land use and management take disaster risk into consideration?	Asunción Ixtaltepec
Description of levels		Resilience characteristics	05
3	Awareness and long-term actions, but no strategy and not all aspects of the problem are addressed.	The community has a land use plan that takes into consideration most aspects of disaster risk, but it is not supported/aligned with local/central government land-use planning and there are difficulties in its implementation.	x

Component 7: Community decision-making		Key Question 7: Is the community decision-making process effective and accountable?	Asunción Ixtaltepec
Description of levels		Characteristics of resilience	05
3	Awareness and long-term actions, but no strategy and not all aspects of the problem are addressed.	Community leaders have medium level of commitment and effectiveness, with more long-term actions, but these address only some aspects of the problem and are not part of a long-term strategy. Community leaders are occasionally accountable to others (e.g. only when dealing with big problems).	x

Component 8: Inclusion of vulnerable groups		Key Question 8: Are vulnerable groups included/represented in DRR and recovery decision-making and management in the community?	Asunción Ixtaltepec
Description of levels		Characteristics of resilience	05
2	Some awareness/motivation and limited, fragmented, short-term actions	Vulnerable groups occasionally participate/are represented in decision-making and management in DRR and community recovery. Community decisions and actions rarely address their needs and priorities.	x

Component 9: Women's participation		Key Question 9: Are women involved in decision-making and management of DRR and recovery in the community?	Asunción Ixtaltepec
Description of levels		Characteristics of resilience	05
4	Long-term actions linked to a strategy; the main aspects of the problem are addressed, but there are still shortcomings (especially systemic).	Women regularly and actively participate in decision-making and management in DRR and community recovery, and hold leadership positions in the decision-making body. Decisions and actions taken usually address most of the needs and priorities of women in the community.	x

Component 10: Income and asset protection		Key Question 10: Are household assets (income, savings and convertible assets) sufficiently large, diverse and protected to reduce vulnerability to disasters?	Asunción Ixtaltepec
Description of levels		Characteristics of resilience	05
2	Algo de conciencia/motivación y acciones limitadas, fragmentarias y de corto plazo.	Pocos hogares en la comunidad tienen una base de activos suficientemente extensa, diversa y protegida como para reducir la vulnerabilidad ante desastres (apoyada por capacidades de afrontamiento y/o de adaptación).	x

Component 11: Access to social protection		Key Question 11: Does the community have access to informal or formal protection schemes to support them in disaster risk reduction or recovery?	Asunción Ixtaltepec
Description of levels		Characteristics of resilience	05
3	CAwareness and long-term actions, but no strategy and not all aspects of the problem are addressed.	Community members can access both informal and formal social protection schemes; however these can only support some of the necessary aspects of risk reduction and recovery.	x

Component 12: Social cohesion and conflict prevention		Key Question 12: Is there a sense of peace/security and effective conflict prevention/mitigation mechanisms, both within the community and with other communities?	Asunción Ixtaltepec
Description of levels		Characteristics of resilience	05
4	Long-term actions linked to a strategy; the main aspects of the problem are addressed, but there are still shortcomings (especially systemic).	There is a sense of security and peace within the community members, with occasional tensions within the community and/or with other communities rarely escalating to violence and resolved in a peaceful and timely manner.	x

Component 13: Contingency and recovery planning		Key Question 13: Does the community use a contingency and recovery plan that has been jointly developed, is widely understood and includes measures to protect vulnerable groups?	Asunción Ixtaltepec
Description of levels		Characteristics of resilience	05
2	Some awareness/motivation and limited, fragmented and short-term actions.	The community has a contingency and recovery plan, but its content only addresses some of the major risks. The plan addresses the needs of very few vulnerable groups and few community members are aware of its contents. The plan has never been implemented (in drills) and updated.	x

Component 16: Leadership and volunteerism in response and recovery		Key Question 16: Does the community play a leadership role in coordinating preparedness, response and recovery, reaching out to all affected people (including the most vulnerable), through organised and trained volunteer corps?	Asunción Ixtaltepec
Description of levels		Characteristics of resilience	05
1	Little awareness/motivation and no action.	The community plays a passive role in preparedness, response and recovery, with the needs of the most affected and vulnerable people neglected. Community volunteering is either non-existent or negligible.	x

Component 14: Early Warning System		Key Question 14: Is there an Early Warning System (EWS) operational in the community?	Asunción Ixtaltepec
Description of levels		Characteristics of resilience	05
1	Little awareness/motivation and no action.	Due to local knowledge, the community knows when a threat is going to occur; but they do not (or cannot) take appropriate action.	x

Component 17: Critical Infrastructure		Key Question 17: Is the community's critical infrastructure and basic services disaster resilient (i.e. located in low-risk areas, using hazard-resistant construction methods and structural mitigation measures)?	Asunción Ixtaltepec
Description of levels		Characteristics of resilience	05
2	Some awareness/motivation and limited, fragmented and short-term actions.	Most critical infrastructure and basic services in the community are located in areas highly vulnerable to disasters. Little infrastructure is adequately protected (either by access to hazard-resistant construction, structural mitigation measures and/or by being located in low-risk areas).	x

Component 15: Preparedness and response capacity		Key Question 15: Is there a trained and operational disaster preparedness, response and early recovery organisation in the community?	Asunción Ixtaltepec
Description of levels		Characteristics of resilience	05
2	Some awareness/motivation and limited, fragmented and short-term actions.	There is a responsible community organisation (preparedness, response and early recovery) but its operational capacity is weak and only some of its members have been formally trained in preparedness, response and early recovery.	x

Component 18: Housing		Key Question 18: Is the housing in the community disaster-resilient (i.e. located in low-risk areas, using hazard-resistant construction methods and structural mitigation measures)?	Asunción Ixtaltepec
Description of levels		Characteristics of resilience	05
2	Some awareness/motivation and limited, fragmented and short-term actions.	Most of the houses in the community are located in areas highly vulnerable to disasters. Few of them are adequately protected against adverse events (*).	x

Component 21: Health access and awareness		Key Question 21: Do community members maintain good health services (through adequate food and nutrition, hygiene and health care) and are they aware of measures to stay healthy and protect life?	Asunción Ixtaltepec
Description of levels		Characteristics of resilience	05
3	Awareness and long-term actions, but no strategy and not all aspects of the problem are addressed.	Some people apply good practices to improve health and protect lives from health risks affecting the community. In general, health status is a good thing in the community.	x

Component 19: Sustainable environmental management		Key Question 19: Does the community adopt sustainable environmental and ecosystem management practices that reduce disaster risk and adapt to risks related to climate variability and change?	Asunción Ixtaltepec
Description of levels		Characteristics of resilience	05
3	Long-term awareness and actions, but no strategy and not all aspects of the problem are addressed.	The community employs longer-term environmental management practices to protect the environment from degradation and the negative effects of climate change. However, these measures only address some aspects of the problem and are not part of a long-term strategy.	x

Component 22: Safe food supply		Key Question 22: Does the community maintain a safe and sufficient food supply?	Asunción Ixtaltepec
Description of levels		Characteristics of resilience	05
5	Long-term actions are linked to a strategy and address all aspects of the problem; actions are sustainable and integrated into society.	All households have or can access safe and sufficient food supplies during disasters as well as in normal times.	x

Component 23: Hazard-resilient livelihoods practice		Key Question 23: Does the community apply resilient livelihood practices for food and income security?	Asunción Ixtaltepec
Description of levels		Characteristics of resilience	05
3	Awareness and long-term actions, but no strategy and not all aspects of the problem are addressed.	Most community members adopt resilient livelihood practices to more numerous and longer-term adverse events; however these are insufficient and/or not part of a long-term strategy. Some significant post-disaster impact remains likely.	x

Component 20: Water supply and water supply and management		Key Question 20: Does the community have access to sufficient quantity and quality of water for consumption as well as for domestic and productive needs?	Asunción Ixtaltepec
Description of levels		Characteristics of resilience	05
5	Long-term actions are linked to a strategy and address all aspects of the problem; actions are sustainable and integrated into society.	The community can access sufficient water quality and quantity, both in normal times and in emergency situations, as a result of the long-term strategy and practices, fully supported by the authorities in water management.	x

Component 24: Market access		Key Question 24: Are local market links for products, employment and services protected against adverse events?	Asunción Ixtaltepec
Description of levels		Characteristics of resilience	05
2	Some awareness/motivation and limited, fragmented and short-term actions.	Most of the local market linkages on which the community depends are extremely vulnerable to adverse events. Fragmented and insufficient measures are in place for their protection and restoration from adverse events.	x

Component 25: Partnerships for DRR and recovery		Key Question 25: Are there clear, agreed and stable partnerships between the community and other actors (local authorities, NGOs, businesses, etc.) that provide resources for DRR and recovery?	Asunción Ixtaltepec
Description of levels		Characteristics of resilience	05
3	Awareness and long-term actions, but no strategy and not all aspects of the problem are addressed.	Partnerships exist with external actors, which provide funds/resources for long-term DRR and recovery actions. However, these are unstable in their frequency and not linked to a long-term plan for DRR and recovery.	x

Component 26: Access to financial services		Key Question 26: Are there accessible and flexible financial services, whether formal or informal (savings and credit schemes, micro-finance)?	Asunción Ixtaltepec
Description of levels		Characteristics of resilience	05
3	Awareness and long-term actions, but no strategy and not all aspects of the problem are addressed.	Community members have access to financial services. However, these are only able to finance some necessary aspects of risk reduction and recovery actions.	x

Component 27: Access to health services during emergencies		Key Question 27: Does the community have access to health services and health workers who are well equipped and trained to respond to the physical or mental health consequences of disasters?	Asunción Ixtaltepec
Description of levels		Characteristics of resilience	05
3	Awareness and long-term actions, but no strategy and not all aspects of the problem are addressed.	There is an accessible health centre staffed with health personnel, medicines and basic equipment. Services (including outreach and referrals) are not sufficient for all health problems during emergencies and are partially consistent with the relevant national strategy for emergencies.	x

Component 28: Education services in emergencies		Key Question 28: Do education services have the capacity to continue operating during emergencies?	Asunción Ixtaltepec
Description of levels		Characteristics of resilience	05
2	Some awareness/motivation and limited, fragmented and short-term actions.	Education services usually experience widespread disruption as a result of adverse events. The community is aware and motivated to act, but measures to ensure continuity of education services are sporadic and fragmented.	x

Component 29: Emergency infrastructure		Key Question 29: Are emergency shelters (purpose-built or modified) accessible to the community and with adequate facilities for the entire affected population?	Asunción Ixtaltepec
Description of levels		Characteristics of resilience	05
4	Long-term actions linked to a strategy; the main aspects of the problem are addressed, but there are still shortcomings (especially systemic).	In addition to the homes of relatives and neighbours, the community has a structure that serves as a shelter during emergencies with adequate conditions to meet the basic needs of most of the affected people and protect most of the vulnerable groups during emergencies.	x

Component 30: Knowledge of rights and advocacy		Key Question 30: Does the community know their rights, the relevant legal mechanisms and the actors responsible for their fulfilment, and do they advocate for them?	Asunción Ixtaltepec
Description of levels		Characteristics of resilience	05
2	Some awareness/motivation and limited, fragmented and short-term actions.	The community has some awareness of their rights, the relevant legal mechanisms and the actors responsible for their enforcement, but takes little or no advocacy action.	x

Table 6 Results of Section B of the ARC-D tool

The questions in this section were designed and adapted to the variables of Community Resilience and Vulnerability. For each question there were five possible answers, which correspond to the "level of resilience", ranked from 1 to 5, (where 1 indicates minimum resilience and 5 indicates maximum resilience). The following table specifies each level and can be used as a percentage or as a level of resilience.

%	Level	CATEGORY
0-20	1	Low Resilience
21-40	2	Low Resilience
41-60	3	Medium Resilience
61-80	4	Resilience
81-100	5	High Resilience

Table 7 Resilience level
Source: GOAL, 2015

It can be concluded for the Municipality of Asunción Ixtaltepec that the level of community resilience to natural disasters is between the category of Low and Medium Resilience, since of the 30 components, 12 were located at level 3; 10 at level 2; 3 at levels 1 and 4 and finally 2 at level 5.

Therefore, the community should place emphasis in the Community Resilience Plan on those components that prevent reaching at least the level of resilience (4) in the medium term, in order to achieve the benefit of the population in general, given that there are external factors (beyond its control) related to the geographical location of Asunción Ixtaltepec, which make the community highly vulnerable to natural disasters and community resilience plays a fundamental role in these cases.

As confirmed in their studies by Kates (1970) and Rubiano (2209) apud Canese et al., (2022), the contribution of the social sciences to disaster management studies has made it possible to understand the social and cultural problems that accompany disasters, in order to guide the management, action, participation and education of citizens. In this sense, Casarrubia (2020) apud Canese et al., (2022), states that risk management has been approached from a macro approach, where the local dimension and citizen participation are not considered. Agreeing with Casarrubia, Durán Vargas points out that local management is an "option for direct action on the most concrete conditions of insecurity in communities and that it acts on the capacities and resilience that the history and social reality of the community builds".

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