

## Socioeconomic Resilience of Fishing Communities During the COVID-19 Pandemic: A Case Study in Puerto Vallarta, Mexico



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### ABSTRACT

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The COVID-19 pandemic had significant socioeconomic consequences for fishing communities in Mexico, affecting both livelihoods and food security. In the state of Jalisco, the crisis led to reduced fishery production, increased unemployment, and the exposure of long-standing structural vulnerabilities in coastal communities. This study evaluates the socioeconomic resilience of fishing communities in Puerto Vallarta in response to the impacts of COVID-19. A retrospective cross-sectional survey was conducted with 42 fishermen from eight fishing cooperatives. Socioeconomic resilience was assessed using a composite index based on 21 indicators grouped into four dimensions: social, economic, mitigation–adaptation, and environmental. The results show substantial vulnerabilities, particularly in the economic and mitigation–adaptation dimensions, including income loss, unemployment, limited access to healthcare, low income diversification, and limited institutional participation. Although some adaptive capacity was observed, mainly through prior disaster experience, overall preparedness and collective adaptive capacity remained limited. Strengthening institutional support, promoting income diversification, and improving public policy will be essential to enhance resilience in future crises. The study presents a multidimensional resilience assessment applied to fishing communities in Puerto Vallarta and provides context-specific evidence to inform resilience assessments in similar small-scale fishing communities.

## 1. INTRODUCTION

The COVID-19 pandemic, declared a global health emergency by the World Health Organization (WHO) in March 2020, profoundly disrupted health systems, economies, and livelihoods worldwide. In Latin America and the Caribbean, the socioeconomic consequences were particularly severe, with poverty increasing by 13.5% and extreme poverty rising by 34.7% as a result of the socioeconomic fallout [1, 2].

Mexico was also significantly affected by these impacts. In 2020, the national Gross Domestic Product (GDP) contracted by 8.2%, and more than 13 million people lost their jobs. Small and medium-sized enterprises were particularly vulnerable to closures and mobility restrictions [3]. Within this broader context of economic contraction, the fisheries sector was among the most affected, despite its critical role in supporting food security, employment, and cultural identity in coastal regions such as Jalisco [4].

Before the pandemic, the fishing sector in Mexico had already shown signs of fragility. In 2018, the national production value reached 41,728 million pesos. By 2020, that

figure had fallen to 18,135 million pesos. In Jalisco alone, production decreased from 990 million pesos in 2018 to just 164 million pesos in 2020 [5]. At the state level, approximately 14,274 people directly depend on artisanal fishing in coastal municipalities [6]. These communities face long-standing structural challenges such as limited infrastructure, low household income, and restricted access to essential services [7].

Globally, small-scale fisheries were among the sectors hardest hit by the pandemic. Studies reported a sharp decline in catch volumes, market access, and income, along with increased food insecurity in many coastal communities [8-12]. Previous research has also highlighted the structural vulnerability of fisheries-dependent economies to environmental and socioeconomic shocks, emphasizing the importance of resilience-building strategies in coastal communities [13]. In Mexico, similar patterns emerged among artisanal fishers, revealing limited access to institutional support and weak social protection systems [14, 15].

These impacts were particularly pronounced in rural coastal areas, where many fishing families already lived in conditions

of vulnerability. Within this context, assessing and strengthening socioeconomic resilience—understood as the ability of communities to absorb, adapt to, and recover from adverse events—has become essential for promoting inclusive recovery and long-term sustainability [16, 17]. International frameworks, such as the Sendai Framework for Disaster Risk Reduction (2015–2030), have underscored the importance of resilience in local development planning [18].

## 2. MATERIALS AND METHODS

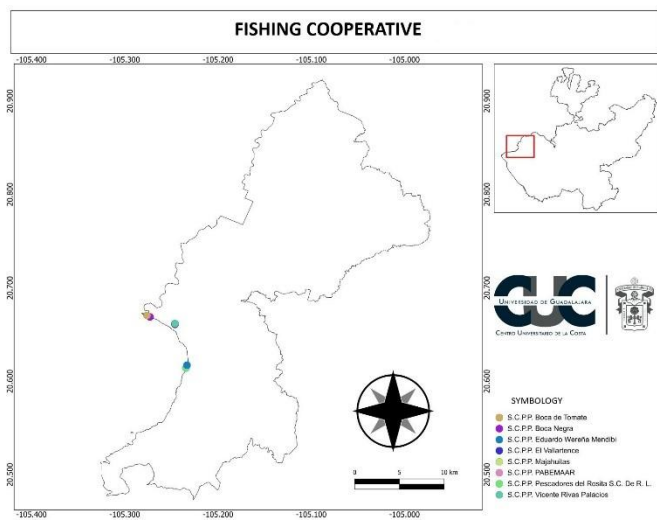
### 2.1 Study design

This study employed a retrospective cross-sectional survey design. Data were collected between January 2023 and December 2024, during which participants were asked to recall socioeconomic impacts experienced during the COVID-19 pandemic period (March 2020 to December 2021). The study focused on eight officially registered fishing cooperatives operating in Puerto Vallarta, Jalisco, Mexico.

To improve recall accuracy, respondents were encouraged to reflect on specific pandemic-related events, including government-imposed lockdowns, tourism shutdowns, and temporary interruptions in fishing cooperative activities.

These cooperatives are composed primarily of artisanal fishers who depend on marine resources as their main source of livelihood (Figure 1).

This design allowed the study to capture retrospective perceptions of the socioeconomic impacts experienced by fishing communities during the pandemic.



**Figure 1.** Location of fishing cooperatives in the municipality of Puerto Vallarta, Jalisco

### 2.2 Study population and sampling

The target population consisted of active members from the eight fishing cooperatives. Due to logistical limitations, transportation barriers, and the need to respect local rhythms and availability, a non-probability convenience sampling strategy was adopted. A total of 42 fishermen agreed to participate voluntarily in the survey. All participants were informed of the objectives of the study and their rights, and participation was anonymous and confidential.

### 2.3 Survey instrument

A structured questionnaire was designed to evaluate socioeconomic resilience based on 21 indicators, grouped into four dimensions: social, economic, mitigation-adaptation, and environmental. The questionnaire included items related to income stability, employment disruption, healthcare access, adaptive experiences, institutional support, and environmental awareness.

### 2.4 Data collection

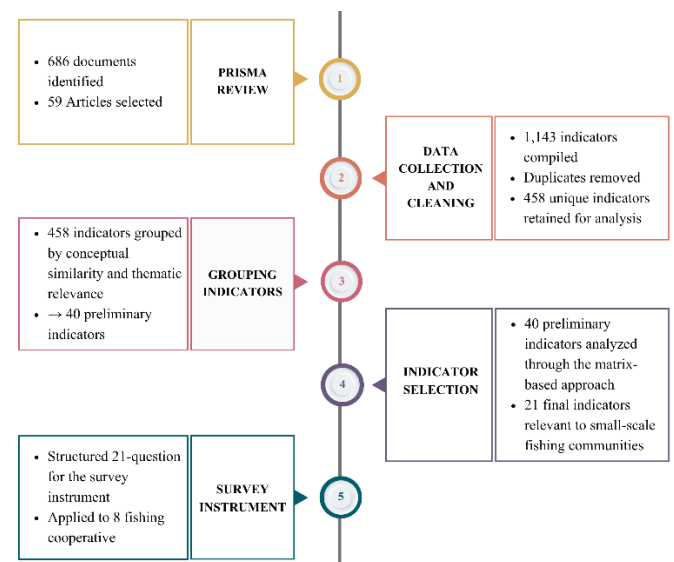
Face-to-face interviews were conducted directly with the fishermen at their cooperative facilities. All participants voluntarily agreed to participate and completed the full survey. Each interview lasted approximately 30 to 45 minutes. To preserve the integrity of the responses, interviews were conducted individually and in settings that allowed for privacy and comfort.

### 2.5 Resilience scoring methodology

Socioeconomic resilience was assessed through a composite index constructed from 21 indicators, grouped into four dimensions: social, economic, mitigation-adaptation, and environmental.

The selection and structuring of indicators followed the multidimensional resilience framework proposed by Hafsi et al. [19], which conceptualizes resilience through interrelated capacities such as resistance, absorption, adaptation, and recovery, and guided the organization of indicators into analytical dimensions (Figure 2).

All indicators were assigned equal weight in the construction of the resilience index, as no prior empirical evidence was available to justify differential weighting among indicators. Equal weighting is commonly used in composite index construction to maintain methodological transparency and avoid subjective bias in indicator importance.



**Figure 2.** Indicator selection and structuring process

In the first phase, a systematic literature review was conducted using the PRISMA approach. Searches were performed in the Scopus and Web of Science databases using the keywords “pandemic”, “indicators”, “resilience”, and

“fishing”. The initial search identified 686 documents, which were screened based on language (English and Spanish), document type (articles, book chapters, and reviews), and relevance to resilience indicators. After removing duplicates and applying eligibility criteria, 59 documents were selected for further analysis.

In the second phase, a content analysis of the selected documents was conducted to extract resilience indicators. A total of 1,143 indicators were initially identified and subsequently consolidated into 458 unique indicators. These indicators were grouped according to conceptual similarities and reduced to 40 preliminary indicators. After evaluating their relevance to the context of small-scale fishing communities and pandemic-related impacts, 21 indicators were selected for the final assessment, see Table 1.

The final selection of indicators was conducted through a matrix-based approach integrating key conceptual components of socioeconomic resilience for fishing communities facing pandemic-related threats. These components were operationalized into specific variables reflecting the characteristics of the disturbance, the capacities of resilience, and the structural conditions of fishing communities. The set of key components used in this process is presented in Appendix A.

**Table 1.** Indicator selection framework

Indicators	Component 1	Component 2	...
Indicator 1	X		...
Indicator 2		X	...
Indicator 3	X	X	...
...	...	...	...

This approach allowed for the systematic exclusion of indicators that did not align with these components and the retention of those consistent with the study context and objectives.

The organization of indicators into dimensions was guided by the multidimensional resilience framework proposed by Hafsi [19], which considers three main domains, social, economic, and institutional, each further divided into two sub-dimensions: social, environmental, economic, infrastructural, institutional, and capacity management. For the present study, this framework was adapted to focus on social and economic capacities, complemented by mitigation–adaptation and environmental dimensions, reflecting the scope of selected indicators and the measurement scale applicable to small-scale fishing communities.

Based on these indicators, a structured questionnaire containing 21 questions was developed and administered to fishermen from eight fishing cooperatives in Puerto Vallarta.

Each indicator was scored on a five-point ordinal scale (0–4), where 0 represents the lowest level of resilience and 4 the highest.

The Resilience Index (RI) for each participant was calculated by summing the scores obtained across all indicators and standardizing the result as a percentage of the maximum possible score. The index was calculated as follows:  $RI = (\Sigma X / 4N) \times 100$ , where  $\Sigma X$  represents the sum of the scores obtained across the 21 indicators,  $N$  is the total number of indicators, and 4 corresponds to the maximum value of the scoring scale. This standardization allowed the resilience index to be expressed as a percentage, facilitating comparisons among participants and across resilience dimensions (Table 2).

To interpret the RI, participants were classified into five resilience levels based on their average scores per indicator, corresponding to specific percentage ranges of the maximum possible score. The classification was as follows:

**Table 2.** Resilience index classification based on indicator scores

Level	Score %	Interpretation
Very Low	0–19%	Severe difficulties in coping with disruptions and limited adaptive capacity.
Low	20–39%	Reflecting vulnerability to changes and partial ability to manage challenges.
Moderate	40–59%	Capacity to manage some challenges but remaining susceptible to larger disruptions.
Moderately High	60–79%	Ability to handle most situations and maintain performance under stress.
High	80–100%	Strong adaptive capacity and the ability to maintain control and performance under most adverse conditions.

This classification provides a standardized framework for interpreting resilience scores, enabling both individual-level assessment and comparisons across participants or resilience dimensions.

### 3. RESULTS

The analysis of the 42 fishermen surveyed provided a multidimensional overview of the socioeconomic resilience of fishing communities in Puerto Vallarta during the COVID-19 pandemic. The results of the resilience assessment are described below according to the four dimensions considered in the study: social, economic, mitigation–adaptation, and environmental. The indicators used to construct the socioeconomic resilience index are presented in Table 3.

**Table 3.** Indicators included in the socioeconomic resilience index

Dimension	Indicators (N)
	Age
	Education level
	Household dependents
Social	Health coverage
	Disability discrimination
	Gender discrimination
	Indigenous discrimination
	Food security
Economic	Income stability
	Financial protection
	Housing conditions
	Unemployment during pandemic, Income diversification
	Job availability perception
Mitigation–adaptation	Participation in public consultations
	Disaster experience
	Risk management training
	Community support networks
Environmental	Knowledge of protected areas; Knowledge of fishing bans
	Ecosystem health perception

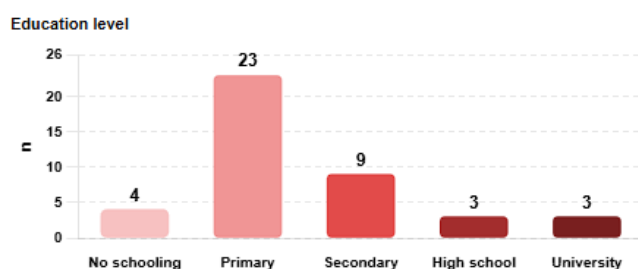
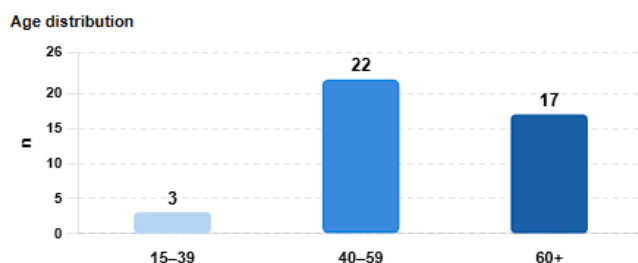
### 3.1 Social dimension: Vulnerability and protection gaps

The social dimension reflects structural and demographic vulnerabilities within the fishing community, including age structure, education level, household composition, access to health coverage, discrimination, and food security.

The age distribution indicates a predominantly older workforce: 52% of respondents were between 40 and 59 years old, 40% were 60 or older, and only 7% were under 40. This demographic structure contributed to a low resilience score for the age indicator (33.3%), as older fishers generally face greater difficulty adapting to sudden economic and health-related disruptions, see Table 4 and Figure 3.

**Table 4.** Social dimension results by indicator

Indicator	N	Score	Level
Age	42	33.3%	Low
Education level	42	36.9%	Low
Household dependents	42	47.0%	Moderate
Health coverage	42	40.5%	Moderate
Disability discrimination	5	100.0%	High
Gender discrimination	2	100.0%	High
Indigenous discrimination	3	100.0%	High
Food security	42	40.5%	Moderate



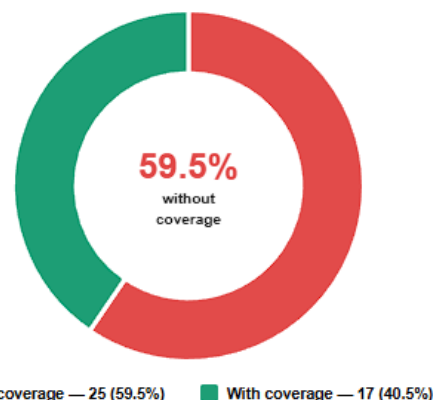
Source: fieldwork survey, Puerto Vallarta (N=42)

**Figure 3.** Demographic characteristics of participants (age and education level)

Education levels were also low, with 55% of respondents having only completed primary school, 10% reporting no formal education, and just 7% holding a university degree. This resulted in a score of 36.9%, reflecting structural limitations in accessing alternative employment opportunities and institutional support programs.

Household composition showed mixed conditions: 33% of respondents reported more than three dependents, while 24% reported none. This score (47.0%) reflects a heterogeneous reality where financial pressure from large households coexists with greater household autonomy in others (Figure 4).

Health coverage emerged as a major gap, with 59.5% of respondents lacking affiliation to any health or social security institution, leaving a significant share of the community without formal safety nets during the pandemic.



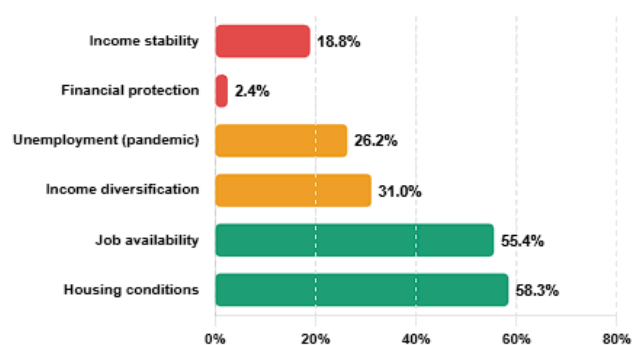
**Figure 4.** Health coverage among participants

The three discrimination-related indicators disability (N = 5), gender (N = 2), and indigenous identity (N = 3) all recorded a perfect score of 100.0%, as no respondent reported experiencing discrimination within their professional context. While these results are positive, they should be interpreted with caution given the small subgroup sizes. Food security returned to a moderate score of 40.5%, with 57% of respondents having experienced some form of food shortage during the pandemic, a direct indicator of how quickly the economic disruption translated into basic needs vulnerability.

Overall, the social dimension reached a moderately high level (62.3%), driven upward by the absence of reported discrimination. However, the underlying structural indicators age, education, and health coverage remain in the Low range, pointing to persistent vulnerabilities that pre-date the pandemic.

### 3.2 Economic dimension: Economic impact on income and limited diversification

The economic dimension assesses the financial resilience of fishers, examining income stability, financial protection mechanisms, housing conditions, unemployment, income diversification, and perceived job market conditions.

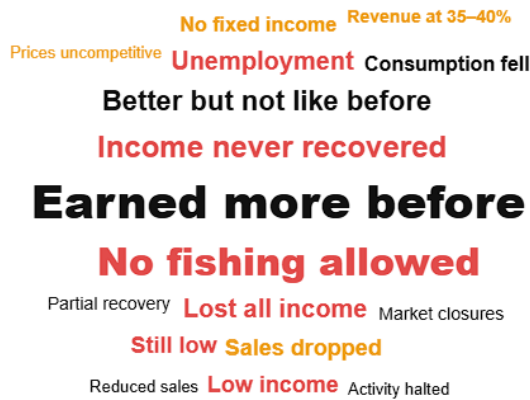


**Figure 5.** Economic dimension results by indicator

The economic dimension represented the most critical vulnerability identified in the study. Income stability scored 18.8% (very low), reflecting the severe impact of the pandemic on fishers' earnings.

Of the 40 respondents who addressed this question, the vast majority described a sharp decline in income during the pandemic that had not fully recovered by the time of the survey with descriptions ranging from a 60–65% income reduction to

the total loss of fishing activity during lockdown periods (Figure 5).



**Figure 6.** Fishers' perceptions of pandemic impact on income and activity

Only 6 respondents reported stable income throughout, and 2 described their situation as broadly positive.

The most critical finding in this dimension is the financial protection score of just 2.4% (very low), the lowest recorded across all 21 indicators in the study. Of 42 respondents, only 1 reported having any form of financial insurance or savings mechanism. This near-total absence of financial buffers meant that when income collapsed, fishers had no institutional or personal safety net to fall back on, directly amplifying their economic vulnerability during the pandemic (Figure 6).

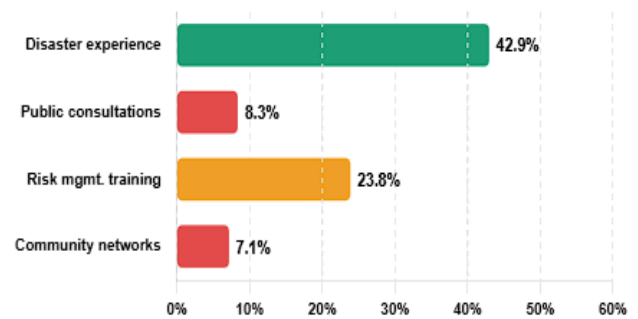
Housing conditions provided some relative stability, with 38% of respondents owning their homes, 38% renting, and 24% living in borrowed housing, resulting in a moderate score of 58.3%. Unemployment during the pandemic was reported by 74% of respondents (31 out of 42), reflecting the severity of activity restrictions imposed on the fishing sector (score: 26.2%). Income diversification was limited, with only 31% of fishers reporting a secondary economic activity, resulting in a low score of 31.0%. Perceived jobs availability produced a moderate score of 55.4%.

Overall, the economic dimension scored 32.0%, corresponding to a low resilience level. The combination of income instability and the near-total absence of financial protection represents the most significant vulnerability identified in this study.

### 3.3 Mitigation-adaptation dimension: Limited adaptive capacity

The mitigation-adaptation dimension evaluates the community's capacity to anticipate, prepare for, and respond to disruptive events, through prior disaster experience, institutional participation, formal training, and community support structures.

This dimension showed the greatest variability among the four analyzed dimensions. Prior disaster experience scored at a moderate 42.9%, with 43% of respondents reporting previous experience with events such as hurricanes or severe storms. This experience provides some informal adaptive knowledge within the community. Risk management training scored 23.8% (low-medium), with only 24% of respondents having completed formal training in epidemiological or emergency preparedness measures reflecting limited individual preparedness within the community (Figure 7).



**Figure 7.** Mitigation-adaptation dimension results by indicator

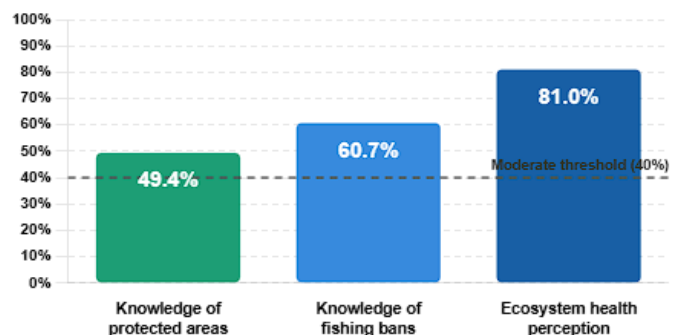
However, institutional participation and collective organization were extremely limited. Participation in public consultations or meetings with public institutions scored only 8.3% (very low): 86% of respondents reported never having participated in any such forum, with only 4 respondents indicating occasional participation and 2 reporting near-regular attendance. Community support networks fared even worse at 7.1% (very low) the second-lowest score across all indicators with 93% of respondents not belonging to any neighborhood support group, civil society organization, or similar collective structure.

These findings reveal a uniformly low adaptive capacity across all four indicators, with no single indicator exceeding the Moderate threshold. Overall, the mitigation-adaptation dimension scored 20.5% (very low), indicating limited institutional engagement, weak collective organization, and low levels of formal preparedness, leaving the community highly vulnerable to future disruptions.

### 3.4 Environmental dimension: Knowledge and discrepancy in perception

The environmental dimension assesses the extent to which fishers possess and apply ecological knowledge, as well as their perception of the health of the marine ecosystems on which their livelihoods depend.

Despite containing only three indicators, the environmental dimension reveals a significant and policy-relevant divergence. Knowledge of protected fishing areas scored 49.4% (moderate) and knowledge of species subject to fishing bans scored 60.7% (moderate-high): the majority of respondents demonstrated awareness of at least one protected zone and could identify regulated species, reflecting a meaningful level of local ecological knowledge embedded in the daily practice of fishing (Figure 8).



**Figure 8.** Environmental dimension results by indicator

In contrast, perception of ecosystem health scored 81% (high). When asked whether the marine environment where they fish maintains a healthy ecosystem and adequate resource availability, most respondents (79%) answered affirmatively, reflecting a broadly positive perception of ecosystem health among fishers. It is nonetheless worth noting that some respondents who answered affirmatively also described signs of degradation or resource pressure in their open-ended comments, suggesting that the positive categorical response may coexist with more nuanced perceptions of ecosystem health in daily practice.

The overall moderate-high score (63.7%) for the environmental dimension reflects both strong ecological knowledge and a broadly positive ecosystem perception, making it the second highest-scoring dimension after social. Nevertheless, the qualitative nuances identified in open-ended responses highlight the importance of monitoring long-term resource sustainability as a core component of fishing community resilience.

### 3.5 Overall resilience levels: A mixed scenario

The resilience profile across the four dimensions indicates that the community faces significant structural vulnerabilities, particularly in the economic and mitigation–adaptation dimensions. The economic dimension scored 32.0% and the mitigation–adaptation dimension 20.5%, both falling in the low or very low range. In contrast, the social dimension reached 62.3% and the environmental dimension 63.7%, both in the moderate-high range, although the social score must be interpreted with caution.

household dependents at 47.0%, and food security at 40.5% averaging around 39.6%, which lands squarely in moderate, not moderate-high. The absence of reported discrimination is a positive finding, but it should not mask the structural fragility of the community's demographic and social protection profile.

The economic dimension (32.0%, low-medium) represents the most critical vulnerability, driven by the near-total absence of financial protection (2.4%) and income instability (18.8%). The mitigation–adaptation dimension (20.5%, very low) reveals uniformly low scores across all indicators disaster experience (42.9%), public consultations (8.3%), risk management training (23.8%), and community networks (7.1%) pointing to a community with limited capacity to anticipate or respond collectively to crisis situations, see Figure 9.

Finally, the environmental dimension (63.7%, moderate-high) reflects strong ecological knowledge of protected areas (49.4%) and fishing bans (60.7%) combined with a broadly positive perception of ecosystem health (81%), positioning it as the second strongest dimension in the resilience profile.

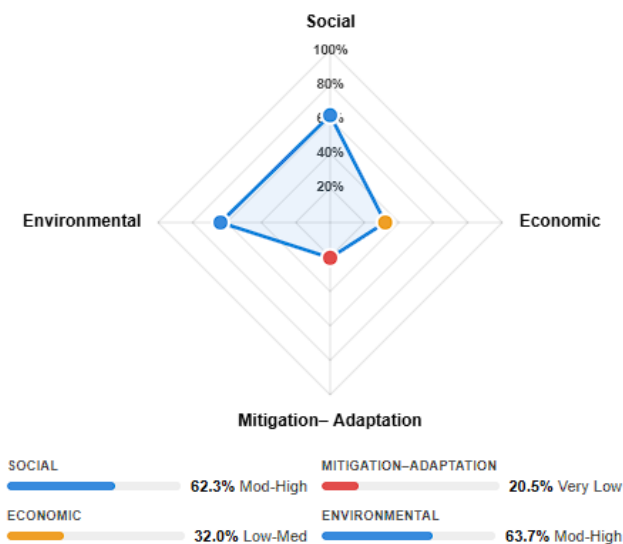
## 4. DISCUSSION

The results of this study indicate that fishing communities in Puerto Vallarta experienced significant socioeconomic vulnerabilities during the COVID-19 pandemic, particularly in the economic and mitigation–adaptation dimensions. The multidimensional resilience assessment shows that while environmental awareness and certain social factors provided partial resilience, structural economic fragility and limited institutional participation significantly reduced the overall adaptive capacity of the community.

The COVID-19 pandemic had a substantial socioeconomic impact on artisanal fishing communities in Puerto Vallarta. The reductions in income, job losses, and food insecurity identified in this study are consistent with previous reports describing the disproportionate effects of the pandemic on vulnerable sectors and informal workers in Latin America [1, 2]. Within the fisheries sector, disruptions in supply chains and restricted market access critically affected livelihoods, particularly for small-scale fishers who often lack financial reserves or institutional protection [3, 4].

The significant income reductions, widespread unemployment, and limited financial protection observed in this study are also consistent with economic impacts reported in other coastal communities in Mexico and Latin America during the pandemic [4, 5]. The fragility of the informal economy in small-scale fisheries, combined with market closures and the decline in tourism, directly contributed to the deterioration of household economic stability [20].

From a social perspective, factors such as limited education, lack of health coverage, and food insecurity represent long-standing structural vulnerabilities in coastal communities, even prior to the pandemic [6-8]. These preexisting conditions exacerbated the challenges faced by fishers during the crisis and significantly limited their capacity for autonomous recovery. Additionally, the presence of disabilities and the representation of marginalized groups within the population further increased levels of social vulnerability. However, although the social dimension recorded the highest resilience score (62.3%), this result is partly inflated by three discrimination-related indicators—disability, gender, and indigenous identity—which were administered exclusively to



**Figure 9.** Graphical representation of the levels of resilience by dimension

The social dimension (62.3%, moderate-high) must be interpreted with caution. Three discrimination indicators disability, gender, and indigenous identity score at 100%, as they were only administered to the respondents directly concerned: the 5 fishers reporting a disability, the 2 women in the sample, and the 3 individuals identifying as indigenous. These three perfect scores mathematically pull the entire dimension up. When restricted to the five indicators applicable to all 42 fishers, the social scores drop significantly: age at 33.3%, education at 36.9%, health coverage at 40.5%,

the respondents directly concerned (5, 2, and 3 individuals respectively, being the only ones affected by these conditions). The absence of reported discrimination among these subgroups, while a positive finding, should not obscure the structural vulnerabilities present across the full sample, where age, education, household dependents and health coverage all remain in the low-medium range. These social vulnerabilities were compounded by the severe economic fragility documented in the study, characterized by the near-total absence of financial protection (2.4%) and the collapse of income stability (18.8%), which together represent the most acute vulnerability profile identified across all dimensions.

Although some fishers demonstrated adaptive responses, including prior experience with natural hazards and limited income diversification strategies, these mechanisms proved insufficient to ensure comprehensive resilience. Similar patterns have been documented in other studies, where disaster experience may provide short-term coping strategies but does not substitute for structural support or long-term risk reduction policies [9, 10]. Previous research on community resilience suggests that adaptive capacity depends not only on past experiences with shocks but also on the presence of institutional support and long-term development strategies that strengthen the social and economic foundations of vulnerable communities [21]. This pattern is particularly evident in the mitigation–adaptation dimension, where all four indicators fall below the moderate threshold. Risk management training scored only 23.8%, public consultation participation 8.3%, and community support networks 7.1% all in the very low or low-medium range. The overall dimension score of 20.5% (very low) reflects a community that lacks both individual preparedness and collective adaptive structures, leaving it highly exposed to future disruptions.

In contrast, the environmental dimension emerged as a relative strength within the resilience profile. Environmental awareness among fishers was relatively high, particularly regarding fishing bans and marine protected areas, with knowledge of protected fishing areas scored 49.4% (moderate) and knowledge of species subject to fishing bans scored 60.7% (moderate-high). However, this knowledge, combined with a broadly positive perception of ecosystem health (81.0%), suggests a community with meaningful environmental awareness, though qualitative comments indicate that localized concerns about resource pressure persist, reflecting a well-documented gap between environmental knowledge and behavior change in resource-dependent communities [11]. Overall, the environmental dimension scored 63.7% (moderate-high), making it the second strongest dimension in the resilience profile alongside social.

The results also reinforce the relevance of international frameworks such as the Sendai Framework for Disaster Risk Reduction, which emphasizes the need for multisectoral approaches to strengthen resilience in vulnerable sectors such as artisanal fisheries [18]. In this context, strengthening institutional support mechanisms, expanding social safety nets, and promoting income diversification remain critical priorities for enhancing the resilience of fishing communities facing future crises.

Finally, this study provides localized empirical evidence from fishing communities in Puerto Vallarta and applies a multidimensional resilience index based on 21 indicators to evaluate socioeconomic resilience during the COVID-19 pandemic. The results should be interpreted within the methodological and geographical boundaries of the study,

particularly considering the use of convenience sampling and the retrospective nature of the survey. Therefore, the findings cannot be generalized to all fishing communities but should be understood as an assessment within the specific context of the surveyed cooperatives. Rather than presenting universal conclusions, this study supports and extends existing evidence on the vulnerability and adaptive capacity of small-scale fishing communities facing socioeconomic shocks.

## 5. CONCLUSIONS AND RECOMMENDATIONS

The findings of this study indicate that the socioeconomic resilience of fishing communities in Puerto Vallarta during the COVID-19 pandemic was significantly constrained by structural vulnerabilities, particularly in the economic and mitigation–adaptation dimensions. Income loss, unemployment, limited financial protection, lack of health coverage, and food insecurity reduced the community's capacity to cope with the crisis. The limited diversification of income sources further increased dependence on fishing and exposure to external economic shocks.

Beyond economic fragility, the mitigation–adaptation dimension revealed consistently low adaptive capacity across all indicators. Prior disaster experience (42.9%) was the only indicator reaching the moderate threshold, while risk management training (23.8%), public consultation participation (8.3%), and community support networks (7.1%) remained critically low, reflecting a community with insufficient individual and collective resources to respond effectively to large-scale crises.

Strengthening resilience in these communities requires institutional reforms aimed at:

- I. Expanding access to social protection and healthcare services.
- II. Promoting income diversification programs that reduce dependence on fishing.
- III. Enhancing environmental education to reinforce conservation practices within fishing activities.
- IV. Strengthening collective adaptive structures, including community networks and participatory governance mechanisms, to translate individual preparedness into coordinated community resilience.
- V. Incorporating disaster risk reduction strategies aligned with international frameworks such as the Sendai Framework for Disaster Risk Reduction.

This study contributes to the literature by providing local empirical evidence on socioeconomic resilience in small-scale fishing communities and by applying a multidimensional resilience index integrating social, economic, environmental, and mitigation–adaptation indicators. However, the findings should be interpreted within the limitations of the study, particularly the use of convenience sampling and the retrospective nature of the survey. Future research could apply similar methodologies using probabilistic sampling, larger sample sizes, and comparative regional analyses to improve representativeness and strengthen resilience assessments in coastal communities.

### 5.1 Limitations

This study has several limitations that should be acknowledged. Because the sample was obtained through

convenience sampling and included only 42 participants from eight fishing cooperatives, the findings cannot be generalized to the entire population of fishers in Puerto Vallarta. Cooperative-level representation may therefore be uneven, and results should be interpreted as exploratory.

In addition, the survey relied on retrospective recall of events during the COVID-19 pandemic period. As a result, responses may be subject to recall bias, as participants may overestimate or underestimate the severity of the socioeconomic impacts experienced between 2020 and 2021. However, the use of contextual recall aids such as references to lockdown periods, tourism shutdowns in Puerto Vallarta, and temporary interruptions of cooperative activities helped mitigate this limitation.

Future studies could consider larger samples and probabilistic sampling strategies, such as stratified sampling by cooperative, to improve representativeness and strengthen resilience assessments in small-scale fishing communities.

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## REFERENCES

[1] WHO. (2020). WHO Director-General's opening remarks at the media briefing on COVID-19—11 March 2020. <https://www.who.int/director-general/speeches/detail/who-director-general-s-opening-remarks-at-the-media-briefing-on-covid-19---11-march-2020>, accessed on Jan. 11, 2026.

[2] CEPAL, Economic Commission for Latin America and the Caribbean. (2022). *Panorama Social de América Latina 2021*. Santiago: Economic Commission for Latin America and the Caribbean. <https://www.cepal.org/es/publicaciones/47718-panorama-social-america-latina-2021>, accessed on Dec. 3, 2025.

[3] INEGI, Instituto Nacional de Estadística y Geografía. (2023). *Monitoring Development Indicators in Jalisco*. <https://mide.jalisco.gob.mx/mide/panelCiudadano/detall eIndicador/4>, accessed on Jan. 11, 2026.

[4] CONAPESCA. (2021). *Comisión Nacional de Acuicultura y Pesca Statistical Yearbook of Fisheries and Aquaculture 2020*. Government of Mexico. <https://www.gob.mx/conapesca/documentos/anuario-estadistico-de-pesca>, accessed on Dec. 3, 2025.

[5] SADER, Secretaría de Agricultura y Desarrollo Rural. (2019). *Program for the Promotion of Fisheries and Aquaculture Productivity 2019*. Government of Mexico. <https://www.gob.mx/sader/documentos/programa-de-fomento-a-la-productividad-pesquera-y-acuicola-2019>, accessed on Jan. 11, 2026.

[6] SAGARPA, Secretaría de Agricultura, Ganadería, Desarrollo Rural, Pesca y Alimentación. (2018). *National Fisheries and Aquaculture Program 2014–2018*. <https://www.gob.mx/cms/uploads/attachment/file/33441>

1/ProgramaNalPyA.pdf, accessed on Dec. 3, 2025.

[7] FAO. (2020). The state of world fisheries and aquaculture. <https://doi.org/10.4060/ca9229en>

[8] Alfaro, D.D.C.T., Domínguez, J.L.C., Salazar, J.I.C. (2023). Pesca ilegal en México durante el periodo 2010-2022. Una exploración desde la criminología verde. *Revista Mexicana de Ciencias Penales*, 7(21): 119-144. <https://doi.org/10.57042/rmcp.v7i21.665>

[9] López-Ercilla, I., Espinosa-Romero, M.J., Fernández-Rivera Melo, F.J., Fulton, S., Fernández, R., Torre, J., Acevedo-Rosas, A., Hernández Velasco, A.J., Amador, I. (2021). The voice of Mexican small-scale fishers in times of COVID-19: Impacts, responses, and digital divide. *Marine Policy*, 131: 104606. <https://doi.org/10.1016/j.marpol.2021.104606>

[10] Bennett, N.J., Finkbeiner, E.M., Ban, N.C., Belhabib, D., Jupiter, S.D., Kittinger, J.N., Mangubhai, S., Scholtens, J., Gill, D., Christie, P. (2020). The COVID-19 pandemic, small-scale fisheries and coastal fishing communities. *Coastal Management*, 48(4): 336-347. <https://doi.org/10.1080/08920753.2020.1766937>

[11] Love, D.C., Allison, E.H., Asche, F., Belton, B., et al. (2021). Emerging COVID-19 impacts, responses, and lessons for building resilience in the seafood system. *Global Food Security*, 28: 100494. <https://doi.org/10.1016/j.gfs.2021.100494>

[12] FAO. (2020). The impact of COVID-19 on fisheries and aquaculture - A global assessment from the perspective of regional fishery bodies. <https://doi.org/10.4060/ca8637en>

[13] Allison, E.H., Perry, A.L., Badjeck, M.C., Adger, W.N., Brown, K., Conway, D., Halls, A.S., Pilling, G.M., Reynolds, J.D., Andrew, N.L., Dulvy, N.K. (2009). Vulnerability of national economies to the impacts of climate change on fisheries. *Fish and Fisheries*, 10(2): 173-196. <https://doi.org/10.1111/j.1467-2979.2008.00310.x>

[14] Mangubhai, S., Olguín-Jacobson, C., Charles, A., Cinner, J., de Vos, A., Graham, R.T., Ishimura, G., Milis, K.E., Naggea, J., Okamoto, D.K., O'Leary, J.K., Salomon, A.K., Sumaila, U.R., White, A., Micheli, F. (2024). COVID-19 highlights the need to improve resilience and equity in managing small-scale fisheries. *NPJ Ocean Sustainability*, 3(1): 61. <https://doi.org/10.1038/s44183-024-00100-7>

[15] Soares, J.B., da Costa, M.R., Monteiro-Neto, C., Loto, L., de Abreu, M.D., de Almeida Tubino, R. (2022). Impacts of COVID-19 on the value chain of a small-scale fishery system in a tropical metropolitan city. *Marine Policy*, 140: 105068. <https://doi.org/10.1016/j.marpol.2022.105068>

[16] Folke, C. (2006). Resilience: The emergence of a perspective for social-ecological systems analyses. *Global Environmental Change*, 16(3): 253-267. <https://doi.org/10.1016/j.gloenvcha.2006.04.002>

[17] Cinner, J.E., Adger, W.N., Allison, E.H., Barnes, M.L., Brown, K., Cohen, P.J., Gelcich, S., Hicks, C.C., Hughes, T.P., Lau, J., Marshall, N.A., Morrison, T.H. (2018). Building adaptive capacity to climate change in tropical coastal communities. *Nature Climate Change*, 8(2): 117-123. <https://doi.org/10.1038/s41558-017-0065-x>

[18] United Nations Office for Disaster Risk Reduction (UNDRR). (2015). *Sendai Framework for Disaster Risk Reduction 2015-2030*. <https://www.undrr.org/media/16176/download?startDo>

wnload=20260113, accessed on Jan. 3, 2026.

[19] Hafsi, A., Aguilar-Becerra, C.D., Frausto-Martínez, O., Rivas-Tapia, A.S. (2023). Assessment of socioeconomic resilience to pandemic disasters in island tourist destinations. *Sustainability*, 15(14): 11246. <https://doi.org/10.3390/su151411246>

[20] Béné, C. (2020). Resilience of local food systems and

links to food security. *Food Security*, 12(4): 805-822. <https://doi.org/10.1007/s12571-020-01076-1>

[21] Béné, C., Newsham, A., Davies, M., Ulrichs, M., Godfrey-Wood, R. (2014). Resilience, poverty and development. *Journal of International Development*, 26(5): 598-623. <https://doi.org/10.1002/jid.2992>

## APPENDIX

### Appendix A

The final selection of indicators was conducted through a matrix-based approach integrating key conceptual components of socioeconomic resilience for fishing communities facing pandemic-related threats. These components were operationalized into specific variables reflecting the characteristics of the disturbance, the capacities of resilience, and the structural conditions of fishing communities. This process allowed for the systematic exclusion of indicators that did not align with these components and the retention of those consistent with the study context and objectives.

Variable	ID	Description of the Specific Variable	
Hazard	AMZ-1	Hazard characteristics	1) High infectivity index; 2) Dose–response relationship; 3) Incubation period; 4) Lethality rate or estimated transmission potential of the pathogen.
	AMZ-2	Short-term hazard effects	1) High unemployment rates; 2) Income reduction; 3) Increase in poverty; 4) Inequality in access to healthcare.
Socioeconomic Resilience	RSO-1	Capacity of an economy	1) Ability to minimize the impact of asset losses on well-being.
	RSO-2	Capacity of an agent or group of agents	1) Ability to reduce the negative consequences of risks and shocks on living conditions.
Fishing Communities	CP-1	Social deprivation	1) Food insecurity; 2) Limited access to education; 3) Lack of social support; 4) Ethnic conflicts.
	CP-2	Lack of investment	1) Limited access to credit for fishers and equipment; 2) Insufficient infrastructure; 3) Inadequate technological equipment; 4) Low investment in small-scale fisheries.
	CP-3	Economic vulnerability	1) Lack of income diversification; 2) Limited employment opportunities in the fisheries sector; 3) Dependence on catch-based income; 4) Decline in demand.
	CP-4	Climate change	1) Changes in sea temperature; 2) Shifts in fish distribution; 3) Exposure to extreme events; 4) Depletion of fishery resources; 5) Loss of biodiversity.

Note. Table prepared using information from Calatayud Díaz, 2014; FAO, 2014; FAO, 2024; FAO, 2002; FAO, 2005; García López et al., 2021; Gutiérrez Pérez, 2014; Hernández Villalobos, 2020; Jumairi Puello, 2021; López-Ercilla, et al., 2021; Martínez-Sánchez, et al., 2015; Bertolotti, 2016; Maya, et al., 2006; Riveiro Domínguez, 2015.

### Appendix B\_questionnaire, coding rules, and scoring examples

APPENDIX — Questionnaire, Coding Rules and Scoring Examples				
A.1 Scoring Framework				
Each indicator was scored on a five-point ordinal scale (0–4), where 0 = lowest resilience and 4 = highest resilience. For conditional questions (Q5.1, Q6, Q7.1), scores apply only to respondents directly concerned. Respondents for whom the question was not applicable were excluded from that indicator's calculation.				
A.2 Full Questionnaire with Coding Rules				
Q#	Question (English)	Response Option	Score	Notes / Coding Rule
<b>SOCIAL DIMENSION</b>				
Q1	How old are you?	15–39	4	Younger age = higher resilience capacity
		40–59	2	
		60 and older	0	
Q2	What is your highest level of education?	No schooling	0	Higher education = higher resilience
		Primary	1	
		Secondary	2	
		High school	3	
		University	4	
Q3	How many people depend on your income?	None	4	More dependents = lower resilience Δ CORRECTED: original scoring was inverted
		1 person	3	
		2 persons	2	
		3 persons	1	
		More than 3 persons	0	
Q4	Are you affiliated with any social security or health insurance?	Yes	4	Coverage = higher resilience
		No	0	
Q5	Do you have any disability affecting your work as a fisher?	Yes → go to Q5.1		Filter question only — no score assigned
		No → skip to Q6		
Q5.1	Have you experienced discrimination related to your disability as a fisher? (Conditional — N=5 only)	Yes	0	Applies only to respondents reporting a disability (N=5). No discrimination = higher resilience
		No	4	

Q6	Have you experienced discrimination related to being a woman as a fisher? (Conditional — N=2 only)	Yes	0	Applies only to female respondents (N=2). No discrimination = higher resilience
		No	4	
Q7	Do you identify as belonging to an indigenous group?	Yes → go to Q7.1		Filter question only — no score assigned
		No → skip to Q8		
Q7.1	Have you experienced discrimination related to your ethnic identity as a fisher? (Conditional — N=3 only)	Yes	0	Applies only to respondents identifying as indigenous (N=3). No discrimination = higher resilience
		No	4	
Q8	During COVID-19, did you experience any form of food shortage?	Yes	0	Food shortage = lower resilience
		No	4	

**ECONOMIC DIMENSION**

	Declining trend	0	
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Q9	How would you describe your income before, during, and after the pandemic?	Stable	2	Open-ended responses coded by income trajectory
		Improving trend	4	
Q10	Do you have any financial insurance protecting you in case of disasters or forced inactivity?	Yes	4	Having insurance = higher resilience
		No	0	
Q11	What is your current housing situation?	Owner	4	Ownership = greater stability = higher resilience
		Borrowed	2	
		Rented	0	
Q12	During COVID-19, did you experience a period of unemployment?	Yes	0	Unemployment = lower resilience
		No	4	
Q13	Besides fishing, do you have another economic activity generating income?	Yes	4	Income diversification = higher resilience
		No	0	
Q14	How do you perceive the availability of work in the fishing labor market?	Very easy	4	Perceived labor market availability
		Easy	3	
		Neither easy nor difficult	2	
		Difficult	1	
		Very difficult	0	

**MITIGATION-ADAPTATION DIMENSION**

Q15	Have you had prior experience with pandemic disasters or emergencies as a fisher?	Yes	4	Prior experience = informal adaptive capacity
		No	0	
Q16	Have you ever participated in public consultations or meetings with public institutions?	Never	0	Institutional participation = collective resilience
		Once	1	
		Sometimes	2	
		Almost always	3	
		Always	4	
Q17	Have you taken training courses on safety measures related to epidemiological or pandemic risks?	Yes	4	Formal training = higher resilience ⚠ CORRECTED: original scoring was inverted (Yes=0, No=4)
		No	0	
Q18	Are you part of a neighborhood support group, civil organization, or similar entity?	Yes	4	Community membership = collective resilience
		No	0	

**MITIGATION-ADAPTATION DIMENSION**

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		No	0	
Q18	Are you part of a neighborhood support group, civil organization, or similar entity?	Yes	4	Community membership = collective resilience
		No	0	

**ENVIRONMENTAL DIMENSION**

Q19	Do you know which areas are protected for fishing? Which ones?	0 zones known	0	Puerto Vallarta has 4 officially designated marine protected areas. Scored by number of zones correctly identified.
		1 zone known	1	
		2 zones known	2	
		3 zones known	3	
		All 4 zones known	4	
Q20	Do you know which species are subject to fishing bans? Which ones?	No response / no knowledge	0	Environmental knowledge = higher resilience
		Incomplete list	2	
		Complete list	4	
Q21	Do you consider the marine environment where you fish has a healthy ecosystem and adequate resource availability?	Yes	0	Note: some respondents answered "Yes" but described degraded conditions in comments. Score reflects declared response as coded in original survey.
		No	4	

**A.3 Scoring Example — Single Respondent**

Indical Response Given	Score	
Age	40-59	2
Education level	Secondary	2
Household dependents	More than 3	0
Health coverage	Yes	4
Food security	No shortage	4
Income stability	Declining trend	0
Financial protection	No	0
Housing conditions	Owner	4
Unemployment pandemic	Yes	0
Income diversification	No	0
Job availability	Difficult	1
Disaster experience	Yes	4
Public consultations	Never	0
Risk mgmt. training	No	0
Community networks	No	0
Knowledge protected areas	2 zones known	2
Knowledge fishing bans	Incomplete list	2
Ecosystem health	Yes (coded 0)	0
<b>RI = (ΣX / 4N) × 100 = (25 / 72) × 100 = 34.7%</b>		<b>34.7%</b>

\* Conditional indicators (Q5.1, Q6, Q7.1) excluded — not applicable to this respondent. ⚠ Yellow = corrected scoring (Q3, Q17) ● Green = conditional indicators □ Grey = filter questions