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Sustainability and climate change: gender perspective in the traditional fishing sector in Ecuador

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In the traditional fishing sector of Ecuador, integrating a gender perspective enhances sustainability and addresses climate change by recognizing the vital roles and knowledge of women in fisheries management. The objective of this study was to validate the content, comprehension, and construction of the designed questionnaire. Additionally, it is intended to identify perceptions of sustainability and climate change amongst women and men in fisheries, and compare their views on the dimensions of sustainability and climate change. The research implemented a questionnaire with a metrically satisfactory scale, providing information on how men and women perceive sustainability and climate change in the artisanal fishing sector. The data were collected by designing an ad hoc questionnaire denominated "Gender perception as regards sustainability and climate change" following a process in which the validity of the content (experts > 0.5823; Content Validity Ratio (CVR) > 6.1; Content Validity Index (CVI) > 0.852), decompression (pilot study, $N = 30$) and construct (KMO = 0.71) were analyzed. The results of the internal consistency reliability analysis indicated that the Likert scale had a high index of reliability, as evidenced by Cronbach's Alpha coefficient of 0.70. This analysis provided evidence of the structure and validity of the scale, resulting in a reliable, integral, and short tool with which to measure perceptions of sustainability and climate change. The questionnaire was administered to 1464 people employed in the traditional fishing industry (17.14% women) in 40 fishing community ports near the coastal profile of Ecuador (Esmeraldas and Manabí). Most of those surveyed stated that the current traditional fishing quotas are not very sustainable in the long term (47.10%, $n = 690$) and that climate change may significantly negatively impact catch rates (50.30%, $n = 736$). Finally, the Wilcoxon test of tests confirmed that women had significantly more positive attitudes than men towards sustainability (3.03 ± 0.69) and climate change (3.35 ± 0.64).

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Introduction

Traditional fishing is a form of capture carried out using manual techniques in small vessels; it and industrial fishing can hurt marine ecosystems due to overfishing, pollution, habitat destruction, and incidental captures (Rousseau et al., 2019). The traditional fishing industry employs around 500 million people worldwide, which represents 40% of catches at a world level (Mutaqin, 2021). Nevertheless, slow progress is being made as regards attempting to implement gender equality as a key factor in the planning, management, and development of traditional fishing.

Although the focus on gender equality is increasing in this sector, many policies and programs do not yet contain data collection broken down by gender (Kleiber et al., 2021). There is gender bias in all the steps in the value chain, for which the United Nations Organisation for Food and Agricultural Organization (FAO) has estimated that approximately 45 million women are employed in the traditional fishing industry worldwide, which supposes 1 in 10 workers registered in this area (Mutaqin, 2021).

In this context, it is essential to incorporate practices that ensure marine sustainability, which can be understood as maintaining the characteristics of the ecosystem after human intervention (Gazzola et al., 2020; Hinojosa-Pérez and Condori-Cáceres, 2023). This means that both men and women should undertake actions to promote the development of sustainable fishing activities (Zhou and Sun, 2020; Sanz-Fernández et al., 2022). Gender-conscious practices include ensuring equal participation of women in decision-making processes related to fishing practices, providing training and resources tailored to women fishers, and recognizing the distinct roles and knowledge that women bring to sustainable fisheries management. In this respect, research has highlighted the diversity of gender perceptions regarding perceived problems and their possible solutions (Santos, 2015; Gazzola et al., 2020; Zhou and Sun, 2020; Brown et al., 2023; Goli et al., 2023; Vijhani et al., 2023).

In a similar vein, numerous studies have shown that women play a vital role in guaranteeing the environmental sustainability of marine ecosystems (Santos, 2015; Gissi et al., 2018; Frangoudes and Gerrard, 2019; Pierce, 2020; Purcell et al., 2020). They are predisposed to design sustainable resource-management plans (Revollo-Fernández et al., 2016), make more sustainable catches than men (Gissi et al., 2018), establish community marine reserves to protect fish populations (Torre et al., 2019), and form cooperatives for the commercialization of sustainably-captured marine products (Martins-De-Andrade et al., 2021).

On the other hand, climate change is provoking changes in the temperature and acidity of oceans, and these factors are altering the distribution and abundance of fish species. This has significant impacts on fishing communities, especially in Latin America (Reyer et al., 2017), where fishing is a fundamental means of subsistence and food security (Harper et al., 2013; Abeldaño-Zuñiga et al., 2021; Islam and Chuenpagdee, 2022).

Scientific literature recognizes that the impacts are not neutral in terms of gender, as cultural norms and gender-based discrimination (Gopalakrishnan et al., 2019; Nakamura et al., 2021) contribute to men and women experiencing different effects (Assan et al., 2020). Women, in particular, face greater limitations (Gutiérrez et al., 2020; Murunga, 2021; Cataldo et al., 2023; Goli et al., 2023) such as gender roles (Frangoudes and Gerrard, 2019; Herrera-Racionero et al., 2021), inequalities in management, policies, and strategies to reduce the effects of climate change (Khan et al., 2018; De-Oliveira-Leis et al., 2019). Despite their knowledge of species and the local environment (Truchet et al., 2021; Galappaththi et al., 2022), the restriction of access to resources conditions the capacity to respond to the phenomenon (Reyer et al., 2017; Frangoudes and Gerrard, 2019; Purcell et al., 2020), leading to reduced fish populations and changing fishing grounds (Abeldaño-Zuñiga et al., 2021; Islam and Chuenpagdee, 2022).

The majority of the aforementioned studies do not consider the gender perspective, where each stakeholder may have a unique outlook on these phenomena (Barrios-Garrido et al., 2019). In this context, understanding perceptions is essential to comprehend how individuals involved in artisanal fishing perceive the problem (Mason et al., 2020; Rodrigues-Awabdi et al., 2021; Toomey, 2023). Therefore, it is crucial to investigate differences in the perceptions of men and women regarding sustainability and climate change to undertake actions that promote conceptual and behavioral change (Fu et al., 2020).

Ecuador a country globally recognized for its extensive biodiversity, has the highest number of artisanal fishing fleets in the region. In recent years, there has been an increase in the participation of women in this activity (Musiello-Fernandes et al., 2020) as regards unloading, post-catch processing, or catching species such as mollusks, shellfish, and other invertebrates (Purcell et al., 2020; Represa-Pérez and Viña, 2021; Aguilar-Manjarrez et al., 2021). However, the studies have excluded the gender dimension in research on sustainability and climate change in fishing (Mendoza-Áviles et al., 2019; Banchón-Torres et al., 2020).

In this context, it is important to mention that in the study population, there has been an increase in the participation of women in decision-making processes; indeed, some associations and cooperatives, especially in the Portoviejo, Jaramijó, Sucre, and Tosagua cantons, are led by women and have high female participation. On the other hand, in highsea species catches, men's participation predominates; meanwhile, in inshore fishing and catches of crustaceans and mollusks in mangroves, women's participation stands out. For product processing, women have assumed a leading role, evident in the ports of Portoviejo and Puerto López. In terms of marketing, respondents work collaboratively, with both men and women working together to sell their products to retail and wholesale merchants. However, they highlight that they would achieve greater profits if their products were marketed directly to the end consumer.

Based on the arguments presented, the research aimed to determine the psychometric properties of the questionnaire utilized as a measurement instrument to evaluate the gender perspectives of those working in the traditional fishing industry about the dimensions of sustainability and climate change. We also seek to simultaneously understand how men and women in the fishing industry perceive and respond to environmental challenges.

The response to the questions was oriented through the following objective: to validate the designed questionnaire's content, compression, and construct. In addition, it is intended to identify perceptions of sustainability and climate change in fisheries, and compare their views on the dimensions of sustainability and climate change.

Materials and methods

Study area. Ecuador is in the northwest of South America and has an extensive coastline bordering the Pacific Ocean. Traditional fishing is consequently an important activity, particularly in coastal provinces such as Esmeraldas (latitude 0°44′0″ N and longitude 79°9′0″ W) and Manabí (latitude 0°45′0″ S and

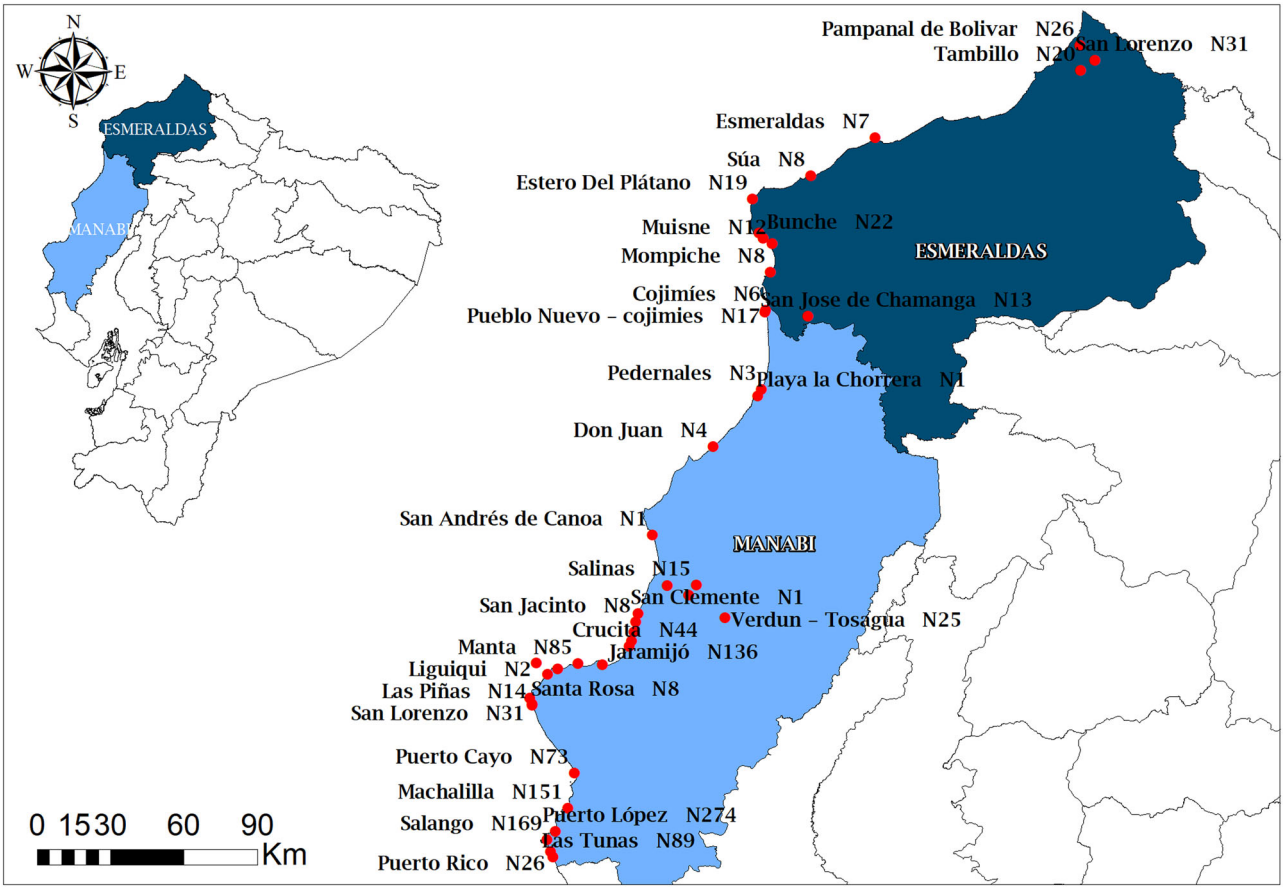

Fig. 1 Artisanal fishing ports of Ecuador. Areas sampled in the provinces of Esmeraldas and Manabí of Ecuador.

longitude 80°5′0″ W), in which numerous communities depend on this activity as a means of support and economic development. According to the Köppen climate classification, the Coastal region has a humid tropical climate, with temperatures that vary between 20 °C and 33 °C (Lopez et al., 2021), and with a mean annual temperature of 25.70 °C (Reyes-Álava, 2019). The rainy season lasts 6 months, from December to May and the annual rainfall may be less than 60 mm or over 2000 mm (Varela and Ron, 2022).

For the development of the research, the two provinces with the highest number of artisanal fishing ports were taken as reference, namely Manabí (66 ports) and Esmeraldas (61 ports). Information was collected from 40 fishing ports in these mentioned provinces, located along the coastal profile of Ecuador. In the province of Manabí, 29 ports were specifically visited (Fig. 1). The average temperature in these areas is 25 °C, with a maximum of 36 °C, and this is usually influenced by the Humboldt cold current, which is characterized by gentle rain and a dry to humid climate (Varela and Ron, 2022). The percentiles for rainfall in the north of Manabí are 70 to 100, with values of up to 4700 mm, while the percentile in the rest of the province is from 0 to 10, with values of between 300 and 900 mm (Portilla-Farfán, 2018). In the case of Esmeraldas, information was obtained from 11 ports (Fig. 1). The average temperature is around 25 °C and there are high indices of relative humidity throughout the year. Rainfall reaches 4700 mm, with percentiles of 70 to 100 (Portilla-Farfán, 2018).

Population. There is a total of 121,930 individuals employed in the traditional fishing industry in Ecuador, with 94.18% ($n = 114{,}830$) being men and 5.82% ($n = 7100$) being women (FAO, 2023).

Sample. The sampling technique applied was convenience sampling (Emerson, 2015), where individuals engaged in artisanal fishing were selected based on the following inclusion criteria: (i) engaging in artisanal fishing activities in the artisanal fishing ports of the provinces of Manabí and Esmeraldas, (ii) expressing willingness to voluntarily respond to the questionnaire, (iii) having the time and predisposition for the instrument's administration. On the other hand, exclusion criteria were established: (i) engaging in different types of fishing (industrial, recreational, among others) not related to artisanal fishing in Manabí and Esmeraldas, (ii) engaging in artisanal fishing activities in Guayas, Santa Elena, and El Oro, (iii) individuals in the artisanal fishing sector who do not wish to participate voluntarily in the research, (iv) individuals who don't have time for the questionnaire administration.

In this way, the participation of 1464 subjects (men = 1213; women = 251) was achieved in 40 artisanal fishing ports (Table 4, Appendix), diversifying and thereby increasing the sample (Maas et al., 2021).

Table 4 in Appendix section shows the data (segregated by geographical area) regarding those surveyed, of whom 87.97% ($n = 1288$) reside in the province of Manabí and 12.03% ($n = 176$) reside in the province of Esmeraldas. Regarding gender, 82.86% ($n = 1213$) were men, while 17.14% ($n = 251$) were women, with a mean number of 3 children per family. The average age of those surveyed was 42, while the level of education that predominated among those who decided to provide information in this respect was basic (12.30% ($n = 180$)).

Design and validation of the data-collection instrument. This research was developed by designing an ad hoc questionnaire organized into two sections and denominated "Gender perceptions as regards sustainability and climate change". The first section obtained information concerning sociodemographic variables (Annex I), including gender, age, guild to which the participants belonged, professional category, type of fishing carried out, education, ethnicity, and number of children. The second section concerned the participants' perceptions of sustainability (Dimension I) and climate change (Dimension II).

The questionnaire was developed by following five differentiated steps that provide precision and reliability (Pérez-Gracia et al., 2021):

1. *Selection and formulation of items*: It was first necessary to carry out a literature review to identify the different items that might be included in the sustainability and climate change dimensions of traditional fishing. The collected information allowed the formulation of 11 items in the sustainability dimension and 7 items in the climate change dimension.
2. *Content validity*: The process was based on the postulates of Lawshe (1975), who established a model for determining the content validity of the questionnaire. The procedure requires a high number of judges and prioritizes agreement among them regarding the instrument's validity. However, Tristán-López (2008) in his proposal asserts that the process can be carried out with a minimum of 7 judges, among whom there should be a unanimous consensus.
   Based on the arguments presented, a panel of 10 scientific experts was contacted (Galicia-Alarcón et al., 2017) who provided a reliable estimation of the validity of the content (Hyrkäs et al., 2003). The experts evaluated each item by considering three characteristics: pertinence, relevance, and clarity. Each item was evaluated using a four-point Likert scale (4—a lot, 3—quite a lot, 2—little, 1—not at all). A space in which the expert could make suggestions in the form of comments was assigned to each item to complement the process (García-Valcárcel et al., 2020).
   The results of the Content Validity Ratio (CVR) indicator established statistics exceeding 58.23%, which was the minimum agreement value to be reached among judges. This validation of the elements and scales as regards content then led to some adaptations to the questionnaire.
3. *Evaluation of understandability*: the recommendations made by Beaton et al. (2000) and Pérez-Gracia et al. (2020) were subsequently considered to validate the understandability of the questionnaire using a pilot test carried out (in person) with 30 male and female workers from the traditional fishing industry who analyzed the understandability of the instrument. This made it possible to evaluate the understandability of the questions and to detect any possible problems.
4. *Evaluation of construct*: The construct was validated using the sequential use of the exploratory factorial analysis (EFA) (Pérez-Gil et al., 2000). This was done by randomly dividing the sample ($n = 500$) into two subsamples (Tondeur et al., 2017). The data were randomly divided into approximately 40% and 60% (40% for the EFA and 60% for the Confirmatory Factor Analysis (CFA). In this case, the largest subsample can be used for the most crucial process of evaluating papers and the construction of scales, and the smallest can be used for cross-validation (DeVellis, 2017). In the first (40%, $n1 = 200$), which was carried out using the EFA (in SPSS 21) (IBM Corp. Released, 2021), we explored the underlying factorial structure of the items. In the case of the CFA (AMOS 21), however, an attempt was made to confirm that structure in the second subsample (60%, $n2 = 300$). The relationship between the sizes of the two subsamples and the number of items (18) fulfilled the minimum requirement of 10 participants per item, whose proportion of sample to variable was 10:1 (Singh and Masuku, 2014), or more than 300 cases were generally considered to be suitable for the factorial analysis. Finally, this large-scale study focused on establishing the quality of the instrument as regards measuring the dimensions of sustainability and climate change. This construct validity was employed to determine whether the instrument measured what it was supposed to measure, in other words, whether it successfully proved the research objectives.
5. The *final step* was the attainment of the definitive questionnaire, which was composed of 11 sociodemographic questions and 18 questions corresponding to Dimension I (sustainability) and Dimension II (climate change).

Administration of the questionnaire. The people working in the traditional fishing industry who participated in the study were informed of the purpose of the research beforehand. Moreover, ethical principles were applied to protect their anonymity, dignity, rights, and well-being throughout the process. The information was collected in person from each of the traditional fishing ports over 7 months, spanning from July 2022 to January 2023. Participation in the research was promoted by the fishing associations and cooperatives in Manabí and Esmeraldas. The average time required to administer the questionnaire was 15 min per person surveyed.

The survey team was made up of 34 people who received prior instructions on how to apply the questionnaire. During the fieldwork, the teams went to the various fishing ports in the provinces of Manabí and Esmeraldas, where they were supported by the presidents and administrators of the traditional fishing associations and cooperatives, who took them to the organizational buildings to obtain information from their members. In some cases, however, the data were collected individually via domestic visits to members of the associations and cooperatives.

Identification of the perceptions of people working in the fishing industry. A frequency analysis was employed to identify the perceptions of the people working in the traditional fishing industry as regards sustainability and climate change. Data were collected using the questionnaire applied, which contained specific questions related to sustainability and climate change in the context of fishing. Once that data had been collected, the frequency analysis was carried out. This analysis consisted of examining the frequency with which different subjects and categories of responses were mentioned in the perceptions of the people from the fishing industry. Patterns and tendencies were identified in the participants' responses, which made it possible to understand the main concerns, knowledge, and attitudes regarding sustainability and climate change when related to fishing.

Comparison of the results obtained for women and men in the traditional fishing industry. In this study, the results obtained for the men and women in the traditional fishing industry as regards the dimensions of sustainability and climate change were compared using SPSS software (IBM Corp. Released, 2021). It was necessary to first collect the data related to both groups and then introduce it into the software. The Wilcoxon test for independent samples was subsequently carried out using the corresponding function in SPSS.

Table 1 Content validity indices of the initial model.

Areas	N°. of items	N°. of experts	Evaluated characteristics	The sum of items (CVR′)	M	Acceptable	Partial CVI′	Total CVI′
Level of adequacy of sociodemographic data items	11	10	Essential	10,285	11	Yes	0.935	0.935
Level of the adequacy of sustainability items	11	10	Clarity	8714	11	Yes	0,792	0.852
			Pertinence	9571	11	Yes	0.870	
			Relevance	9857	11	Yes	0.896	
Level of the adequacy of climatic change items	7	10	Clarity	6142	7	Yes	0.877	0.9455

Table 2 Results of the factorial load of exploratory factorial analysis (EFA).

	Higher loading for each one of the two factors	
	Factor 1	Factor 2
Items	Sustainability dimension	Climate dimension
V20	0.519	
V21	0.469	
V22	0.481	
V30		0.510
V31		0.515
V32		0.500
V33		0.384
V34		0.427
V35		0.531

Note: V20 = Decreasing catch rates in recent years; V21 = More effort required for fishing in recent years; V22 = Types of fishing, such as use of paternoster line, unsustainable; V30 = Climate change may have a negative effect; V31 = The variation in phenomena has had a great impact on the distribution of fishing resources; V32 = Catch rates will decrease in the future owing to climate change; V33 = The size of the species caught will decrease in the future owing to climate change; V34 = Climate change may modify the species captured; V35 = Climate change may modify the seasonal nature of catches.

Table 3 The goodness of fit indices of multi-group CFA.

	Models	Final model
Absolute fit measures	X^2	0.000
	RMSEA	0.072
Incremental fit measures	CFI	0.898
	TLI	0.822
	NFI	0.886
Parsimonious fit measures	PRATIO	0.571
	PCFI	0.513
	PNFI	0.506
	AIC	180,759
	GFI	0.978
	AGFI	0.950
	PGFI	0.435

χ^2 Chi-Squared Test for model fit, *RMSEA* Root means square error of approximation, *CFI* Comparative fit index, *TLI* Tucker Lewis index, *NFI* Normalized fit index, *PRATIO* Parsimony Ratio, *PCFI* Parsimonious comparative fit index, *PNFI* Parsimonious normalized fit index, *AIC* Akaike information criterion, *GFI* Goodness of fit index, *AGFI* Adjusted goodness of fit index, *PGFI* Parsimonious goodness of fit index.

Results

Validation of the content, compression, and construct of the questionnaire. Table 1 (*content validity*) showed the sum of the CVR′ included in the model, along with the number of items that the experts considered to have a positive relationship (M). It also showed whether or not the items were accepted. The level of adequacy of the sociodemographic data and the level of adequacy of the items relative to Dimension I and Dimension II is acceptable since the experts' satisfaction indicator was >0.5823.

Furthermore, the results obtained from the participants in the pilot study (*understandability validity*) made it necessary to modify two questions, of which one corresponded to the sustainability dimension: do you think that some types of fishing, such as the use of the paternoster line, are unsustainable? while the remaining item was in the climate change dimension: could climate change modify the phenology (seasonal nature) of catches?. The people surveyed had difficulty interpreting these questions because they did not know terms such as paternoster line and phenology.

About the *construct validity* (EFA), the mean obtained for the Kaiser-Meyer-Olkin test (KMO = 0.71) showed that the sample had a high level of adequacy, while the Bartlett sphericity test was significant ($\chi^2 = 1255.483$; $gl = 118$; $p = 0.001$). The results showed that the two expected factors, which explain 42.20% of the variance, and all the items fitted their proposed dimensions correctly. The factorial load (Table 2) represented the strength of the relationship between each item and the corresponding factor. In this case, it suggests that item V20 has a stronger correlation with the Sustainability Dimension, while items V30, V31, V32, and V35 have a stronger correlation with the Climate Dimension. The remaining items (V21, V22, V33, and V34) have moderate loadings on both factors, suggesting some level of association with both sustainability and climate.

The transcultural invariance of the three-dimensional structure found in the confirmatory factorial analysis (CFA) was tested using a multi-group CFA analysis. As Table 3 showed, the three-dimensional model, which is provided in Fig. 2, appropriately fits the sample. The goodness of fit index (GFI) of the sample considers that the minimum threshold is a good fit GFI (Hooper et al., 2008). The GFI of the model was 0.978, indicating that the model captures the patterns and relationships in the data quite well (Table 3). Furthermore, the adjusted goodness of fit index (AGFI) is the same indicator as the GFI but is adjusted according to the degrees of freedom (Westland, 2015). A value close to 1 indicates a perfect fit, while the minimum limit is generally agreed to be 0.8 (Bentler and Bonnett, 1980). The AGFI value for the model was 0.950, which is, therefore, within this threshold and suggests that the model accounts for a substantial portion of the variation in the data while considering its complexity. The Parsimonious goodness of fit index (PGFI) had a value of 0.435 indicating that the model may be relatively complex and might benefit from simplification.

Factor 1, representing the Sustainability Dimension, has three items with their respective loadings (Fig. 2). These loadings indicate the strength of the relationship between each item and the Sustainability Dimension. Higher loadings suggest a stronger association. In this case, V21 has the highest loading (0.61), indicating a strong correlation with the Sustainability Dimension. Factor 2, representing the Climate Dimension, includes five items with their corresponding loadings. Again, these loadings indicate

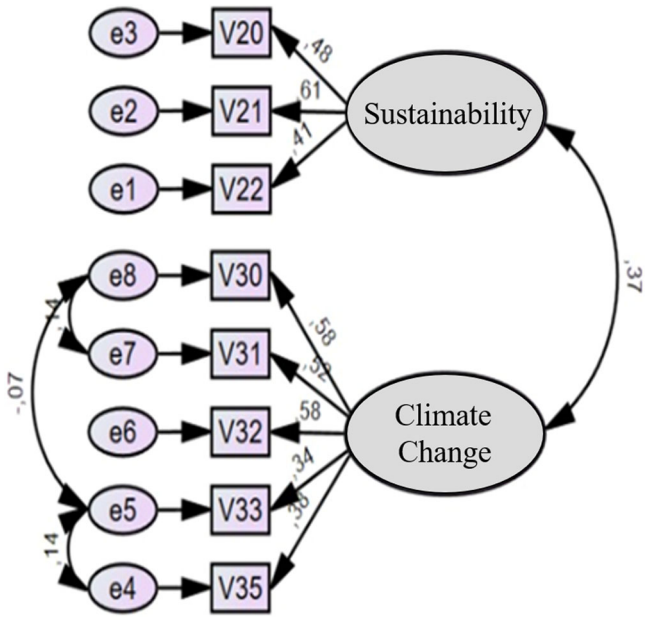

Fig. 2 Three-dimensional model of results of confirmatory factorial analysis ($p < 0.001$). Note: V20 = Decreasing catch rates in recent years; V21 = More effort required for fishing in recent years; V22 = Types of fishing, such as use of paternoster line, unsustainable; V30 = Climate change may have a negative effect; V31 = The variation in phenomena has had a great impact on the distribution of fishing resources; V32 = Catch rates will decrease in the future owing to climate change; V33 = The size of the species caught will decrease in the future owing to climate change; V35 = Climate change may modify the seasonal nature of catches.

the strength of the relationship between each item and the Climate Dimension. The items V30, V32, and V35 have relatively higher loadings, suggesting a stronger association with the Climate Dimension compared to V31 and V33. Overall, this CFA analysis provides insights into the factorial structure of the measured variables, highlighting the items that have a stronger relationship with the Sustainability and Climate Dimensions

Finally, the results of the internal consistency reliability analysis indicated that the Likert scale had a high index of reliability, as evidenced by Cronbach's Alpha coefficient of 0.70 obtained for the sustainability and climate change dimensions. In other words, the internal consistency reliability coefficient proves that the items on the scale measure the same construct.

Identification of the perceptions of people working in the fishing industry. The study allowed identifying the perceptions of men and women engaged in activities related to artisanal fishing regarding the sustainability dimension (Fig. 3). From the subjects' perspective, artisanal fishing is currently seen as somewhat unsustainable in the long term, with women expressing this view more strongly (57.0%, $n = 143$) compared to men (45.1%, $n = 547$). Moreover, men believe that catch rates have decreased significantly in recent years (51.4%, $n = 623$), while women assert that catches have decreased much more (50.6%, $n = 127$). Faced with this phenomenon, men have considerably increased fishing efforts in recent years (45.8%, $n = 555$), while women believe that a lot of effort has been put into fishing activities (55.0%, $n = 138$).

Regarding fishing gear such as longlines, men consider them quite unsustainable (28.6%, $n = 347$), in contrast to women who described them as somewhat unsustainable (36.3%, $n = 91$). Concerning compliance with quotas for the captured species, men believe that the maximum number of species caught is often met (38.7%, $n = 470$), whereas women state that the quotas are rarely met (52.2%, $n = 131$).

In terms of measures implemented to ensure sustainability, both genders believe that minimum size limits for caught species are often respected, with men emphasizing this more (46.8%, $n = 568$) than women (30.7%, $n = 77$). Similarly, both genders believe that closed seasons for species mating are respected, with men expressing this view more strongly (56.3%, $n = 683$) compared to women (41.8%, $n = 105$).

In this context, reference is also made to economic compensations through subsidies. From the perspective of men, this alternative would contribute significantly to sustainable fishing (42.9%, $n = 520$), while women state that it would help a lot in sustaining artisanal fishing (65.7%, $n = 165$). Another option is the creation of a sustainable fishing label, where men believe this would guarantee sustainable fishing to a great extent (55.4%, $n = 672$), whereas women affirm it would serve much for the revaluation of fish and sustainability (53.4%, $n = 134$).

Protected marine areas are seen as an alternative that, from the perception of men, could help considerably in the regeneration of fishery resources (43.6%, $n = 529$). However, women consider that it could contribute much (51.4%, $n = 129$). At the same time, men recognize that prioritizing artisanal fishing over industrial fishing would be quite important (44.4%, $n = 538$), while women believe that this option would help a lot (64.9%, $n = 163$).

Regarding the results of the climate change dimension (Fig. 4), respondents believe that this phenomenon can have a significant impact on catch rates, with women's perspective (55.4%, $n = 139$) standing out compared to men (49.2%, $n = 597$). In addition, they acknowledge that the variation in natural phenomena such as El Niño and La Niña has had a substantial impact on the distribution and availability of fishery resources, as affirmed by both men (44.0%, $n = 534$) and women (49.8%, $n = 125$). According to men, there is a considerable likelihood that catch rates will decrease in the future due to climate change (48.6%, $n = 589$); in this regard, women believe that catch rates will decrease significantly (52.2%, $n = 131$).

Similarly, men believe that there is a fair chance that the size of species will decrease in the future due to climate change (46.6%, $n = 565$); whereas, women state that the likelihood of this happening is high (48.2%, $n = 121$). Regarding species change, men believe that there is a fair likelihood that climate change could modify them (52.7%, $n = 639$); in contrast, women think there is a high likelihood of modifications occurring in species (41.8%, $n = 105$).

Both genders mention that climate change can significantly alter the phenology of catches, with women's perspective (52.2%, $n = 131$) standing out compared to men (39.2%, $n = 476$). Finally, they have highlighted diverse opinions regarding the invasion of marine species as a consequence of climate change. In this regard, men express that it is highly unlikely that climate change will increase invasions of other marine species and that this situation will affect artisanal fishing (65.6%, $n = 796$); however, women oppose this perspective, asserting that climate change can often lead to an increase in invasions of other marine species that affect fishing (40.6%, $n = 102$).

Compare the results obtained for women and men in the traditional fishing industry. This study also tackled gender differences as regards fisherwomen's perceptions of sustainability and climate change when compared to those of fishermen, both in the traditional fishing industry. The results show that the women's attitudes towards sustainability were significantly more positive (3.03 ± 0.69) than those of their male counterparts (2.92 ± 0.63), W $(1464) = 199500{,}00$, $p = 0.0094$). In this regard, it is

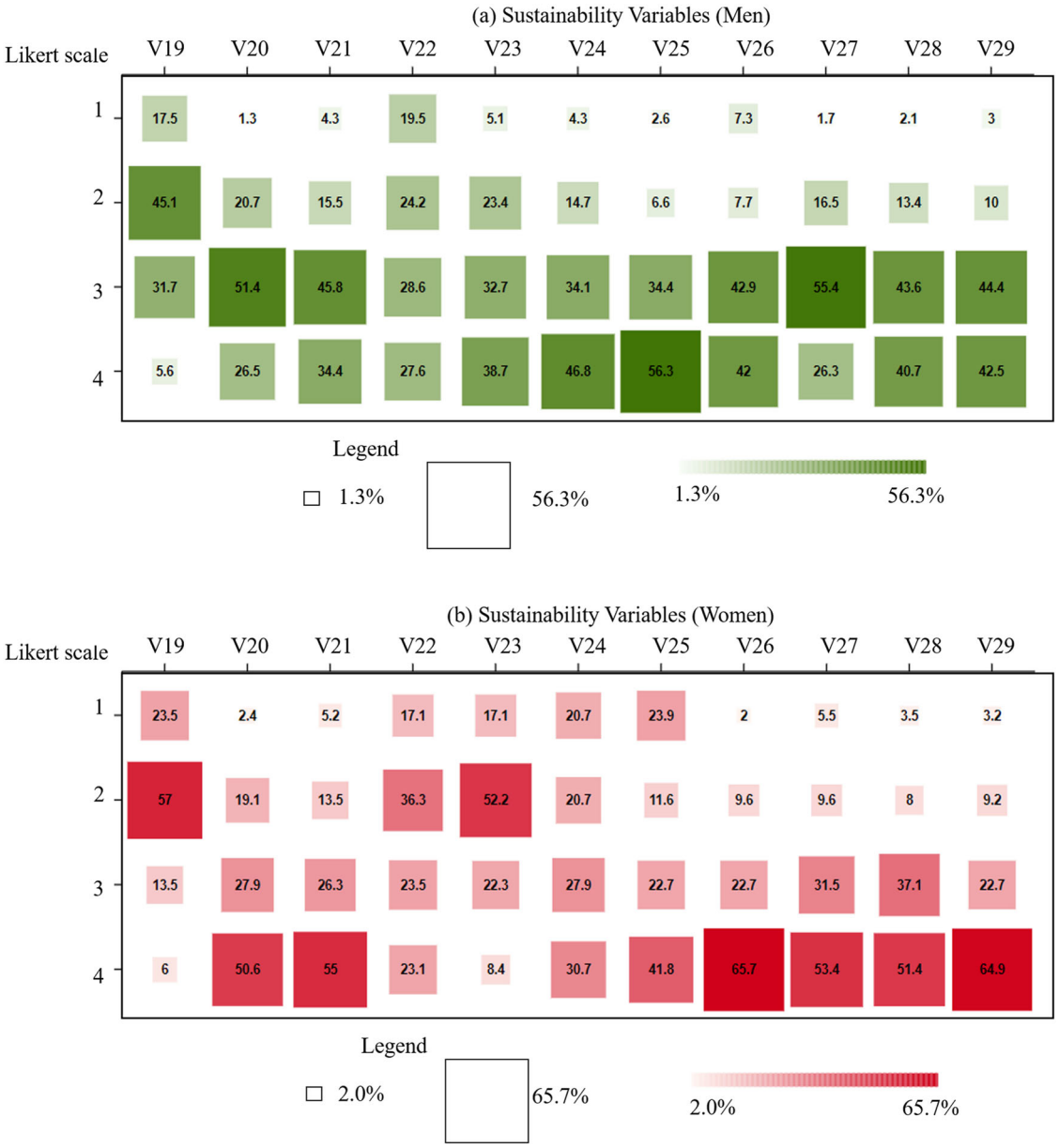

Fig. 3 Proportion (%) of responses to the sustainability dimension. Matrix plot of results obtained for items in the sustainability dimension according to the Likert scale to discover the level of agreement and disagreement among those surveyed (%) **a** men and **b** women. Note: V19 = Long-term sustainable traditional fishing; V20 = Decreasing catch rates in recent years; V21 = More effort required for fishing in recent years; V22 = Types of fishing, such as use of paternoster line, unsustainable; V23 = Fulfils quota for species fished; V24 = Respect the minimum size of the species you fish, V25 = Respects closed season for breeding of species; V26 = Economic compensation would make fishing sustainable; V27 = The sustainable fishing label revalue fish, V28 = Extend protected marine areas; V29 = Prioritise traditional fishing over industrial fishing.

noteworthy that women have perceived a reduction in catches of target species over the years (50.6%, $n = 127$); a situation that has increased their effort in artisanal fishing activities (55.0%, $n = 138$). In most cases, women engage in shore fishing, an activity considered unsustainable (57.0%, $n = 143$). Faced with this reality, women consider economic subsidies during closed seasons (65.7%, $n = 165$) as suitable alternatives, as well as the conservation of ecosystems through marine protected areas, avoiding industrial fishing practices that overexploit marine resources.

The perceptions of women show greater affinity towards sustainability, as it is a mechanism that ensures the availability of marine resources for future generations. Unlike men, who assume the primary purpose of immediate acquisition of economic resources to meet the basic needs of the family environment; for this reason, they sometimes engage in practices that contradict ensuring sustainability.

Artisanal fishing carried out by men has perceived a lower incidence of catch reduction, as when they do not find target species, they move further offshore to find a space for their catches. However, men have emphasized the importance of respecting fishing bans (56.3%, $n = 683$) to allow species to reach minimum sizes for capture (46.8%, $n = 568$).

The women similarly had a more significantly positive perception of climate change (3.35 ± 0.64) than did the men (3.27 ± 0.53), W (1464) = 208409,00, $p < 0.0001$. In this regard, surveyed women have perceived that climate change can negatively impact the size of species (48.2%, $n = 121$), their

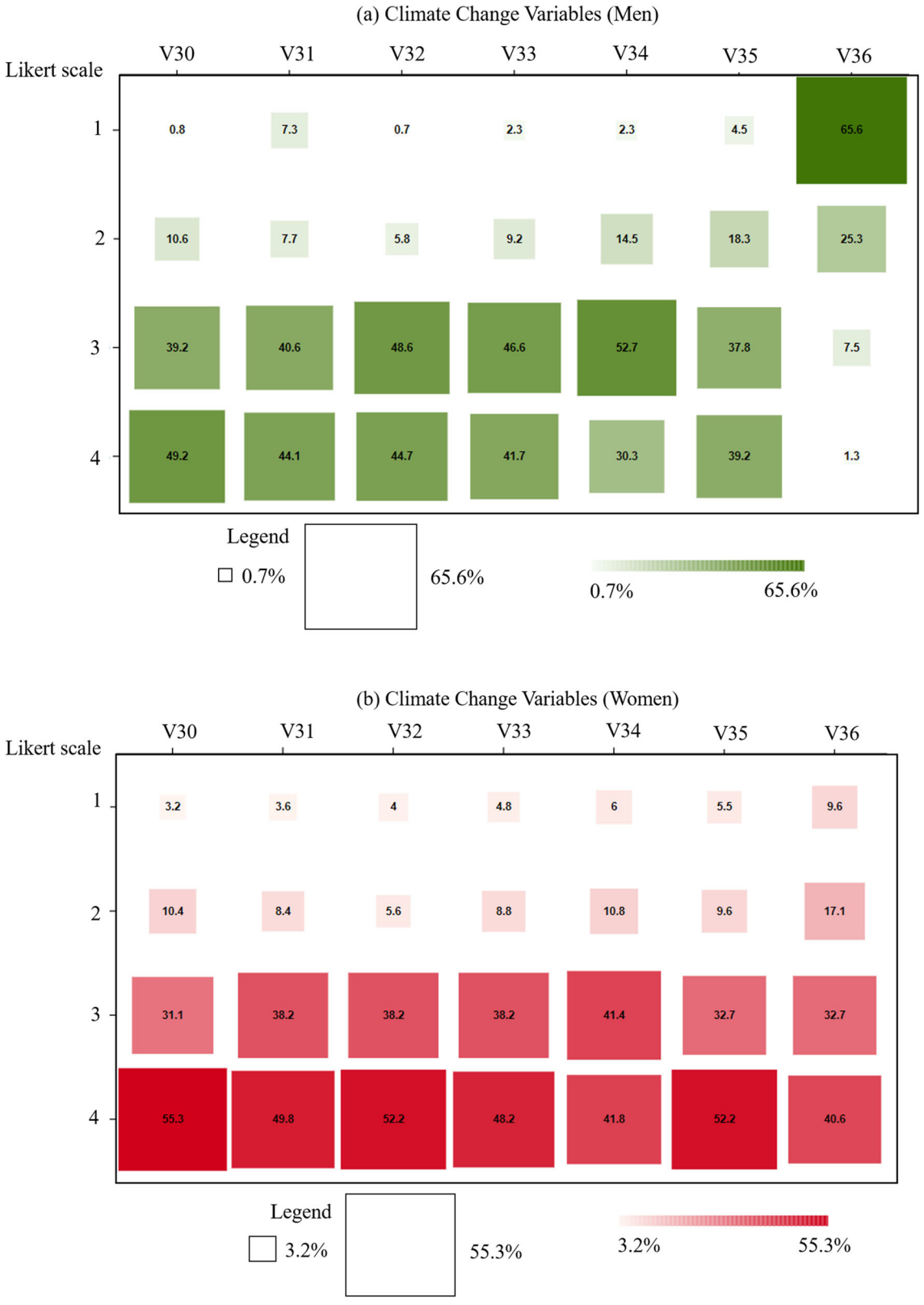

Fig. 4 Proportion (%) of responses to the climate change dimension. Matrix plot of results obtained for items in climate change dimension according to the Likert scale to discover the level of agreement and disagreement among those surveyed (%) **a** men and **b** women. Note: V30 = Climate change may have a negative effect; V31 = The variation in phenomena has had a great impact on the distribution of fishing resources; V32 = Catch rates will decrease in the future owing to climate change; V33 = The size of the species caught will decrease in the future owing to climate change; V34 = Climate change may modify the species captured; V35 = Climate change may modify the seasonal nature of catches; V36 = Climate change may increase invasions by other marine species that.

phenology (52.2%, $n = 131$), invasions of other species (65.6%, $n = 796$), leading to repercussions on catch rates (40.6%, $n = 102$). However, men tend to dissociate the repercussions that climate change has caused on marine species (65.6%, $n = 796$).

Discussion and conclusions

This work describes the procedure followed to design and validate an evaluation questionnaire regarding the perceptions of people in the traditional fishing industry. It also shows that there may be differences between these people's perceptions of sustainability and climate change. As the first objective of this study, the content and understandability were validated using an analysis carried out by a panel of experts and by using a pilot study. Both analyses were very useful as regards improving the legibility, internal consistency, and adequacy of the questionnaire. The results obtained show that the elements selected were appropriate in terms of content and that they coincide with those of previous research works concerning: sustainable traditional fishing in the Zambrano Bolívar municipality (García-Samper, 2019); the effects of incidental fishing on the population of sea turtles on the coast of Ecuador (Vergara-Mite, 2020), and the effects of climate change on the nesting of sea turtles *(L. olivacea, E. imbricata, C. mydas)* on the south coast of Manabí (Gutiérrez-Zambrano and Vélez-Molina, 2022). It also complies with the longitude and integral parameters indicated by De-Von et al. (2007).

The results presented herein definitively show that the scale has a satisfactory quality metric since it has been evaluated using confirmatory procedures and shows that the proposed model has a suitable fit. These results make it possible to specifically conclude the structure of two dimensions: sustainability and climate change. They also show suitable reliability as regards internal consistency, which facilitates the application of the scale in various contexts. Each dimension is supported by previous studies, which highlight the need to consider these aspects during the process of constructing the perceptions of people working in the traditional fishing industry.

Concerning the sustainability dimension, studies highlight the importance of involving this dimension in the species extraction process to avoid putting the availability of marine resources at risk in the future (Revollo-Fernández et al., 2016), while in turn considering the gender approach, in which the considerable role played by women in sustainable practices is recognized (García-Samper, 2019; Martins-De-Andrade et al., 2021; Mangubhai et al., 2022). Actions should be driven by interdisciplinary and multidimensional perspectives (Ther-Ríos et al., 2018). About the second dimension of climate change, it is vital to recognize that climate change is placing communities in a vulnerable position that increases in rural areas (Gutiérrez et al., 2020; Goli et al., 2023), of which the traditional fishing sector can be highlighted. The gender approach contributes to the evaluation of the perceptions of climate change (Assan et al., 2020).

In the case of the second objective, i.e., the perceptions of those surveyed as regards the sustainability dimension, traditional fishing is becoming an unsustainable activity owing to the reduction in the catch rates. According to Restrepo-Yepes et al. (2022), this is because of the incidence of the climate change dimension in the coastal areas of the region. In the face of this reality, the aforementioned authors referred to the implementation of certain mechanisms that could contribute to sustainable fishing practices, such as respecting closed seasons. This opinion is similar to that of Flores-Morales (2022), who mentions that the closed seasons in Chile have led to a series of benefits of which the recovery of fishing resources is highlighted, and this contributes to an increase in members of the fishing sectors' earnings when the closed season culminates. Another alternative stated in research consists of the use of ecological labeling which, as indicated by Zamora-Saenz (2022), favors the value chain since it certifies that catches were made by taking conservation measures and following international standards, strategies that even permit the exportation of marine products.

According to the present work, those working in the traditional fishing industry see the need for economic assistance which, as stated by Roldán and Urcola (2022), would be given to these people and their families during the closed season. The participants in this study also stressed that it is vital to extend protected marine areas, since this would contribute to protecting habitats that are essential for the feeding and reproduction of species, thus favoring an increase in populations in terms of size and abundance, as stated in the study carried out by Moreno-Gutiérrez and Herrera-Carmona (2023).

Furthermore, concerning the climate change dimension, the people from the traditional fishing industry recognized that climate change could hurt catch rates since natural phenomena such as El Niño and La Niña have modified distribution and reduced the availability of species. This point of view is shared by Mina-Rivas (2023), who states that climate change is affecting the distribution and productivity of populations of fish and marine invertebrates. Changes in the temperatures of oceans (Restrepo-Yepes et al., 2022) may similarly increase invasions by marine species which may, as stated by Martínez-López (2022), favor the displacement of those fish that are tolerant to a wide range of temperatures.

Finally, the various gender perspectives evidenced in the results of this research (third research objective) could be attributed to the gender roles assumed by both men and women in traditional fishing associations and cooperatives. These results coincide with the ideas put forward in the works of Santos (2015); Gissi et al. (2018); Frangoudes and Gerrard (2019); Torre et al. (2019); Pierce (2020); Purcell et al. (2020), who assert that women stand out from men as regards their work in management and sustainable catches. In the case of climate change, the research developed by Cataldo et al. (2023) and Goli et al. (2023) similarly attribute the difference in perspectives to the opportunities that each gender has with the training, experience, fishing effort, access to resources and expenditure created by the activity (Purcell et al., 2020), aspects that condition the role played in the management, production, and commercialization of marine species.

Regarding gender roles in traditional fishing in Ecuador, what stands out is that men tend to be more involved in activities related to catching species and management, which is evident in the fishing-related decision-making processes (Uc-Espadas et al., 2018). Women are, however, more involved in the processing (Santos, 2015; Martins-De-Andrade et al., 2021) and the commercialization of marine products (Harper et al., 2013; Musiello-Fernandes et al., 2020).

It is, therefore, possible to show that the results obtained evidence that gender perspectives play a fundamental role in the promotion of sustainable practices in traditional fishing activities in Ecuador. These fishing activities have, on a small scale, become an important source of livelihood for the communities on the Ecuadorian Coast (Martínez-Ortiz et al., 2015; Marín-Guerrero, 2021). Nevertheless, unsustainable fishing practices and the repercussions of climate change threaten the sustainability of the sector, a situation that is increased by gender-based inequalities (Mina-Rivas, 2023).

In this respect, research has shown that involving women in the decision-making processes related to sustainable fishing practices may lead to the attainment of more effective results (Torre et al., 2019; Aguilar-Manjarrez et al., 2021). For example, women may acquire different knowledge, of which it is possible to

highlight the management of sustainable fishing strategies (Revollo-Fernández et al., 2016; Martins-De-Andrade et al., 2021). Moreover, women are more conscious of the impacts that climate change has on traditional fishing, as evidenced by the modification to climate patterns and the decrease in target species (Monnier et al., 2020).

It is, therefore, necessary to promote gender equality in traditional fishing associations and cooperatives (Mangubhai et al., 2022) by involving women in decision-making and raising awareness in fishing communities of the importance of employing more sustainable practices (Frangoudes and Gerrard, 2019; Purcell et al., 2020) that are better adapted to the repercussions of climate change. It is also necessary to promote the establishment of policies and the carrying out of programs that support women's access to education, training, and resources. This will provide them with the possibility of assuming leadership roles in a framework of equality and will in turn guarantee that benefits are distributed equally among the men and women of the fishing sector. It is necessary to support the role of women in fishing (Carpio et al., 2022) by highlighting their roles, skills, and capacity for leadership, thus allowing them to participate by expressing their opinions and taking part in decision-making processes to the same extent as men (Torre et al., 2019).

The traditional fishing sector in Ecuador is also affected by the repercussions of climate change, which increases with the passing of years. These effects can be perceived in the increase in the temperature and acidification of the oceans (Abeldaño-Zuñiga et al., 2021; Islam and Chuenpagdee, 2022), a situation that is leading to a reduction in marine species (Reyer et al., 2017). In this respect, women in other geographical areas have become the protagonists as regards promoting policies and actions directed toward minimizing the impact of climate change (Khan et al., 2018).

The study of gender perspectives concerning sustainability and climate change in traditional fishing activities in Ecuador is socially relevant because it sheds light on the intersectional impacts of climate change on different groups of people. By evaluating the psychometric properties of a questionnaire, this research could provide a more in-depth understanding of men's and women's roles and responsibilities in traditional fishing activities and how they are affected by climate change. The results of this study could contribute to the development of policies and programs promoting gender equality and sustainability in the fishing sector, thus eventually benefitting local communities and the environment.

In summary, sustainability in traditional fishing in Latin America requires the incorporation of an inclusive and collaborative approach that involves considering gender in fishing policies, a recognition of the diversity of perspectives, and the contribution made by women to the industry. These actions will lead to more sustainable and fairer fishing practices. As shown herein, gender perspectives are fundamental as regards promoting sustainability and climatic resilience in the traditional fishing activities carried out in the provinces of Manabí and Esmeraldas in Ecuador. Recognizing and tackling gender inequalities in the decision-making processes, along with promoting gender equality in fishing communities, will make it possible to promote more effective and sustainable fishing practices that will benefit both the environment and the people who depend on it to earn their living. This research may provide information regarding how gender forms the experiences and perceptions of men and women in the fishing sector in this context, and how these experiences are related to environmental challenges and the climate.

It is, in turn, recognized that many of the socio-cultural limitations related to the fishing culture, such as conservation values, family relationships and hierarchies, and the knowledge and beliefs related to fishing (Teh et al., 2015), make the effective transference or implementation of knowledge difficult, signifying that a multidisciplinary conservation approach is required (Komoroske and Lewison, 2015). Moreover, the fact that this study is based on a self-informed questionnaire (perceptions) may have led to problems with the responses, such as the social conventions and sincerity of the sample when responding, which may have affected the analysis. It would, therefore, be appropriate to contrast the information obtained with another type of data collection (such as interviews) and to incorporate other agents from the world of traditional fishing.

To enhance the rigor of these findings, future research could delve deeper into how specific gender roles shape individual perceptions and responses to sustainability initiatives. This would provide a more nuanced understanding of how to effectively integrate gender perspectives into policies and practices to promote sustainable fishing and address climate change in Ecuador's traditional fishing sector.

Appendix

See Table 4.

Table 4 Characteristics of the population of which the sample was composed.

Ports sampled	Men (*n*)	Men (%)	Women (*n*)	Women (%)	Total population (*n*)	Total population (%)
Province of Manabí						
Cojimíes	3	0.20%	3	0.20%	6	0.40%
Pueblo Nuevo	17	1.16%	0	0%	17	1.16%
Pedernales	2	0.14%	1	0.07%	3	0.21%
La Chorrera	0	0%	1	0.07%	1	0.07%
Don Juan	0	0%	4	0.27%	4	0.27%
San Andrés de Canoa	1	0.07%	0	0%	1	0.07%
Salinas	1	0.07%	14	0.96%	15	1.03%
Verdum	0	0%	25	1.71%	25	1.71%
San Agustín	0	0%	16	1.09%	16	1.09%
Ébano	0	0%	4	0.27%	4	0.27%
San Clemente	0	0%	1	0.07%	1	0.07%
San Jacinto	0	0%	8	0.55%	8	0.55%
Las Gilces	0	0%	9	0.61%	9	0.61%
Los Arenales	0	0%	9	0.61%	9	0.61%

Table 4 (continued)

Ports sampled	Men (*n*)	Men (%)	Women (*n*)	Women (%)	Total population (*n*)	Total population (%)
Crucita	43	2.94%	1	0.07%	44	3.01%
Jaramijó	85	5.81%	51	3.48%	136	9.29%
Manta	85	5.81%	0	0%	85	5.81%
San Mateo	36	2.46%	0	0%	36	2.46%
Santa Marianita	31	2.12%	0	0%	31	2.12%
Ligüiqui	2	0.14%	0	0%	2	0.14%
Cabo San Lorenzo	31	2.12%	0	0%	31	2.12%
Las Piñas	14	0.96%	0	0%	14	0.96%
Santa Rosa	8	0.55%	0	0%	8	0.55%
Puerto Cayo	73	4.98%	0	0%	73	4.98%
Machalilla	151	10.31%	0	0%	151	10.31%
Puerto López	270	18.44%	4	0.27%	274	18.71%
Salango	169	11.54%	0	0%	169	11.54%
Puerto Rico	26	1.77%	0	0%	26	1.77%
Las Tunas	88	6.01%	1	0.07%	89	6.08%
Province of Esmeraldas						
Pampanal de Bolívar	26	1.77%	0	0%	26	1.77%
San Lorenzo	31	2.12%	0	0%	31	2.12%
Tambillo	20	1.37%	0	0%	20	1.37%
Esmeraldas	0	0%	7	0.48%	7	0.48%
Súa	0	0%	8	0.55%	8	0.55%
Estero de Plátano	0	0%	19	1.30%	19	1.30%
Bunche	0	0%	22	1.50%	22	1.50%
San Francisco	0	0%	10	0.68%	10	0.68%
Muisne	0	0%	12	0.82%	12	0.82%
Mompiche	0	0%	8	0.55%	8	0.55%
San José de Chamanga	0	0%	13	0.89%	13	0.89%
Total	1213	82.86%	251	17.14%	1464	100%

Data availability

The datasets generated during and/or analyzed during the current study are available from the corresponding author upon reasonable request.

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Author contributions

Conceptualization: AGVS, BOO, and RSR; methodology: AGVS, BOO, and RSR; software: AGVS and BOO; validation: AGVS, BOO, RSR, and KDML.; formal analysis: AGVS, BOO; investigation: AGVS, BOO, and RSR; resources: AGVS, BOO, RSR, and KDML; data curation, AGVS, BOO; writing—original draft preparation: AGVS, BOO, and RSR; writing—review and editing: AGVS, BOO, RSR, and KDML; visualization: AGVS, BOO, RSR, and KDML; supervision: AGVS, BOO, RSR, and KDML; project administration: RSR; funding acquisition: RSR. All authors have read and agreed to the published version of the manuscript.

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Competing interests

The authors declare no competing interests.

Ethical approval

Fishers were previously informed about the purpose of the present study and research ethical principles were applied to protect their anonymity, dignity, rights, and welfare throughout the whole research project.

Informed consent

Since the research is based solely on insights data and does not involve direct interaction with human respondents, obtaining informed consent from individuals is not applicable in the traditional sense. Nevertheless, every effort has been made to ensure that the information used in this study is aggregated and presented in a manner that preserves individual privacy and confidentiality.

Additional information

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