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RESEARCH ARTICLES

Risk Perception of Small Islands Community on Climate Change: Evidence From Mepar and Baran Islands, Indonesia

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This study explores climate risk perception of communities in two small islands, Mepar and Baran, located in Lingga Regency, Riau Islands Province to fill in the lack of knowledge regarding the topic in Indonesia and to support island bottom-up climate change adaptation planning. This study uses proportional random sampling and a questionnaire survey of 165 households to collect data related to demography, level of knowledge, level of risk perception, and adaptation actions taken by communities. We use descriptive statistics and employ discriminant analysis to determine factors influencing risk perception of these small islands' communities. We identify two categories of risk perception in this study as a basis for analysis, namely risk perception on climate change hazards and climate change risk perception on community's life. This study finds four factors that consistently influence both types of risk perception on climate change. These are the number of climate change indicators perceived, age, and the experience on extreme weather both at sea and on the island. Other influencing factors which have a partial role include the duration of residence on the island, place of birth, education level, and trade relations. We then critically discuss the results within the complexity of small island development and bottom-up climate change adaptation.

1. Introduction

Small islands and coastal regions are among the most vulnerable areas to climate change. Kelman (2018) describes small islands with their vulnerability as an icon of climate change impacts, while the IPCC (2022, p. 2046) projects that "reef island and coastal area habitability in small islands is expected to decrease because of increased temperature, extreme sea levels and degradation of buffering ecosystems, which will increase human exposure to sea-related hazards." Compared to continental areas, community settlements located in low-lying coastal areas and small islands are much more vulnerable to climate change risks and its impacts particularly in term of people's livelihoods (Hiwasaki et al., 2015; Leal Filho et al., 2020; McGranahan et al., 2007; Petzold & Ratter, 2015). Even though the majority of small island communities contribute very little to climate change and its impacts, they are the first group to feel and bear climate change and its impacts (Major et al., 2021).

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Small islands and coastal areas suffer from various kinds of vulnerability due to climate change that is expressed in a number of situations, ranging from sea level rise, extreme events and storms, changes in rainfall patterns, rising air temperatures, and extensive droughts in some areas (Bott et al., 2021; Johnston & Cooper, 2022; Leal Filho et al., 2020; Major et al., 2021; Philippenko et al., 2021; Tallar & Dhian, 2021). IPCC (2021) has reported that global mean sea level increased by 0.20 m between 1901 and 2018. The loss of mass of ice sheets and glaciers was the dominant contributor to the increase in global mean sea level and it is almost certain that global mean sea level will continue to increase until the end of this century due to continuing deep-ocean warming (IPCC, 2021). Recent projections of the IPCC (2021) show that by 2100, depending on the scenario, the global mean sea level will increase in the range of 0.28 m to 1.01 m and by 2150 will increase in the range of 0.37 m to 1.88 m. This change in combination with other climate drivers has impacted various sectors of the coastal economy and people's welfare such as small-scale fisheries, agriculture, and tourism (Amfo & Ali, 2020; Le Cornu et al., 2018; Uyarra et al., 2005).

Small islands face multiple challenges due to the limitations that become their characteristics such as limited land, isolation, and poverty, coupled with limited access to skilled human resources, local weather forecast data, and financial resources in comparison to big cities. These make it more difficult for small islands to develop their adaptive capacity (Bambrick, 2018; Major et al., 2021). Doust et al. (2021) raised a concern that a great number of small coastal cities particularly in small islands are not able to adequately adapt to climate change. Furthermore, unsustainable extraction of natural resources in small islands that causes environmental damage, economic dependence, and declining health could reduce resilience, undermine the adaptive capacity of island ecosystems, and exacerbate the vulnerability of small islands to climate change and its impacts (Bambrick, 2018; Hiwasaki et al., 2015; Maharaj et al., 2019). IPCC (2022, p. 2046) highlights "the continued degradation and transformation of terrestrial and marine ecosystems of small islands due to human-dominated will amplify the vulnerability of island peoples to the impacts of climate change."

Community and stakeholder perceptions influence the policies and actions taken to anticipate impacts of climate change. A desirable perception, timely initiative, and preparedness from the community are often the main factors needed to handle and anticipate sea related hazards (McGranahan et al., 2007; Tourlioti et al., 2021). Public perception and understanding of climate change and its risks affect public support for the formulation and implementation of climate change policies (Pondorfer, 2019; Pyhälä et al., 2016; Takakura et al., 2021). In addition, risk perception is the main driving factor for people's motivation to adapt to climate change and its impacts (Grothmann & Patt, 2005). Although risk perception of climate change has been studied extensively over the last decades, the geographic focus of study on small islands in the equatorial region of the Asian continent, especially Indonesia is under represented.

In fact, Indonesia is an archipelagic country with a land area of nearly 2 million km^2 which has a total of around 17,000 Islands with a number of small islands reaching around 13,000 islands (Tallar & Dhian, 2021). This study aims to understand the climate change risk perceptions of communities living in Indonesian small islands and identify factors influencing their perceptions. It enriches empirical risk perception studies particularly in Indonesian small islands setting which remains limited.

2. Climate Risk Perception of Small Island Communities

The risk perception of climate change has been studied extensively over the last decades and much research has been devoted to uncovering the factors that shape climate change risk perceptions. Research have been carried out in various parts of the world. Wang et al. (2021), for example, focused on the influencing conditions of climate change risk perception on climate change inaction in China, where, a higher level of climate change risk perception will reduce the climate change inaction and positively related to climate change beliefs. Meanwhile, Philippenko et al. (2021) studied the perceptions of climate change and adaptation in the subarctic regions in North America. The research shows that the perception of the people of Saint-Pierre and Miquelon is strongly influenced by factors related to where they live, personal experiences related to coastal hazards, and environmental awareness. Philippenko et al. (2021) shared the same finding with previous research (Whitmarsh, 2011), based on the UK context, stated that environmental concern is proven to be one of the factors that can influence and determine people's perceptions on climate change. In terms of where people live, Whitmarsh (2011) found that people living in rural areas tend to be more doubtful about climate change issues compared to those living in urban areas.

Rothermich et al. (2021) studied the influence of personality traits on attitudes towards climate change in the USA. It reveals that gender and age factors are correlated with individual attitudes on climate change, where older respondents are more likely to resist climate change and male respondents are more likely to believe in climate change. Meanwhile, Whitmarsh (2011) shows that males are more skeptical in viewing climate change and its impacts than females, while older people, 45 years and over, are more skeptical than younger. At this point, Rothermich et al. (2021) and Whitmarsh (2011) have an agreement on the age factor instead of sex.

A study in Papua New Guinea and the Philippines shows that education, access to information via cell phones and radio, as well as market integration (trade relations) are influencing factors of climate change awareness, regardless of any cultural background and the probability of hearing about climate change increases with an individual's level of education, age, and connectivity (Pondorfer, 2019). Furthermore, Ahmed et al (2021) conducted a study on climate change risk perceptions in riverine islands community in Bangladesh and argued that higher levels of education and access to information increase resilience and reduce people's vulnerability in dealing with climate change and its impacts.

However, education and access to information, which are associated to knowledge, should not be simplified as factors leading to adaptation. Tourlioti et al. (2021) examine residents' knowledge and perceptions about coastal erosion in Greece. They found that although residents can recognize the anthropogenic impacts and causes of coastal erosion in their daily lives, including the impact of climate change, they prefer self-help actions and community awareness raising activities rather than having to pay for coastal area restoration and protection activities.

The same case appears on people-place attachment and perceived self-efficacy factors. Strong attachment and relatedness to place of residence seems to be a barrier to adaptation (Philippenko et al., 2021). People who are attached and related to where they live have a better perception of climate change impacts, but it turns out that they seem more reluctant to accept changes. Meanwhile, Maltby et al. (2021) stated that perceived self-efficacy influences fisher's low risk perception in the UK.

We identify two categories of risk perception in this study as a basis for analysis, namely risk perception on climate change hazards and climate change risk perception on community life. While the former focuses on the ability of a group of individual to see, feel, detect, or become aware of climate change related hazards such as increased temperature, sea level rise, and extreme weather and then construct their sense into a risk level opinion, the later emphasizes the impact of these climate change hazards on everyday life such as how they settle, work, and play.

Doust et al. (2021) argue that challenges faced in regions are different, but there are common attributes playing substantial roles which are their communities, government, collective resourcefulness, and means to respond and adapt. Figure 1 shows a systematic categorization of climate change risk perception and its relation to the wider system of climate change adaptation particularly in the small islands context of developing countries, which are often associated with the lack of resources and government support. As a result, most of adaptation in small islands falls in the bottom-up model of adaptation.

Madsen et al. (2019) make an important contribution by connecting a study on climate risk perceptions with the mechanism shaping urban adaptation innovation. Using case study on pluvial and coastal flooding events in Copenhagen, they argue that "an increase in climate risk perception following a localized extreme event gives professionals an opportunity to re-evaluate the wider knowledge subsystem" (p. 36), which lead to climate adaptation innovation given the availability of proactive policy responses to facilitate and extend collaborative professional learning processes and more committed involvement of citizens. Therefore, changes in public risk perception are not only about shifting community awareness in general, but also part of collaborative learning processes amongst communities of professionals.

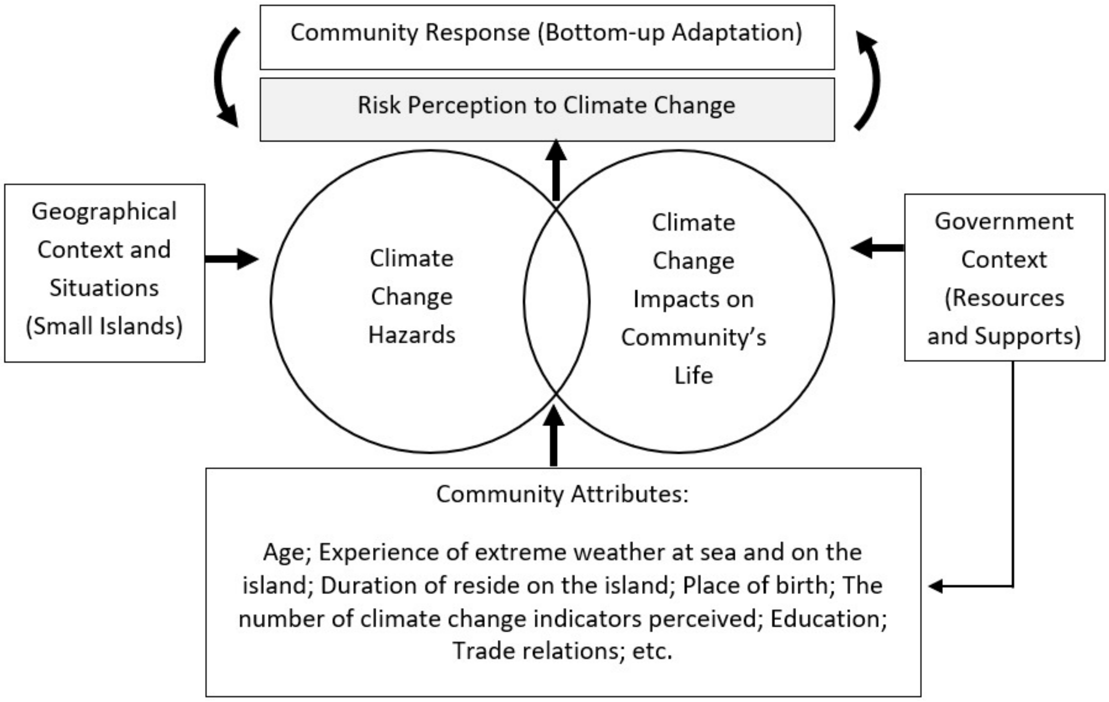

Figure 1. An Analytical Framework on Climate Risk Perception of Small Islands Community

3. Methods

3.1. Study Design

This is a cross-sectional study employing quantitative approach and a survey method. This study relied on primary data collected from a questionnaire to describe and further explain community perception to climate change risk in the small island context.

3.2. Study Area

This research focusses on two tiny islands in Lingga Regency – Riau Islands Province, namely Mepar and Baran Islands as shown in Figure 2. Riau Islands Province itself is a province that has the highest number of small islands in Indonesia. Mepar has 13.83 hectares of land area with a population of 472 people, while Baran Island has 4.75 hectares of land area with a population of 428 people. Besides the limited land area, another unique characteristic is the high population density on these islands. Population density of Mepar Island is about 3174 people/km^2. It is approximately equal to the density of Staten Island in New York City, USA. Meanwhile, population density of Baran Island is much higher reaching at 9106 people/km^2, which is a little denser than Island of Venice, Italy. In fact, the density of Baran Island is also comparable to a half of Jakarta's population density in 2020.

The geographical situation between these two islands is quite different. While Mepar Island experiences coastal erosion as a result of the regular attack of strong annual waves in the region, the geographical situation of Baran Island can be said to be safer than Mepar Island where Baran Island is surrounded by other small islands with mangrove beaches that can function as natural wave barriers. The southern coastal area of Mepar Island is very vulnerable to

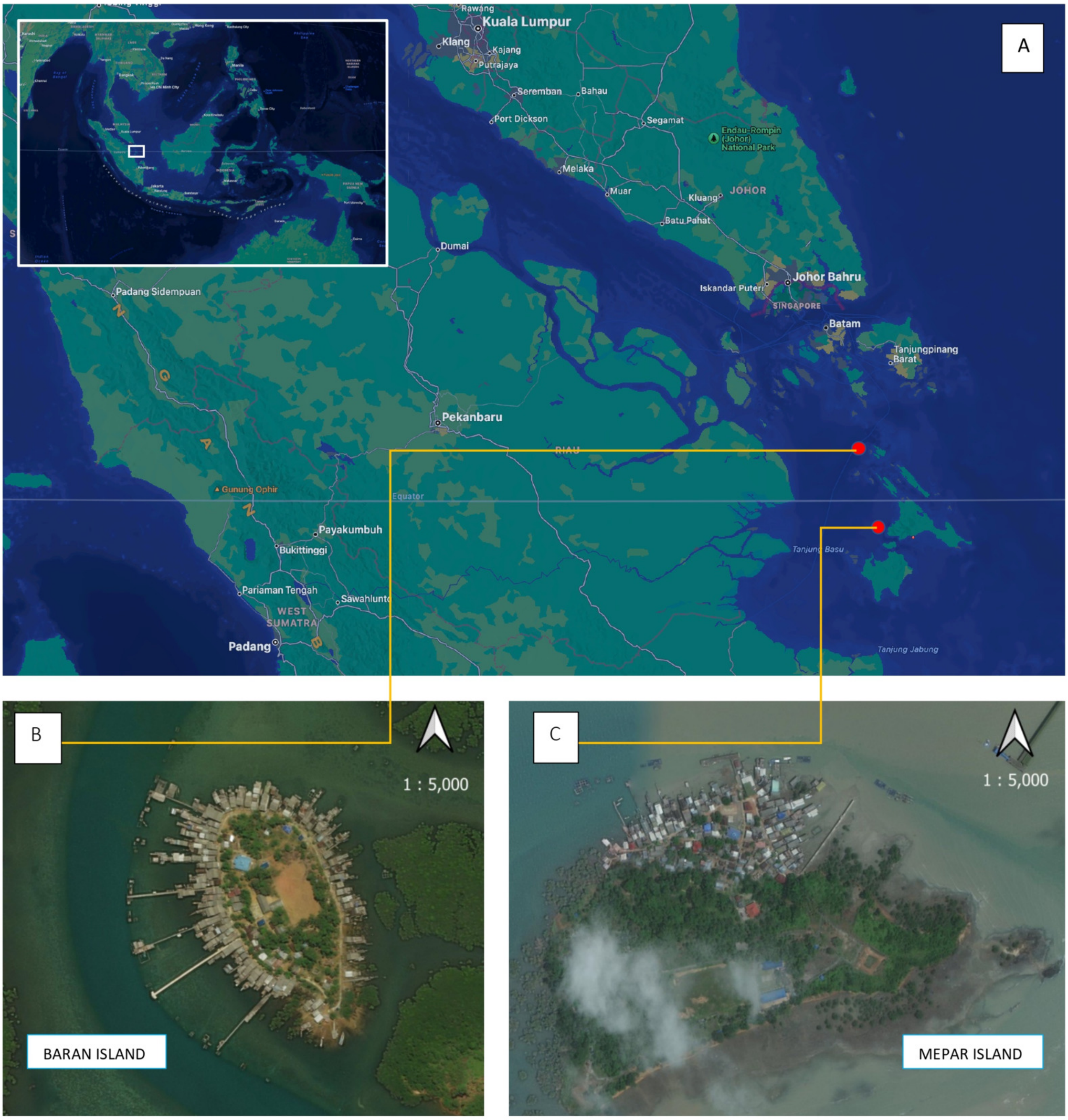

Figure 2. (A) Geographical orientation of the study area; (B) Baran Island; (C) Mepar Island

big waves, especially in the period from May to September. The absence of wave-breaking infrastructure has caused severe beach erosion in this area. These conditions explain local wisdom that settlements are built in the north of the island which is safer from extreme waves throughout the year.

In terms of climate change adaptation, we highlight some contextual situations on the case study. First, the Government of Lingga Regency has mainstreamed the issues of disaster resilience and climate change into its medium-term regional development plan document. Unfortunately, these have only been listed as a strategic issue and have not explicitly appeared in the program and budgeting action plan matrix. Disaster risk reduction and climate change programs in general have received minimal attention and budget allocation. As a result, there are many massive erosion spots in the southern part of Mepar Island which have not yet received repair or remediation measures. An early warning system is not available, neither are there standard procedures for evacuation and evacuation shelter on these islands.

Second, there has been limited preparedness or shifted practices in the community. For example, the majority of the boats that are used daily by the fishermen and islanders are not equipped with safety buoys, although they are familiar with and utilize maps and compass technology on smartphones which are increasingly affordable for them. Another example is that it was local wisdom for the majority of the islander to store reserves of clean water and basic food in their respective homes. However, such practices are rarely found at the village level, including optimizing home gardens to grow food or living pharmacies.

Third, as it is experienced by many other tiny islands in general, Mepar and Baran Islands face vulnerabilities in the provision of safe clean water for the community. The wells on the island cannot fulfill the demand for clean water throughout the year. However, these two islands are quite lucky because they already have a clean water supply infrastructure system sourced from the main island. However, dependence on clean water supplies from other areas adds to the long list of additional vulnerabilities for the people of Mepar and Baran apart from the threat of climate change and its impacts.

Fourth, communities in these islands struggle to access services during the storm season. For example, students, teachers, health workers, employees, traders, and other people living in these islands have to cross back and forth every day to the sub-district and regency capitals on the opposite island, regardless of the weather conditions. Anxious conditions are experienced by patients and their families when they have to undergo advanced medical treatment in the capital. Finally, only a few people have migrated to other safer places in order to avoid disaster, which illustrate either the tendency of the community to maintain its current way of life or the lack of support from the governments to facilitate more transformative adaptation.

3.3. Sampling Procedure and Size

Initial visits to each island were carried out to obtain population demographic data and island conditions. Population and housing data are useful for determining the number and point of sample houses. This study used the Slovin formula (Eq. (1)) to determine the number of samples for each island. Out of 472 people in Mepar and 428 in Baran and by using an error tolerance of 10%, we then collected 83 samples in Mepar and 82 samples in Baran. Then, we used the proportional random sampling, taking into account the number of blocks (RT), the percentage of the population in each block, gender percentage, and the level of maturity to determine the respondent. We consider a table of random numbers in which the last two numbers in the random number table indicate the order of houses/respondents used as the research sample.

$$n = \frac{N}{1 + Ne^2} \quad (1)$$

in which, n = sampling size; N = population number; e = error tolerance

3.4. Questionnaire

We developed a closed type questionnaire containing 78 questions grouped into six sections: (i) respondent's identity, demographic, social and economic characteristics, (ii) indicators of climate change and its perceived impacts, (iii) climate change knowledges, (iv) risk perception on climate change hazard and on community's life, (v) factors which are influencing risk perception, and (vi) adaptation actions taken.

Some questions have follow up questions, so a question in one section sometimes is closely connected to a question in another section. For example, the key section on risk perception on climate change hazard itself consist of six questions following respondent's identification on the climate change indicators. Therefore, a question found in the questionnaire such as: "Among these indicators, six listed types of hazards (e.g., drought, disruption of seasons, increasing surface temperature, etc.), do you find that they have been increasingly worrying?" Then, for each listed hazard, five answer options based on a 5-point Likert Scale (e.g., strongly disagree, disagree, undecided, agree, and strongly agree) are provided. A similar approach was also used for the climate change risk perception on the community's life. It consists of eight questions adapted from the risk perception index by Leiserowitz (2006). An example of question such as: "Among these conditions (eight listed elements of community life), how do you agree that these are affected by the identified hazards?"

3.5. Data Collection

The principal researcher administered data collection with the support of one local community member surveyor in each island. The principal researcher trained the surveyor and tested the questionnaire prior to data collection. The questionnaire survey took place in the last quarter of 2022 and lasted for approximately two months. It was a paper-based questionnaire in the Indonesian language. The surveyor read the questions to the respondents and then they wrote down the answers. Finally, principal researcher reviewed all the sheets and recapitulated the answers.

3.6. Data Analysis

The primary data was then processed using descriptive statistical analysis to determine the level of climate change knowledge, risk perception of climate change hazards, and climate change risk perception in community life. The climate change knowledge score is a composite value of average percentage of the number of "yes" answers to a total of seven questions related to knowledge of climate change. The risk perception on climate change hazard score is calculated based on the average percentage of "strongly agree" and "agree" answers out of a total of six questions related to risk perception on climate change based on the source of the threat. The climate change risk perception on community life score considers the average percentage of "strongly agree" and "agree" answers out of a total of eight questions related to risk perception on climate change based on people's life stages.

Finally, this study employs a discriminant analysis on SPSS to determine factors influencing the risk perception on people of Mepar and Baran Islands towards climate change hazards and its impacts on community life. Twenty-three independent variables were tested for their influence. This study identified risk perception, either based on hazard or its impact, into three categories, low, medium, and high, as dependent variables. Then, normality, homogeneity, and multicollinearity tests were applied to the analyzed group of samples to determine its adequacy.

4. Results

4.1. Demographic Profile

People living on Mepar and Baran Islands are dominated by Malays (94.59%), married (92.12%), and work as fishermen (46.67%). The majority live in stilt houses (70.91%), they were born on the island (79.39%), and generally have lived on the island for more than 15 years (85.45%). The majority (96.97%) have an average monthly income below three million IDR which is the regional minimum wage standard and most of them (50.91%) have only graduated from elementary school. The age group of the sample was relatively evenly distributed at the age of 30 and over and only a few below 30. There were no samples aged 20 and under. Most people on the Baran Island live above the seawater (73.17%), while on Mepar Island those living above the seawater, beach, and land are relatively evenly distributed. Table 1 provides the summary of key demographic profile of these two case study islands.

4.2. Knowledge and Risk Perception on Climate Change

The descriptive statistical analysis shows that overall, the level of climate change knowledge of the population in both islands is moderate (58.18%). The level of climate change knowledge between these two islands is relatively balanced. Mepar community's level (59.55%) is slightly higher than those on Baran Island (56.79%) as shown in Table 2.

Meanwhile, the level of risk perception on climate change hazard in both islands is a quite high (78.48%) and it is at moderate level (47.30%) on climate change risk perception on community's life category. For these perception risks, however, the risk perception scores of the population in Baran Island are higher than those in Mepar Island. Table 2 shows the level of climate change knowledge and perception of risks in both Island's community.

4.3. Factors Influencing Risk Perception

We analyzed factors influencing risk perception based on several categories including demographic (e.g., working age and elderly age groups), location (e.g., Mepar, Baran, and both groups), and gender (male and female groups). Then, we conducted tests using these groups of samples to determine their acceptability for further analysis. All these groups must pass normality, homogeneity, and multicollinearity tests. Based on the result of Table 3, we

Table 1. Demographic, social, and economic characteristics of the respondents

		Mepar	Baran	Average
Gender	Male	49.40%	52.44%	50.91%
	Female	50.60%	47.56%	49.09%
Age	< 21	0.00%	0.0%	0.0%
	21 - 30	6.02%	2.44%	4.24%
	31 - 40	28.92%	24.39%	26.67%
	41 - 50	24.10%	25.61%	24.85%
	51 - 60	25.30%	28.05%	26.67%
	>= 61	15.66%	19.51%	17.58%
Ethnic	Malay	97.59%	91.46%	94.55%
	Chinese	1.20%	2.44%	1.82%
	Other	1.20%	6.10%	3.64%
Marital status	Married	95.18%	89.02%	92.12%
	Not married	4.82%	10.98%	7.88%
Profession	Fisher	40.96%	52.44%	46.67%
	Office / government employee	7.23%	4.88%	6.06%
	Education / health personnel	2.41%	2.44%	2.42%
	Trader / seller	19.28%	18.29%	18.79%
	Farmer	1.20%	1.22%	1.21%
	Others (including housewives)	28.92%	20.73%	24.85%
Distance to job location	< 100 m	46.99%	39.02%	43.03%
	100 m – 1 km	19.28%	17.07%	18.18%
	>1 km	33.73%	43.90%	38.79%
Type of house	House on stilts	63.86%	78.05%	70.91%
	Landed house	25.30%	14.63%	20.00%
	Others	10.84%	7.32%	9.09%
Settlement typology	Above the sea	37.35%	73.17%	55.15%
	Coastal	38.55%	17.07%	27.88%
	Inland	24.10%	9.76%	16.97%
Duration of reside on the island	<5 years	4.82%	1.22%	3.03%
	5 – 15 years	6.02%	17.07%	11.52%
	>15 years	89.16%	81.71%	85.45%
Level of education	Never go to school	0.00%	10.98%	5.45%
	Not finish primary school	25.30%	15.85%	20.61%
	Primary school	57.83%	43.90%	50.91%
	Secondary school	7.23%	18.29%	12.73%
	Senior High School	8.43%	8.54%	8.48%
	Under graduate	1.20%	2.44%	1.82%
	Post graduate	0.00%	0.00%	0.00%
Monthly income	< Regional minimum wage	98.80%	95.12%	96.97%
	> Regional minimum wage	1.20%	4.88%	3.03%
Place of birth	Island	78.31%	80.49%	79.39%
	Outside the island	21.69%	19.51%	20.61%

Source: primary survey 2022

excluded analysis factors influencing perception of risks for male group and both combined Mepar and Baran groups because they have not succeeded in passing all the required tests. We also excluded those groups which only passed the test partially such as elderly age, Mepar, and Baran groups.

Table 2. The level of climate change knowledge and perception of risks

Island	Climate Change Knowledge	Risk Perception on	
		Climate change hazard	Community's life
Mepar	59.55%	73.70%	42.30%
Baran	56.79%	83.33%	52.30%
Average	58.18%	78.48%	47.30%

Note: Low (<40%); Moderate (40-75%); High (>75%)

Table 3. Factors influencing risk perception in Mepar and Baran Islands

Categories / Influencing Factors	Risk Perception on			
	Climate change hazards		Community's life	
	Function 1	Function 2	Function 1	Function 2
BY DEMOGRAPHIC:				
Working Age Group				
Age (X_1)	-0.559	0.271	-0.473	0.390
Experience of extreme weather at sea (X_2)	0.598	-0.318	0.890	-0.056
Experience of extreme weather on island (X_3)	-0.371	0.212	-0.636	-0.408
Duration of residence on the island (X_4)	1.041	2.471		
Place of birth (born in the location or not) (X_5)	-1.437	-1.529		
The number of climate change indicators perceived (X_6)	0.421	-0.080	0.423	0.052
Education level (X_7)			0.013	0.688
Trade relations (X_8)			-0.927	1.522
(Constant)	-1.633	-3.379	-1.238	-1.209
Elderly Age Group				
The number of climate change indicators perceived (X_6)	not pass statistical tests		0.610	
(Constant)			-3.049	
BY LOCATION:				
Mepar Group				
Duration of residence on the island (X_4)	2.775	0.323	not pass statistical tests	
Place of birth (born in the location or not) (X_5)	-1.991	2.190		
(Constant)	-3.557	-2.311		
Baran Group				
The number of climate change indicators perceived (X_6)	0.755		not pass statistical tests	
(Constant)	-4.124			
Both Mepar and Baran	not pass statistical tests		not pass statistical tests	
BY GENDER:				
Combined Male Group	not pass statistical tests		not pass statistical tests	
Combined Female Group				
Duration of residence on the island (X_4)	1.815	-1.918		
Place of birth (born in the location or not) (X_5)	-1.874	1.079		
The number of climate change indicators perceived (X_6)	0.458	0.471	0.655	-0.262
Experience of extreme weather at sea (X_2)			0.595	0.818
Experience of extreme weather on island (X_3)			-0.699	-0.108
(Constant)	-3.886	0.354	-3.078	0.307

Table 4. Classification results[a,c] on risk perception on climate change hazard

Risk perception on climate change hazard				Predicted Group Membership						Total
				Low		Moderate		High		
Original	Count	Low	1	1	100.0%	0	0.0%	0	0.0%	1
		Mod.	90	3	3.3%	64	71.1%	23	25.6%	90
		High	45	1	2.2%	10	22.2%	34	75.6%	45
Cross-validated[b]	Count	Low	1	0	0.0%	1	31.1%	0	0.0%	1
		Middle	90	3	3.3%	63	31.1%	24	26.7%	90
		High	45	1	2.2%	14	31.1%	30	66.7%	45

a. 72.8% of original grouped cases correctly classified.

b. Cross validation is done only for those cases in the analysis. In cross validation, each case is classified by the functions derived from all cases other than that case.

c. 68.4% of cross-validated grouped cases correctly classified.

Table 5. Classification results[a,c] on climate change risk perception on community's life

Climate change risk perception on community's life				Predicted Group Membership						Total
				Low		Moderate		High		
Original	Count	Low	13	8	61.5%	4	30.8%	1	7.7%	13
		Mod.	89	21	23.6%	51	57.3%	17	19.1%	89
		High	34	2	5.9%	4	11.8%	28	82.4%	34
Cross-validated[b]	Count	Low	13	5	38.5%	7	53.8%	1	7.7%	13
		Middle	89	22	24.7%	49	55.1%	18	20.2%	89
		High	34	2	5.9%	7	20.6%	25	73.5%	34

a. 64.0% of original grouped cases correctly classified.

b. Cross validation is done only for those cases in the analysis. In cross validation, each case is classified by the functions derived from all cases other than that case.

c. 58.1% of cross-validated grouped cases correctly classified.

Adequate analysis on factor influencing perception of risks can be found in the female and working age groups. However, this study highlights analysis on working age group, which is reasonable as it shared almost 83% of the total of population, the largest compelling demographic group in the study area.

In this working age group both in Mepar and Baran, several factors were found to influence risk perception on climate change hazards, namely: age, the experience of extreme weather at sea, the experience of extreme weather on the island, duration of reside on the island, place of birth, and the number of climate change indicators perceived by the population. Whereas on the risk perception on community's life, the influencing factors include age, education level, the experience of extreme weather at sea, the experience of extreme weather on the island, frequency of interactions through trade relations, and the number of climate change indicators perceived by the population. Table 3 outlines factors influencing risk perception the study area by based on various categories.

Table 4 and 5 shows the final results of the discriminant analysis using the SPSS program (as represented by all of the working age group).

The number of climate change indicators perceived by respondents is a new finding under this study which is also a factor influencing the risk perception of small island communities on climate change. There are a total of eight

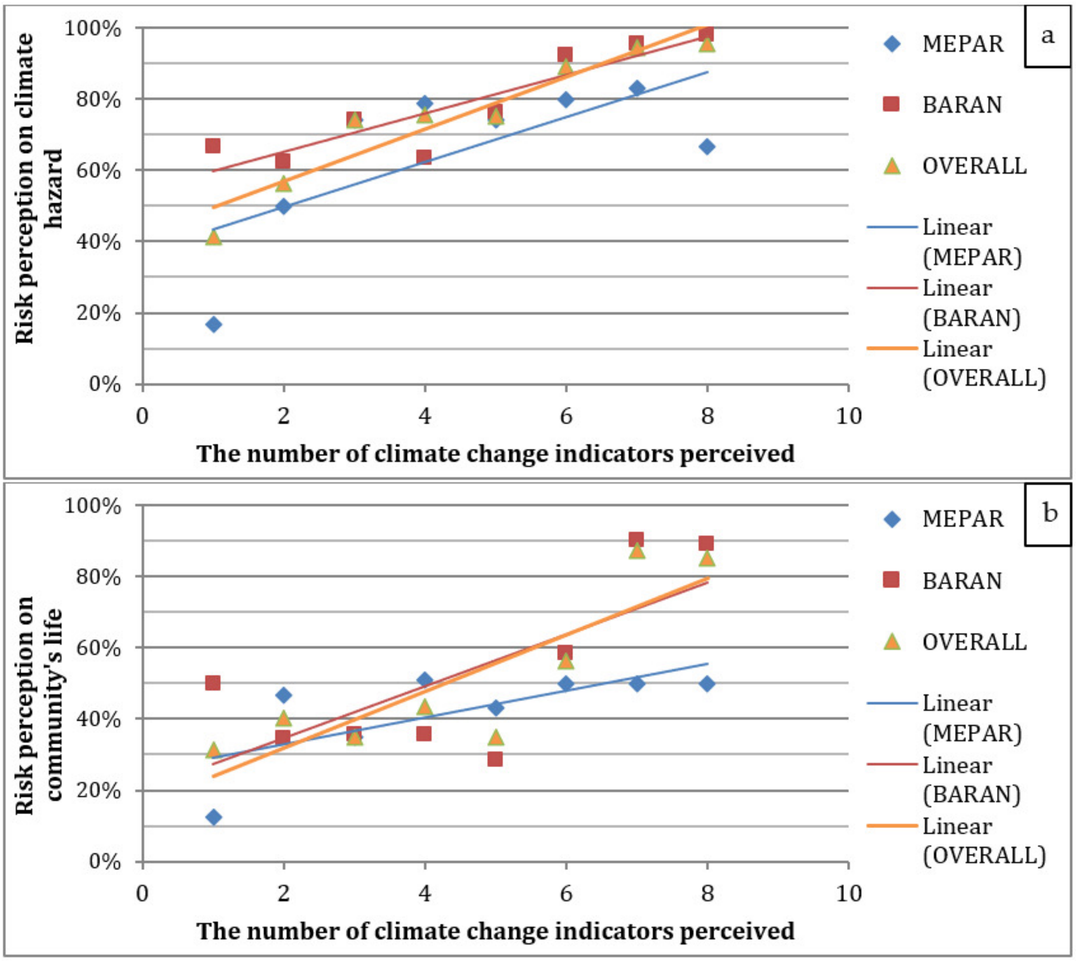

Figure 3. Risk perception on climate change hazard (a) and on community's life (b) based on the number of climate change indicators perceived.

climate change indicators which can be selected more than once according to what each respondent's experience. The descriptive statistics also shows a pattern of a positive relationship between the number of indicators of climate change perceived and the level of risk perceptions, both risk perception on climate change hazard and on community life. The greater the number of climate change situations perceived, the higher the risk perception scores of the population as shown in Figure 3. This factor appears strongly in the analysis of the productive age – the majority percentage of population in the islands – and elderly groups.

5. Discussion

Although the level of knowledge on climate change in Mepar and Baran categorized as moderate, this study discovered that the level of risk perception on climate change hazard in both islands is quite high (78.5%) and moderate (47.3%) in the community's life category. However, the risk perception scores of the population on Baran Island are greater than those on Mepar Island for similar perception issues.

There are several categories in which the highest scores for the climate change knowledge and risk perception indicators are dominated simultaneously by the same sample group for each category. Men aged 21-30 years old who repeatedly experience extreme weather at sea are aware of weather changes, have a positive attitude towards the hazard and impacts of climate change, are intense in conducting trade interactions, and are literate with climate change information will likely have a high level of knowledge as well as a high-risk perception of climate change. These results align with the research of Rothermich et al. (2021) in the United States, which revealed that older respondents were more likely to reject climate change issues and men were more likely to believe in climate change. However, it contradicts the results of studies by Fletcher et al. (2021) and Pondorfer (2019) which state that women pay more attention to and worry about climate change issues and that age level is positively related and influences the community's climate change awareness. It shows that findings in this field vary across case study context.

There are four factors found in this study that consistently influence both types of risk perception on climate change, namely: age (X1), the experience of extreme weather at sea (X2) and on the island (X3), and the number of climate change indicators perceived (X6). The results of previous research stated that the age factor is also a factor that influences the level of public awareness, skepticism, and concern about climate change (Fletcher et al., 2021; Pondorfer, 2019; Rothermich et al., 2021; Whitmarsh, 2011). As for the experience of extreme weather at sea and on the island, they are in accordance with the results of Philippenko et al. (2021) which state that personal experience of coastal hazards is one of the factors influencing people's perceptions on climate change.

The duration of residence on the island (X4) and place of birth (X5) are two factors that only affect the risk perception of climate change hazards and do not affect the climate change risk perception on community's life. These two variables represent attachment to location and inner relationship among the residents. The results of the discriminant analysis which is corroborated by descriptive statistics shows that the longer the respondents live on the island, the higher the level of risk perception of climate change hazards. This finding supports the results of a previous study by Philippenko et al. (2021) which stated that there is a relationship between the location of birth and inner relationship among the residents, and people's risk perceptions on climate change (Goeldner-Gianella et al., 2019; Philippenko et al., 2021; Pondorfer, 2019; Whitmarsh, 2011). The duration of stay on the island and place of birth factors are in line with and related to the factor of the experience of extreme weather on the island and also at sea. The longer the respondents live on the island, the more likely they will feel and experience various hazards of climate change, which affect their risk perception on climate change (Pondorfer, 2019).

A similar condition is also evident for the factor of education level (X7) and trade relations (X8). These are two factors that affect climate change risk perception on community life, but do not affect risk perception of climate change hazards. Adequate level of education seems to be the differentiator under this study. A high level of education may not be necessary for someone to recognize the obvious danger of climate change. However, the ability to link the climate change being perceived with the affected sectors of life such as increasing poverty and decreasing quality of life, certainly requires a certain level of awareness that comes from education. This result is consistent with a number of studies that find educational factors influencing various parameters related to risk perception, such as level of skepticism and uncertainty about climate change, climate change awareness, climate change knowledge, and the willingness to accept limitations in the context of climate change adaptation policies and its impacts, both directly and indirectly (Ahmed et al., 2021; Goeldner-Gianella et al., 2019; Jamero et al., 2019; Philippenko et al., 2021; Pondorfer, 2019; Whitmarsh, 2011).

This study informs the extent of the small island communities in Indonesia accepting the idea of climate change as a basis to initiate further development of plans and policies in small islands that are adaptive to climate change and its impacts. We discuss our result from its potential to improve climate change adaptation actions and policies in small islands and the tendency of collaborative and bottom-up adaptation. First, a good level of community risk perception on climate change may influence community response to disaster risk reduction and adaptation actions, as well as community support for the formulation and implementation of policies to address climate change and its impacts (Grothmann & Patt, 2005; Maltby et al., 2021; McGranahan et al., 2007; Pondorfer, 2019; Pyhälä et al., 2016; Takakura et al., 2021; Tourlioti et al., 2021). In contrast, a decrease in climate change risk perception would weaken common intentions to deal with climate change (Wang et al., 2021; Xiang et al., 2019). Furthermore, Bradley et al. (2020) also emphasize that individual actions and behavior make a major contribution to climate change, and therefore analyzing the factors that influence individual's attitude or perception towards climate change risks is an important step to changing habits, improving behavior, and developing adaptation to climate change and its impacts (Bradley et al., 2020).

Apart from being one of the factors influencing risk perception, education plays a key role for successful climate change adaptation measures in small islands because education is the main driver of behavior change (Siegner, 2018). This case study showed that respondents have a quite high level of risk perception on climate change hazard category, but have a lower level on the category of climate change risk perception on community life. In other words, although they are aware of and understand the critical hazards of climate change that they do see and feel on a daily basis, it is evident that recognition of the impact of climate change on people's lives is somewhat lower. Overall, the community has a moderate level of climate change knowledge and risk perception, while evidence of climate change adaptation measures in the community and government in these islands are limited. As most of community attributes in small islands are given and predestined, this study therefore recommends that the local government needs to incorporate climate change education agenda into the school curriculum, extracurricular activities and local community organizations or forums. This initiative aims to strengthen and increase the level of knowledge and the risk perception of small island communities and transmit it to all levels of society.

The level of education plays a key role in increasing public knowledge about climate change at least after the senior high school (Goeldner-Gianella et al., 2019) and diploma (Philippenko et al., 2021) levels, which are part of the younger generation. With a case of the center region of the Philippines, Jamero et al. (2019) shows that improving the quality of education through formal and vocational educations on the island succeeded in increasing awareness of the younger generation to relocate to safer places voluntarily. A higher level of education also has an effect on increasing community resilience and reducing community vulnerability in dealing with climate change and its impacts (Ahmed et al., 2021). In short, improving risk perception through education will likely have a positive impact on the island's young generation so they have awareness to address future climate change. Additionally, the involvement of island senior community leaders and competent individuals who have experienced extreme weather at sea and on islands, born and reside for a long period of time on the islands and also can perceived many climate change indicators, can be involved to optimize the success of increasing risk perception and changing the behavior of the next generation.

Second, taking into account that collaboration is one of the keys to encouraging community resilience (Syddall et al., 2022), this study suggests "risk-framing work by professionals" (Madsen et al., 2019). In addition to enhancing risk perception among the community, it is also beneficial to engage professional communities including politicians, local governments, NGOs, and academics to have a higher or better risk perception to climate change and its impacts, particularly on small islands. The involvement of these professionals who have access to determining development policy directions and budget priorities, data, research, and policy advocacy, is expected to be able to complement the improvement of climate change risk perception of the small island communities, though their profession supports adaptation or transformation.

Third, considering the complexity and unfavorable conditions in small islands, appropriate adaptation strategies are needed to increase the resilience of small islands by taking into account their economic potential, social, and local culture (Major et al., 2021; Teniwut et al., 2022). Regardless the type of adaptation strategies, it will only be effective if it is combined with behavior change prioritizing climate change on their socio-cultural awareness (Siegner, 2018).

The examination of community risk perception about climate change is mostly linked to the urgency of bottom-up adaptation, especially in developing countries, where the institutional arrangement and resources to support adaptation is not reliable (Doust et al., 2021). Awareness and adequate perception to risks is one of prerequisites so that bottom-up adaptation may flourish. However, considering that the key conditions of the case study are relevant with many other small islands, as appears in number of studies (IPCC, 2022; Lehmann et al., 2021; O'Donoghue et al., 2021), this study suggests that improving risk perception is not sufficient to ignite adequate climate change adaptation, particularly in the small islands context which mostly lack of resources and capacity in comparison to major cities on the mainland. IPCC (2022, p. 2047) with a high confidence category highlight that "for many small islands, adaptation actions are often incremental and do not match the scale of extreme or compounding events. Much of the currently implemented adaptation measures remain small in scale (e.g., community-based adaptation projects), sectoral in focus and do not address the needed structural and system-level adaptations to combat climate impacts and achieve long-term sustainability of adaptation interventions." These barriers and constraining conditions need to be addressed creatively. Therefore, addressing availability of finance and technology, human resource capacity, skills and toolboxes of methodology, and locally relevant information for decision making, as well as integrating local wisdom of the island communities remain crucial (Doust et al., 2021; IPCC, 2022; O'Donoghue et al., 2021).

Despite thousands of other small islands in the province which may have different characteristics, this research can only collect data on two small islands. However, the robust methodology we employed leads to a strong result in this case, but increasing the number of islands for data collection and analysis in future research will be useful for testing the consistency of result. Further research related to the relationship between the risk perceptions of the islanders and the adaptation actions taken is important. In the setting of small islands, we suspect that there is no link between risk perceptions and planned adaptation behaviors because the role of government and governance does matter. This leads to the last direction of further research based on our proposed analytical framework (see Figure 1). Further research needs to emphasis the governmental and governance contexts of the small islands to understand its strengths and the limits of support for small islands' bottom-up adaptation planning.

6. Conclusion

This study aims to understand the climate change risk perceptions of communities living in both small islands and identify factors influencing their perceptions. Results confirmed a number of previous research related to the factors influencing climate risk perception of small island communities. It concludes that the number of climate change indicators perceived, age, the experience on extreme weather both at sea and on the island, the duration of residence on the island, place of birth, education level, and trade relations play role with different degree in influencing the level of climate risk perception. This study identified four characteristics influencing both forms of climate change risk perception. These are the number of perceived climate change indicators, age, and experience with extreme weather both at sea and on the island. However, this study indicates that risk perception to climate change has nothing to do with adaptive behavior of the islander. Therefore, improving risk perception is not sufficient to ignite adequate climate change adaptation, particularly in the small islands context which mostly lack of resources and capacity. Therefore, leveraging bottom-up adaptation with a more transformative one through eliminating barriers and constraints as well as facilitating collaborative professional communities such as politicians, local governments, NGOs, and academics who have access to determining development policy directions and budget priorities, data, research, and policy advocacy remains crucial for small islands.

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