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The role of gender as a model of climate change adaptation in fisherman settlement communities

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Abstract. Women are the largest proportion of the world's poor, including children and young women. Women are very vulnerable to climate change. But until now gender considerations are still not explicitly stated in various climate change policies. In the marine and fisheries sector, extreme climate change makes many fishermen unable to go to sea and fish declines. The unequal division of gender roles causes the level of vulnerability to climate change to differ between women and men. This study aims to analyze the vulnerability and gender roles of fishing communities due to climate change in West Sumatra. A positivistic-deductive research approach. Indicators / parameters used by the index to measure vulnerability in 2 coastal areas, namely Bungus Beach and Pariaman Beach. Secondary data obtained from the Geophysical Meteorology Agency station. Primary data through interviews with questionnaire tools on 60 respondents. The vulnerability model (V) is a function of exposure (E), sensitivity (S), and adaptive capacity (AC), which are then expressed mathematically. The results showed a vulnerability index of 305 with a vulnerable classification. Efforts to increase adaptive capacity and reduce women's vulnerability to climate change through a comfortable place to live, better access to climate change information and livelihood options. Gender-based climate change adaptation models for coastal areas are increasing women's political role, increasing women's skills capacity through field schools Climate and enhancement productive work.

1. Introduction

Climate change will have different impacts in each country, region, generation, class, occupation, gender, age and income. From 1975 - 2006, most natural disasters occurred on the Asian continent. Of the vulnerable groups, including 3.4 million people from groups of poor people, children, indigenous peoples, farmers and fishermen. Women are the largest proportion of the world's poor, including children and adolescent girls, very vulnerable to climate change [1].

Climate change has the most severe impact on women from the lowest social groups. In each disaster it turns out that female victims are larger than men with a ratio of 4: 1. The results of the analysis of disasters that occurred in 141 countries proved that differences in the number of victims due to natural disasters were closely related to women's economic and social rights [2].

Gender is an important issue because of the inequality factor and the specific needs of women in disaster situations [3]. In a hazard perspective, the spatial dimension is very important to identify risky societies, but must be linked to understanding socio-economic differentiation, linkages and dynamics within the region. But until now gender considerations are still not explicitly stated in various climate change policies [3].



In the maritime and fisheries sector, after being hit by various destructive efforts in coastal areas, extreme weather changes made many fishermen unable to go to sea. The results of aquaculture and fishing are decreasing. Previously, the number of days they went to sea was 240-300 days a year, now it is only 160-180 days. As a result, the income of traditional fishermen has also reduced to around 50 to 70 percent. That is, the income of fishermen's family is reduced. And usually, the woman redeemed the deficiency.

Natural signs that are usually used by fishermen determine the harvest season. Now you can't be a guide anymore. On the coast of Indramayu, people used to know about the signs of nature. Until 2003, fishermen were still able to estimate the west and east winds. The west season was marked by abundant catches of Rajungan and Sotong. But, for the past three years, since 2005, the public has been unable to predict the weather changes [4]. Desmawan's research due to climate change is the presence of floods such as in the coastal areas of Central Java with the impact of Damage to residential buildings because in addition to flooding the floor and yard surfaces, Rob flooding is corrosion and damaging to buildings [5].

West Sumatra Province has a coastline of approximately 375 km, in the form of lowland as part of the archipelago of the bow face. The mapping location along the coast belongs to the Province of West Sumatra, and covers two cities and four districts, namely Padang City, Pariaman City, Pesisir Selatan Region, Agam Region, west Pasaman Region, and Padang Pariaman Region [6].

On this occasion, a gender perspective will look at the level of vulnerability of fishing communities and the role of gender that is created in efforts to deal with climate change in West Sumatra Province. The level of vulnerability and community adaptation patterns were analyzed using gender analysis that emphasized gender relations and roles created in fishermen's households. The unequal division of gender roles causes the level of vulnerability to climate change to differ between women and men. This study aims to analyze the vulnerability and strategy of gender roles of fishing communities due to climate change in West Sumatra. So that research is beneficial for the government as information that can influence decision making in determining development policies, especially development in the fisheries and health sectors.

2. Research Methods

The Research was conducted with a quantitative approach that was positivistic-deductive. Starting from the concept and operationalized into indicators / parameters in the form of indexes to measure vulnerabilities. Quantitative research methods identify variables that influence the index of vulnerability. In a variety of quantitative research, this study classified research explanations to describe the gender disparities in adaptation to environmental changes and find adaptive strategies. The population is all family heads of people living in coastal areas in Padang city, West Sumatra Province. The number of coastal areas of the city as many as 7 regions, researchers took 2 coastal areas namely Bungus beach and Pariaman beach with 234 families. The sample is a portion of the population with a probability proportional to size (PPS) sampling. Based on the calculation of the sample, the number of samples for the city of Padang was 30 respondents and the Pariaman beach was 30 respondents.

The data used were primary and secondary data. The collection of secondary data was obtained from the climatology Geophysical Meteorology Station. Primary data through interviews with questionnaire tools. Processing and analyzing data using a computer. The sequence of analysis carried out in this study is as follows: a. direct data collection to analyze the criteria and indicators used in determining the level of community vulnerability to climate change. The vulnerability index model constructed in this study is a static model of coastal area environmental vulnerability index. Turner (2013) uses the concept of environmental vulnerability. Where vulnerability (V) is an function overlay of exposure (E), sensitivity (S), and adaptive capacity (AC) [7]. Then expressed mathematically by Metzger et al. (2006) as in equation (1). Equation (1) is further expressed in the form of mathematical equations by Hamzah et al. (in press) and also has similarities developed by UNU-EHS (2006) to [8]:

$$V = (E \times S) / AC \quad (1)$$

The EVI report for an area is arranged on one page. The information available on the report includes the overall EVI score in points, with the percent of data calculated and the overall vulnerability classification. The classification, shown below, quickly identifies whether the environment of an area of vulnerability is very high overall [9].

Table 1. Classification of Vulnerability Indices an Area

Classification	Total scores
- Extremely vulnerable	375 +
- Highly vulnerability	315 +
- Vulnerability	265 +
- at risk	215 +
- resilient	< 215

3. Result and Discussion

3.1. General Description

The research location for the city of Padang is at the Bungus district. Bungus district has a coastline length of 21,050 meters and a bay length of 5,418 meters, volume 223,255,052.2 m³, has a rounded surface shape and a surface area of 1383.86 Ha located south of Teluk Bayur and has a strategic position overlooking the Indian Ocean. This bay is included in Bungus district and is one of the coastal sub-districts in the southern region of Padang City. Astronomically this sub-district is in the position 01°01'21 " - 01°05'02 " South Latitude (SL) and 100°21'58 " - 100°26'36 " East Longitude (EL) and located on the west coast of Sumatra Island. Bungus district is at an average height of around 0-5 m above sea level for coastal areas, and <850 m for hilly areas. The temperature ranges from 22.5°C - 31.5°C and rainfall is 314.47 mm / month.

Bungus beach is affected by the condition of the Indian Ocean. Dominant incoming wave directions from the West and Northwest, where waves come from the Indian Ocean towards the Bay of Bungus. Significant wave height, which is an average of 1/3 of the measured average wave height, shows the range of wave height ranges between 0.02 m - 0.2 m, with the highest wave amplitude of 0.189 m and the average wave amplitude (mean) 0.0975 m. The dominant tidal current direction at high tide is westward, while at low tide the dominant tide moves towards the bay to the southeast. Bungus male population is more than the female population.

Geographically, Pariaman City is located on the West Coast of Sumatra Island and faces directly to Indonesia Ocean. The astronomical position of Pariaman City is between 00°33' 00" - 00° 40' 43" South Latitude and 100° 04' 46" - 100° 10' 55" East Longitude, with an area of about 73.36 Km², and coastline length of 12.00 Km. The land area of this area is only 0.17 percent of the land area of West Sumatra Province. Pariaman City is also identical with the coastal city where all Sub-districts in Pariaman City have an area bordering the beach except East Pariaman District. The average height of the region is in the range of 0-15 meters above sea level.

Pariaman Beach are strongly influenced by the strong Indian Ocean waves reaching the coast. The abrasion process (coastal erosion) occurs predominantly along the coast, while the process of land erosion is also intensive in the upstream area, marked by the high supply of sediment carried by the river flow to the sea. Wind direction comes from the west with the percentage of wind incidence as much as 8.49%. While the minimum percentage is achieved by winds from the south with an incidence percentage of 0.04%. wave conditions in these waters are relatively normal with altitudes ranging from 0.1-1 m. The most common wave is the westward wave with the percentage of occurrence of 8.49%, the highest percentage is 8.47% with an altitude between 0.1-1 m.

3.2. Climate Change

Based on the Sicincin BMKG analysis of the monthly temperature of the Padang City during 2017 January and December shows the temperature variations of these two regions. The average temperature in the city of Padang is higher than in the Pariaman City and the increase in temperature is higher in May in both regions.

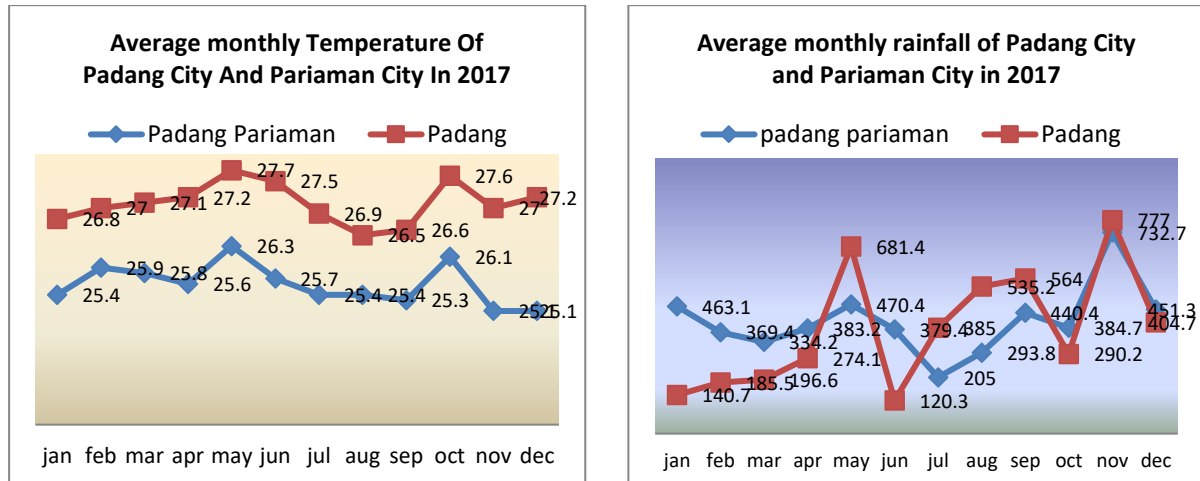


Figure 1. Average temperature and monthly rainfall of Padang City and Pariaman City in 2017

Source: BMKG Sicincin Station

Based on temperature trend data during the 2008-2017 period at Sicincin BMKG Station, which represents the coastal area of Padang city, the average annual temperature is around 27, 43°C with a minimum temperature of 27.1 C and a maximum temperature of 27.7 C. Pariaman City obtained an annual average temperature of around 26.51°C with a minimum temperature of 25.6 C and a maximum temperature of 27.0 C. Results of analysis of rainfall trends annual shows that Padang City has an average annual rainfall of around 364.67 mm with a minimum rainfall of 271.9 C and a maximum temperature of 471.9mm. Pariaman City obtained an average annual rainfall of around 392.97 mm with a minimum rainfall of 361.7mm and a maximum temperature of 435 mm. from both regions there was a decrease in rainfall. These dynamics indicate atmospheric disturbances, minimal disturbances on local and regional scales that affect rainfall in the Padang City and Pariaman city in 2017.

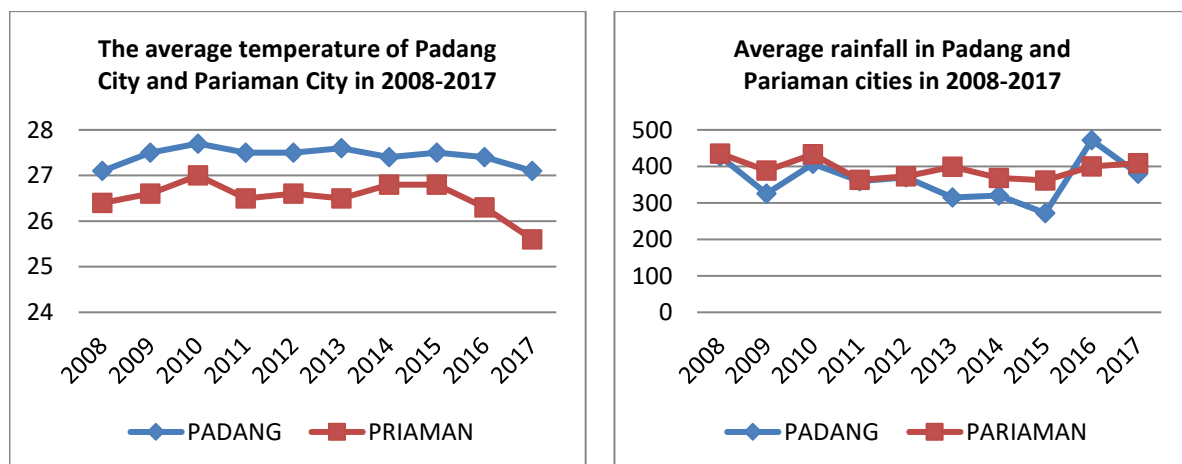


Figure 2. Average temperature and rainfall of Padang City and Pariaman City in 2008- 2017

Source: BMKG Sicincin station

3.3. Fisherman Profile

3.3.1. Productive Activities of Education and Income. Profile profiles of respondents conducted daily include productive activities, reproductive and social activities to be examined in this study. The average time for the fishermen's productive activities in one day is 8.35 hours, while for the activity is 6.7 days a month and the average time to go to sea is 7.87 hours a day. The level of formal education of respondents varies from not completing primary school to graduating from first grade. The average level of education of fishermen's family is still dominated by the low education level, namely graduating from elementary school where the husband is 36.7% and wife is 23.3%.

The level of education is very important in the management of a business, both formal and non-formal education. Formal education is a very valuable capital to get a decent economic life. Education is also very influential on the pattern of life in each individual, both ways of thinking, ways of making decisions and how to behave. The low level of education of respondents was due to the very small income level of their parents, so that respondents had to help their parents to take fish at sea. On the other hand, there are still some parents who have the perception that girls are not required to be highly educated on the grounds that women are more important to work on domestic activities such as taking care of children, taking care of their homes and husbands. The level of education is an influential factor for understanding climate change and its impact on health [10].

The level of income of fishermen in research locations is generally low, where 43.3% and wives 56.7%. Fisherman's wife's income is generally still below the regional minimum wage. The level of income of fishermen is a very important factor in family life and well-being, one's income will affect the level of family welfare. The higher the level of income, the higher the level of life can be expected [11].

3.3.2. Family Status of Fishermen. In accordance with the abundance of natural resources support in the fisheries and marine sector in West Sumatra most of the community's main occupation of their husbands in the family is as fishermen and this work has been passed down from their parents. Husband respondent category is greater with the status of fisherman ship owner, that is 46.7%, but few have status as sea skipper / captain / helmsman, which is 21.7%. Likewise, with wife respondents, only a few wives worked in the fisheries sector with categories as fishermen by 1.7%, as fish traders 10% and as fish processors by 15%. This happens because many wives do not work and only do homework or wives who work outside the fishery sector such as trading.

3.3.3. Decision Making in Productive, Reproductive and Social Activities. Decision making on productive activities in fishing households carried out by husbands, wives and husbands and wives such as preparing for fishing, fishing, drying and storing fish, selling fish and labor work. In Figure 3, this activity is more dominated by husbands (58%). Reproductive activities such as cooking, washing, bathing children, taking school children and integrated health post are dominated by wives (80%). Social gathering activities, community service, death and marriage and health cadres are dominated by wives 36%.

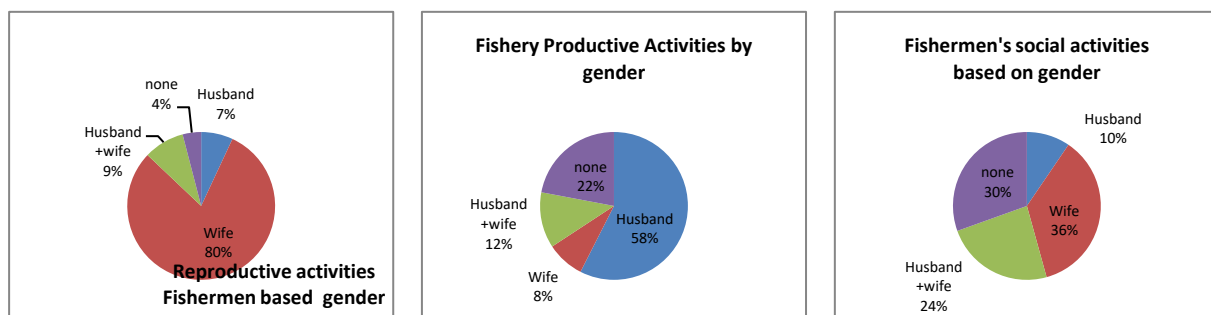


Figure 3. Decision making in productive, reproductive and social

Activities In the productive activities of fisheries business management both in preparing the needs for fishing, fishing, drying and selling the catch of the husband's role is very dominant in decision making. In general, fishermen's wives are not much involved in decision making. This shows that in productive activities the role of the wife is still low. Thus, there is an indication of a gender gap in decision making on productive activities.

In social activities, there is a tendency for institutional separation for women and men. Formal social institutions such as PKK and posyandu activities are a forum for women, while the activities of fishermen groups such as community service are a forum for men, while non-formal institutions such as meeting are a forum for women. Besides that, the influence of boat ownership and fishing gear is a gap for women in the research location, where fishermen's wives cannot do much in their management, so the full decision is in the hands of the husband, for the activities of educating schoolchildren the decision making is done together [12].

3.4. Knowledge of Fishermen About Climate Change

3.4.1. *Acceptance of Information on Climate Change.* Climate change information received by fishermen from various sources of information. It was seen that fishermen had received information about the change of seasons by 63.3%. Changes in sea level by 45%, Changes in intensity / rainfall 63.3%, Change / shift in direction and current strength by 45%, Changes in the west wind season and east wind season 45%, Changes in the rainy season and dry season 55%, Increased extreme weather events of 45% and ice melting were 28.3%.

Table 2. Climate Change Information Received by Respondents

Information Climate change	%
Change in wave season: strong, calm and transition	63.3
Change in sea level	45.0
Change in intensity / bulk rain	63.3
Changes in direction and current strength	45.0
Changes in the seasons of the west wind and east wind season	45.0
Changes in the rainy and dry seasons	55.0
Increases in extreme weather events	45.0
Ice melting poles	28.3

3.4.2. *Acceptance of information the main causes on climate change.* Receipt of information the main causes of climate change by fishermen are industry/factories by 23.3%, logging/burning of forests/mangroves by 25%, Damage to coral reefs by 18.3%, development / coastal reclamation by 23.3%, solid sea transportation 21.7%, annual cycle of 65% and ordinary natural occurrence of 48.3%.

Table 3. Information on The Causes of Climate Change Received by Respondents

Information on The Causes of Climate Change	%
Industry / factory	23.3
Logging / burning of forests / mangroves	25.0
Coral reef damage	18.3
Development / coastal reclamation	23.3
Dense sea transportation	21.7
Mining / offshore drilling	18.3
Annual cycle	65.0
Ordinary natural events	48.3

3.4.3. Changes in Weather Conditions Felt by Fishermen. Climate change information felt by fishermen states that what is most felt is an increase in sea water temperature (73.3%), erratic current direction, fish in the catchment area are decreasing (71.7%), and uncertain sea wave season (71.7%).

Table 4. Changes in Weather Conditions Perceived by Respondents

Changes in perceived weather conditions	%
1. Strong winds occur more frequently	71.7
2. Seasons waves (strong waves, calm, transition)	71.7
3. current direction	73.3
4. Fish in the area decreases	71.7
5. Catchment Sea level decreases	68.3
6. Changes in seasons west and east wind season shift	70.0
7. Flow getting stronger	66.7
8. Temperature / sea water temperature increases	73.3
9. Flood	15.0
10. Flood rob	16.7

3.4.4. Impact Felt by Fishermen Due to Climate Change. Perceived impact due to climate change fishermen had felt a few years ago. Generally, fishermen stated that the perceived impact of climate change was to disrupt time to go to sea (73.3%), disrupt fishing areas (70.0%), and disrupt fisheries production (70.0%).

Table 5. Impacts of Climate Change On

Climate change impacts on fishermen activities	%
Disrupt time when fishing	73.3
Disturb capture areas	70.0
Affect species / fishing gear	68.3
Fisheries Disrupt fisheries production	70.0
Activities Disturb aquaculture activities	23.3

3.4.5. Fishermen Efforts Towards Climate Change. Generally, the effort of fishermen's adaptation in anticipating the perceived impacts of climate change is to maintain the source of clean water (75.5%), not throw garbage into the sea (71.7%) and make changes in fishing time (70.0%).

Table 6. Attempts to Adapt Fishermen to Climate Change

Efforts to adapt fishermen to climate change	%
Change time and time of capture	70.0
Change the type of fish caught	61.7
Form a group of mothers	21.7
Looking for side jobs	41.7
Not burning garbage / opening land	36.7
Not cutting trees carelessly	63.3
Doing crops resistant to drought	16.7
Removing places for breeding mosquitoes	36.7
Do not dispose of trash into the sea and rivers	71.7
Maintaining clean water sources	75.5

Based on knowledge of climate change related to understanding climate what is felt, the causes, impacts, and efforts made, will be useful to improve resilience and health and health due to the effects of climate change [10].

3.5. Coastal Area Vulnerability Index Vulnerability

Consists of three dimensions or components namely exposure, sensitivity and adaptive capacity. Adaptive capacity has an element in resource readiness that influences the resilience of a system and adaptation actions that can be taken to overcome and reduce vulnerability. Sensitivity reflects the response of a system to changes or events that occur such as an increase in temperature and low rainfall and the rate of change caused by these changes. Vulnerability in coastal areas will be seen in Figure 4.

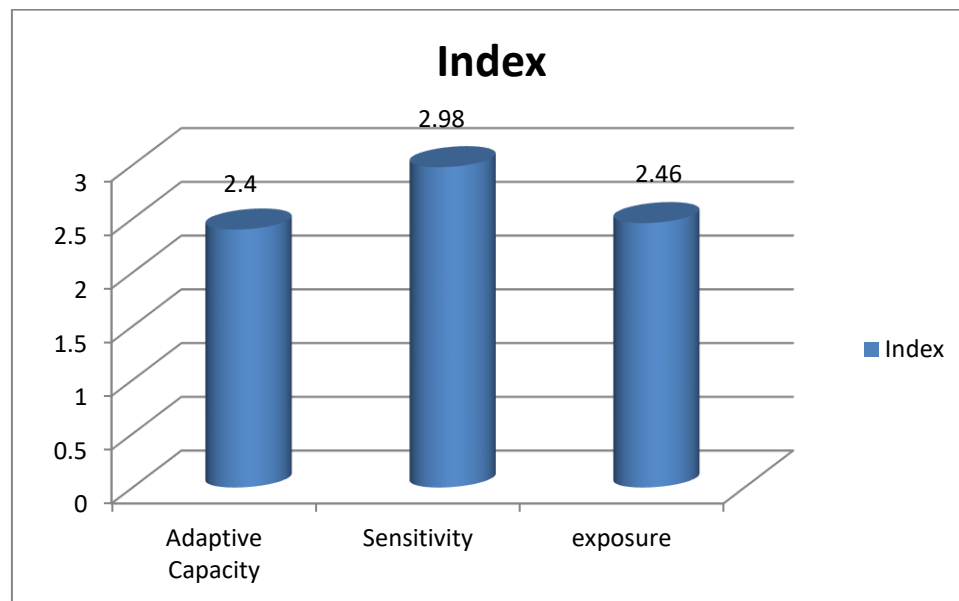


Figure 4. Vulnerability index change in fishing community

Figure 4 shows the index of adaptation ability of coastal communities depending on the value of weight and score. The indicators of adaptability are: indicators of the number of family dependents, income, education level, Climate Information and adaptation efforts 2,4 (low class). Sensitivity index in the coastal area is 2.98 (classification is caused by the weight value and score of each indicator of different sensitivity). Indicators of sensitivity are: length of activity, length of day of going to sea, inequality of domestic decision making, inequality of environmental health responsibilities, inequality of service request responsibility HealthIndex Coastal area exposure is 2.46. This change in outcrop shows that coastal areas are vulnerable to climate change with indicators of rainfall, population density, disease, perceived changes in conditions and perceived impact. Figure 4 above shows the level of vulnerability of the community to climate change beach depending on size of index exposure, sensitivity and adaptive capacity, the vulnerability index is a positive function of exposure and sensitivity and negative functions of adaptability. Thus obtained coastal vulnerability index of 305 (classification vulnerable).

3.6. Model gender-based adaptation of coastal communities

The role of husband and wife in fishing settlements as a form of adaptation in the face of climate change is grouped into productive roles, productive roles and social roles. The reproductive (domestic) role is the role or task related to reproduction, and household management. Productive (Public) is the role of a breadwinner or other role performed outside the home to make money. The social role is a role in its relationship with other community members. Changing roles is a response to the impacts of climate change. Changes in roles cause women's adaptive capacity or vulnerability to climate change to increase [13].

McCright (2010) argues that women are knowledgeable in climate change rather than men, but women have a greater concentration on climate change than men. Women face special barriers from their capacity to adapt to the impacts of current and future climate change [14], so a strategy is needed specifically to mainstream women in climate change adaptation. This strategy is needed to ensure efforts to increase adaptive capacity and reduce women's vulnerability to climate change. Adaptation needs and priorities are classified into 3 (three) aspects, namely:

1. a comfortable place to live, better
2. access to climate change information and its impact, health services, and access to transportation,
3. other livelihood options through increased technical knowledge and availability of fisheries resources and local counseling and assistance and knowledge of climate change at sea

Based on the description above, the strategy that can be taken as a gender-based climate change adaptation model for coastal areas in the research location includes:

1. Increasing the political role of women in terms of leadership, community organizations, and disaster management. This political role has begun to look good for women in Bungus, the city of Padang, with the election of women as village heads.
2. Enhancing women's skills can be in the form of climate education through the field climate school, ornamental fish cultivation, fish salting and others.
3. Increased productive work is a type of work that makes money. Husbands not only earn income as fishermen, but also have the ability to market catches. And when you don't go to sea your husband must find a side job. Also when a husband does not go to sea, he can also help his wife for reproductive roles such as taking children to school.
4. Equalization of reproductive work is work that guarantees the management and reproduction of the workforce (which includes taking care of domestic work and childbearing. This reproductive work usually does not make money. Although the husband does not do the reproductive role in full, but household activities such as home management such as the provision of clean water, waste management, routine household hygiene and family nutrition fulfillment.

The community needs to connect climate vulnerability to current problems and identify future challenges that are important to themselves, their families and livelihoods [15]

4. Conclusion

The vulnerability index is positive function of outcrops and sensitivity and negative function of adaptation ability. Then obtained coastal area vulnerability index of 305 (vulnerable classification) Efforts to increase adaptive capacity and reduce women's vulnerability to climate change through privacy to stay, better access to climate change information and other livelihood options. Gender-based climate change adaptation models for coastal areas are enhancing women's political roles, enhancing women's skills capacity through Climate Field Schools and improving productive work.

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