Tuijin Jishu/Journal of Propulsion Technology
ISSN: 1001-4055
Vol. 44 No. 4 (2023)

Economic Vulnerability of Coastal Households in Southern Tamilnadu

[1] Dr. D. Radhika, [2] Dr. A. Priyanka, [3] Dr. F. Cisma

[1]Head & Associate Professor , PG & Research Department of Zoology
V.O.Chidambaram College, Thoothukudi

[2]Assistant Professor, Department of Commerce (Unaided)
V.O.Chidambaram College, Thoothukudi

[3] Assistant Professor, Department of Commerce (Unaided)
V.O.Chidambaram College, Thoothukudi

Abstract: India is the world's largest fish employer and a leader in the fish business, according to statistics on fisheries and aquaculture. Regrettably this industry is largely affected by the change in the nature and one among it is climate changes. The effects of this climatic change manifest in the form of extreme weather events with varying frequency and intensity and due to which the sea level is increasing by the end of 21st century. The lives of coastal communities are also made more difficult by the increase in cyclones, storm surges, and coastal floods as well as the decrease in ocean fish catch brought on by human-caused climate change. Tamil Nadu is one of the top fish producing States located on the southern coast of India. In 2019 Tamilnadu produces 3.56 million metric tons of marine fish up 2.1% year on year. Tamil Nadu recorded 21 fishing villages in Thoothukudi district while the district's revenue and administrative boundaries mention 24 fishing villages or hamlets in six coastal taluks. A structured questionnaire was administered and the respondents were personally contacted upon getting receiving assistance from the religious and community leaders. Employing random sampling, 689 samples from 24 coastal villages in Thoothukudi District. Economic Vulnerability Index (EVI) was measured with three different constructs namely; Exposure, Sensitivity, and Adaptive Capacity for each taluks. During the lean period, extreme weather conditions and climate change, the traditional fishing communities are also forced to adopt alternate livelihoods to satisfy their needs and the economic development of the country. The findings of the study show that the extreme weather conditions make costal households more vulnerable and lead to financial loss to the economically backward people. Out of six taluks Tiruchendur and Srivaikundam region people are more vulnerable due to the high degree of dependency on fishing and fishing- related economic activities.

Key Words: Sustainability, Economic Vulnerability Index (EVI), Climate Change, Costal Households

1. Introduction

India is a leading country in fish industry employing the largest fisher workforce in the world as per Fishery and Aquaculture Statistics (2018). Unfortunately, this industry is largely affected by the any change in the nature. Climate change is undisputedly the most challenging issue that the industry faces (Salehi, et al., 2015). The effects of climate change manifest in the form of extreme weather events with varying frequency and intensity, and due to which the sea level is projected to rise between 43 and 84 cm by the end of the 21st century (IPCC, 2019). On the other hand, the rising number of cyclones, storm surges and coastal flooding, the decline of fish harvest in oceans due to anthropogenic climate change further torments the lives of coastal communities (Free, et al., 2019). Hence, the coastal communities represent one of the most vulnerable sections in the country. Besides, the geographic and socioeconomic characteristics of the fisher community render them highly vulnerable to weather conditions related adversities, making them highly susceptible to experience economic losses. In order to avoid the economic loss of the changes in the nature and to maintain the sustainable livelihood, the small-scale coastal households started adopting alternate survival strategies. In this context, the survival need of coastal households has opened up some small-scale sea-based businesses.

India is a leading country in fish industry employing the largest fisher workforce in the world as per Fishery and Aquaculture Statistics (2018). Tamilnadu is one of the top fish-producing states, located on the southern coast of India. In 2019, the country produced 3.56 million metric tons (MT) of marine fish, up 2.1

percent year-on-year. Tamil Nadu was the biggest producing state with 775,000 MT, followed by Gujarat with 749,000 MT, and Kerala with 544,000 MT (CMFRI, 2020). It has the largest fisherfolk population in India, out of which the majority belongs to small-scale fisher communities. However, a rise in the incidence of extreme weather events in the ocean is found to affect the marine fish landings of the state (Sreya, et al., 2021). The extreme weather conditions and climate change make the fishing community of the state even more vulnerable, especially the district like Thoothukudi which mainly entails major activities such as harbour fishing, salt production, shell fishing, seaweed cultivation etc. On the other hand, fish are being over-harvested until the catch has become a fraction of the original resources and the fish are incapable of breeding successfully to replenish the population. If fish is over- harvested, the ecological functions of the marine ecosystem are lost. In order to protect the blue eco-system, lean period is imposed in Tuticorin from April to June every year. During the lean period, extreme weather conditions and climate change, the traditional fishing communities are also forced to adopt alternate livelihoods to satisfy their needs and the economic development of the country (Jacob, et al., 2016).

2. Methodology

2.1 Data collection and processing

Marine Fisherfolk Census 2010 of Tamil Nadu recorded 24 fishing villages in Thoothukudi district while the district's revenue and administrative boundaries mention 24 fishing villages or hamlets in siX coastal taluks viz., Vilathikulam (four villages), Ottapidaram (three villages), Thoothukudi (five villages), Srivaikundam (two villages), Thiruchendur (nine villages), and Sathankulam (one village). The list of villages has been presented in Table 1. Total number of ***** samples randomly selected in the above mentioned 24 villages. Out of which *** households wholly depend upon fishing and fishing related occupations whereas **** are non- fisher-folk families. A structured questionnaire was administered and the respondents were personally contacted upon getting receiving assistance from the religious and community leaders.

2.2 Quantifying household economic vulnerability

Economic Vulnerability Index EVI, was developed based on the vulnerability assessment framework formulated by Intergovernmental Panel on Climate Change (IPCC), the united body for assessing the science related climate change. The EVI tool was basically formulated based on the three vital components of vulnerability i.e., exposure, sensitivity and adaptive capacity. Here, exposure is characterized as the magnitude of disasters affectedand losses suffered from them, sensitivity as the extent to which the livelihood was affected byexposure, and adaptive capacity as the households' ability to come out or endure theexposure (Ebi et al., 2006) . The exposure component includes four sub-components while the sensitivity and adaptive capacity components include siX and five sub-components respectively.

Even though each main component comprised of a different number of sub-components, the EVI was quantified in such an approach that all the sub-components contributed equally to its final value. To meet out the objectives of the study, a balance weighted average method employed by various vulnerability assessment studies (Hahn et al., 2009). All the sub- components were standardized using the following equation which was adopted from Human Development Index. The same equations at different approaches were used in similar kind of research papers in the recent times (Sreya et al, 2021; Umamaheswari et al., 2021).

$$\text{Index Stk} = \frac{S_{tk} - S_{min}}{S_{max} - S_{min}} \quad (1)$$

Where Stk is the original sub-component of taluks. $S_{max} - S_{min}$ are the minimum and maximum values obtained from each sub-component from five different taluks of the coastal city. For example, value of the sub-component 'Number of times natural disasters affect the household were taken as the minimum and maximum values and were used to transform the 'natural disasters and climate variability' indicator into a standardized index. For variables that measure frequencies such as the 'Percentage of house- holds that did not receive a warning about a pending natural disaster', the minimum

value was set as zero and the maximum as hundred. After standardizing, the sub-components were averaged using Eq. (2) to calculate the value of each major component:

$$M_{tk} = \frac{\sum_{i=1}^{n} index_{S_{tk}{}^{i}}}{n} \quad (2)$$

where M_{tk} = one of the three major components for different taluks [Exposure (E), Sensitivity (S), Adaptive capacity (A)], index S_{tk} i represents the sub-components indexed by i, which make up each major component, and n is the number of sub-components in each major component.

Once the values for each of the three major components were calculated for the households in all the five different taluks, they were averaged using Eq. (3) to obtain the LVI:

$$EVI_{tk} = \frac{w_{EX}EX_{tk} + w_{SN}SN_{tk} + w_{AD}AD_{tk}}{w_{EX} + w_{SN} + w_{AD}} \quad (3)$$

where EVI_{tk}, the Economic Vulnerability Index for taluks$_{tk}$, equals the weighted average of major components. The weights of each major component, w_{Mi} were determined by the number of sub-components in it. Weights were included to ensure that all sub-components equally contributed to the overall EVI (Sullivan et al., 2002). In this study, the value of EVI represents the vulnerability status of the households which ranges from 0 (least vulnerable) to 0.8 (most vulnerable).

3. Socio Demographic Profile

Table 1: List of fishing villages in Thoothukudi district – as per India Census of India (2011)

Taluks (Households / Population)	Name of Marine Fishing Village	Sampling
Vilathikulam (VKM) (38,335/1,39,581)	1. Vembar	23
	2. Periyasamypuram	22
	3. Keelavaippar	37
	4. Sippikulam	13
Ottapidaram (OPM) (32,955/1,23,356)	5. Pattinamarudhur	14
	6. Tharuvaikulam	43
	7. Vellapatti	22
	8. Saveriarpuram T	17
	9. Siluvaipatti	35
Thoothukudi (TUT) (1,22,574/4,78,328)	10. Thoothukudi North	55
	11. Loorthammal Puram	31
	12. Thoothukudi South	57
Srivaikundam(SVM) (52,689/2,02,962)	13. Palayakayal	52
	14. Ratchaniyapuram	21
Thiruchendur (TCR) (78,321/3,10,945)	15. Kombuthurai	11
	16. Singithurai	22
	17. Veerapandianpattinam	31

	18. Amalinagar	23
	19. Alanthalai	24
	20. Jeevanagar	9
	21. Manappad	32
	22. Punnaikayal	37
	23. Kulasekaranpattinam	23
Sathankulam (SNK) (25,971/98,690)	24. Periyathazhai	35
Total		**689**

Table 2: EVI Main and Sub Components

Main Component	**Sub component**	**Survey questions**
Exposure	EX1:Extreme weather events the households witnessed in a year	How many times your household affected by coastal flood/storms/cyclones?
	X2:Loss Due to the extreme weather conditions	How severe you were affected financially? 1. No loss 2. Less than Rs.10,000 3. Rs.10000 – Rs.50,000 4. Rs.50,000 to Rs.1,00,000 5. More than Rs.1,00,000
	EX3:Recovery status of the households from the loss	Describe the recovery status of the loss (If any) 1. Never recovered 2. Still recovering 3. Recovered over time 4. Recovered immediately
	EX4:Number of households do not care of warnings and continue with their routine*	Do you normally continue your routine work even in the times of warning? 1. Yes 2. No
Sensitivity	SN1:Percent of households depending upon fishing alone for income **	How much do you earn through fishing?
	SN2:Proportion of non-fisheries income households' annual income**	Does any of your family members earn income through any means other than fishing? If yes mention their income

	SN3:Capacity of the households to meet the financial requirements of the family*	Which of the below describes the best of your household ability in meeting the basic needs? 1. We struggle to meet our basic needs 2. We meet basic needs. But we struggle to make lump sum payment for education and health 3. We usually pay for basic, health care, and education. Sometimes, we struggle to make lump sum payments 4. We are able to make payments without any struggle even in lump sum.
	SN4: Reaction of households due to the sudden stoppage of primaryincome due to extreme conditions	If your primary livelihood is no longerearn money, what would you do? 1. Find an alternative livelihood 2. Rely more on other existing income generating activity 3. Rely on family support / loan / SHGs Rely on charity
	SN5:Issues in income in terms of frequency of income availability	How predictable this income available throughout the year? 1. Unpredictable 2. Predictable, but dramatically depending on the season 3. Predictable, but with some slight changes 4. Predictable throughout the year
Adaptive capacity	AD1:Productive assets	Do you have any assets generating incomelike cattle / land / agriculture / equipment?** 1. No productive assets 2. Have few livestock/cattle 3. Have livestock & some equipment 4. We have a lot of productive assets

	AD2:Savings pattern of the households	How much do you save in a month? Doyou have any savings pattern?** 1. Less than Rs.50,000 2. Rs.50,000 to Rs.1,00,000 3. Rs. 1,00,000 to Rs.2,00,000 4. More than Rs.2,00,000
	AD3:Annual income status	How much do you earn in a year? ** 1. Less than Rs.50,000 2. Rs.50,000 to Rs.1,00,000 3. Rs. 1,00,000 to Rs.2,00,000 4. More than Rs.2,00,000
	AD3:Annual income status	How much do you earn in a year? ** 5. Less than Rs.50,000 6. Rs.50,000 to Rs.1,00,000 7. Rs. 1,00,000 to Rs.2,00,000 8. More than Rs.2,00,000
	AD4:Economic Status	Households' perception about their economic position.** *1.* Destitute: Barely surviving *2.* Struggling to survive *3.* Prepared to grow (Stable) *4.* Not vulnerable

Adapted from 1. Household Economic Vulnerability Tool Indicator Guide,
2. Sreya et al.(2021),
3. * developed sub-component based on the requirement of the study
4. **the raw data converted into a categorical from 1-4

The economic vulnerability of households was calculated based on the main components namely; Exposure, Sensitivity, and Adaptive capacity. These main components have sub- components which have been given in Table 2. Exposure has four sub-components, Sensitivity and Adaptive capacity has five and four sub-components respectively. The maximum and minimum value is clearly detailed in Table 3. Some sub-components were measured in percentage, average, and in Ratio. The Economic Vulnerability index is measured among five different taluks of Thoothukudi district namely, Vilathikulam (VKM), Ottapidaram (OPM), Thoothukudi (TUT), Srivaikundam (SKM), Tiruchendur (TCR), and Sathankulam (SNK). These six different taluks have 24 coastal villages all together. Vilathikulam has four villages, Ottapidaram has three villages, Thoothukudi has five villages. Besides, Srivaikundam,Tiruchendur, and Sathankulam taluks have two, nine, and one village respectively. In order to obtain indices at taluk level, the data of villages were grouped and were averaged at respective scales. The taluk-level indices were given in Table 3 to give the overall insight of the taluks.

Table 3: EVI values – Sub-components

Main Component	Sub component	Units	VKM	OPM	TUT	SVM	TCR	SNK
Exposure	EX1	Count / 10	2.14	1.52	1.91	2.03	2.89	1.70
	EX2	Range (1 – 5)	3.25	3.33	3.87	3.91	4.02	2.72
	EX3	Range (1 – 4)	1.62	2.21	1.47	1.19	1.87	2.03
	EX4	Percent	13.1	11.3	1.12	19.1	18.2	09.32
Sensitivity	SN1	Percent	37.1	33.7	42.12	53.2	69.7	34.1
	SN2	Ratio	0.70	0.63	0.71	0.67	0.87	0.76
	SN3	Range (1 – 4)	2.64	2.28	2.71	1.51	1.78	2.48
	SN4	Range (1 – 4)	2.13	2.07	2.81	2.87	2.27	2.11
	SN5	Range (1 – 4)	3.05	3.27	2.87	3.27	3.41	3.26
Adaptive capacity	AD1	Range (1 – 4)	1.91	2.63	1.33	1.87	2.12	1.63
	AD2	Range (1 – 4)	1.20	1.27	1.34	1.41	1.08	1.24
	AD3	Range (1 – 4)	2.32	2.8	3.1	2.48	2.37	2.8
	AD4	Range (1 – 4)	1.75	2.37	1.93	1.84	1.58	1.61

4. Results and Discussion

4.1 Exposure

Exposure refers to the extent to which the coastal households are exposed to the climate related disasters in terms of frequency of events, intensity of events, and the potential losses these households suffer (Sreya et. al., 2021). EX1 describes of how many extreme weather events affected the places in a year. The counts of the places were taken in average. It says that the households in Tiruchedur witness high number of extreme weather events than the other taluks which roughly accounts to 23 events in a year. OPM Taluk has lesser number of exposures to unfavourable weather conditions comparatively than the other taluks which

account to 15 events in a year. However, the data of this kind (EX1) may be affected by recall bias of the respondents (Sreya et. al., 2021). Due to the extreme weather condition, the taluks have reported of having financial losses which were tested in the range of 1 -5 (refer table 2). The results clearly indicate all the taluks witness financial loss within the range of Rs.50,000 to Rs.1,00,000. Wherein TCR taluk alone witnesses more than one lakh of financial loss due to the extreme weather conditions. It is mainly because the majority of the coastal households wholly depend on the ocean for income. In terms of the recovery status, households irrespective of the taluks find it more difficult to recover from the financial loss. By the time the respondents recover from the loss, another halt comes on the way. However, it should also be noted that the results can be biased due to the tendency of stating the financial losses slightly high (Ebi et al., 2006). Fisherman residing at the boundary of the district seem to ignore the government warnings and continue fishing even during the times of extreme weather condition. Especially the fishermen in SVM and TCR taluks largely ignore the warning and continue with their routine which reported around18 percent and 19 percent respectively.

4.2 Sensitivity

Sensitivity refers to the extent to which the coastal households could be adversely affected by the climate related disasters. In other words, it also denotes how potentially these households be affected in association with financial terms (Sreya et. al., 2021). SN2 was calculated to the proportion of AD3. The dependency of households towards the blue economy has been measured in SN2 which clearly depicts the proportion of sea-based income in their total income. In terms of SN1, it denotes the percent of households completely depends on fishing as their main source of income. SVM and TCR taluks have major dependency comparatively than the other taluks which account to 53.2 and 69.7 percent respectively. These two taluks have high degree of economic sensitivity and these villages would be affected largely when the primary source of their income is no longer giving them enough earnings. In terms of the ability of households to meet their needs like food, education, healthcare, and shelter (SN3), the responses were tested in the range of 1-4 where the maximum were given to the struggling and the minimum were given to the financial freedom. The average score ranges from 1.51 to 2.64 which portrays that the households in the taluks have no financial freedom and the households struggle make lump sum payments for education and healthcare. This indicator can also potentially be limited with the tendency of people to project themselves as poor (Hahn et. Al., 2009). During the days of struggle, the households opt financial assistance from the private sector financial lenders for high interest which further aggravates their financial vulnerability. Hence, they are forced to work extra time to meet their financial requirements. However, the fishermen resist themselves moving to another income generating activity instead they stick on to their primary source until the weather conditions turn back to ordinary. SN4 indicates their inclination to move to the other alternative which range from 2.07 to 2.87. the lower value is the favourable inclination to move away to the other income generating activity. The scores are more than 2.00 which denotes the households stick on to their primary source and they dwell in to the debt crisis by availing loans from private money lenders. SN5 is the important factor which predicts the income of their primary source. The score ranging from 2.87 to 3.41 which denotes the income is not predictable throughout the period. The lower the score is stable income and the higher is unpredictable.

4.3 Adaptive Capacity

In terms of Adaptive capacity, the subcomponents have been measured in the range of 1 to 4 where the lesser the values define high degree of vulnerability. Rudiarto (2020) analysed adaptive capacity of costal households and confirmed that the households are comparatively more vulnerable than the general population. AD1 is measured based on the productive assets the households have in order to reduce the financial stress of the family. The productive assets like cattle, land, agricultural field, tools and equipment. Being near to oceans, the land they live would not be of appropriate for crop cultivation. Hence, their choice for diversifying their income generating capacity is concentrated towards growing productive assets like cattle. The AD1 scores are less which describes the families have very few productive assets and their income is not generated through productive assets. Comparatively, OPM taluk households have considerable assets than the other taluks. This taluk is having lesser vulnerability in terms of their income generating capacity through productive assets other than fishing. AD2 is the vital element of AC which confirms the saving capacity of the

households. The lesser score confirms the high degree of financial vulnerability. AD2 confirms that the households do not have the habit of saving money for the future. The tendency leads them to financial crisis and pave way for getting trapped in the hands of local money lenders. AD4 measures their economic status in four different dimensions, namely, Destitute, Struggling, Prepared to grow, and Not vulnerable which range from 1 to 4 respectively. The lesser the score denotes either the households are in destitute position or in struggling position. The score of the subcomponent ranges from 1.61 to 2.37. out of five taluks OPM taluk is considerably stable in terms of economic status.

5. Conclusion

Being one of the deprived and marginal section of the society, the life of coastal households is wholly dependable on blue economy which makes the more vulnerable than the general population. The findings of the study show that the extreme weather conditions make costal households more vulnerable and lead to financial loss to the economically backward people. Out of six taluks Tiruchendur and Srivaikundam region people are more vulnerable due to the high degree of dependency on fishing and fishing-related economic activities. These two regions have also revealed substantially lower adaptive capacity. In the era of rapidly changing climatic environment, the coastal households must look beyond the traditional livelihood in order to have a stabilized economic status. The fishermen in the coastal villages must seek the help of coastal communities, unions, and religious committees for financial assistance for commencing small- scale businesses instead of demanding money for the lavish expenses. Besides, the intervention of private money lenders in the name of SHGs are quite popular in coastal villages who easily convince women of the villages to opt loans, this practice ultimately put them in poverty trap. Hence, interference of government bodies is the need-of-the-hour to overlook the system of SHGs in the villages. They must also ensure giving the households proper awareness on alternative income generating activities. This would ensure a stable income earning capacity of the households even during off season or ban period.

Acknowledgement

The authors thank **V.O.Chidambaram College** for the moral support. The article is published availing financial support under **UGC-STRIDE (Component-1)** scheme. The authors also thank the people who are directly or indirectly helped us in collecting the data from the coastal households.

References

[1] **C. Sullivan, J.R. Meigh, T.S. Fediw**, Derivation and testing of the water poverty index phase 1, FinalReport. Department for International Development, UK, 2002.

[2] **Cai J, Hishamunda N and Ridler N** Social and economic dimensions of carrageenan seaweed farming: A global synthesis. In Social and economic dimensions of carrageenan seaweed farming [Journal] // Fisheries and Aquaculture Technical. - Rome, Italy : [s.n.], 2013. - 580. - pp. 5-59.

[3] **CMFRI** Marine Fish Landings in India 2019, Central Marine Fisheries Research Institute [Online]. - 2020. - http://eprints.cmfri.org.in/id/eprint/14325.

[4] **CMFRI** Marine Fish Landings in India 2019, Central Marine Fisheries Research Institute [Online]. - 2020. - http://eprints.cmfri.org.in/id/eprint/14325.

[5] **Cotas J [et al.]** A Comparative review of the nutraceutical and therapeutic applications of red seaweeds (Rhodophyta) [Journal] // Life. - 2020. - 3 : Vol. 10. - pp. 1-19.

[6] **Ebi K.L, Kovats R.S and Menne B** An approach for assessing human health vulnerability and public health interventions to adapt to climate change [Journal] // Environ. Health Perspect.. - 2006. - Vol. 114. - pp. 1930–1934.

[7] **Free C.M [et al.]** Impacts of historical warming on marine fisheries production [Journal] // Science. - 2019. - Vol. 363. - pp. 979–983.

[8] **Free C.M [et al.]** Impacts of historical warming on marine fisheries production [Journal] // Science. - 2019. - Vol. 363. - pp. 979–983.

[9] **Hossain M. Shahadat [et al.]** Seaweeds farming for sustainable development goals and blue

economy in Bangladesh [Journal] // Marine Policy. - 2021. - p. 104469.

[10] **Hossain M.S, Chowdhury S.R and Shariffuzaman S.M** Blue Economic Development in Bangladesh: A Policy Guide for Marine Fisheries and Aquaculture, Institute of Marine Sciences and Fisheries [Book]. - Bangladesh : University of Chittagong, 2017.

[11] **Hussin Hanafi and Khoso Abdullah** Seaweed Cultivation and Coastal Communities in Malaysia: An overview [Journal] // Asian Fisheries Science. - 2017. - Vol. 30. - pp. 87-100.

[12] **IPCC** In IPCC Special Report on the Ocean and Cryosphere in a Changing Climate [Online].2019.https://www.ipcc.ch/site/assets/uploads/sites/3/2019/12/SROCC_FullReport_FINAL.pdf.

[13] IPCC In IPCC Special Report on the Ocean and Cryosphere in a Changing Climate[Online].-2019. https://www.ipcc.ch/site/assets/uploads/sites/3/2019/12/SROCC_FullReport_FINAL.pdf.

[14] **Jacob Jeyakumar M and Rao Brahmaji P** Socio-ecological studies on marine fishing villages in the selective south coastal districts of Andhra Pradesh [Journal] // Ecotoxicology and Environmental Safety. - Dec 2016. - 2 : Vol. 134. - pp. 344-349.

[15] **Jacob Jeyakumar M and Rao Brahmaji P** Socio-ecological studies on marine fishing villages in the selective south coastal districts of Andhra Pradesh [Journal] // Ecotoxicology and Environmental Safety. - Dec 2016. - 2 : Vol. 134. - pp. 344-349.

[16] K.L. Ebi, R.S. Kovats, B. Menne, An approach for assessing human health vulnerability and public health interventions to adapt to climate change, Environ. Health Perspect. 114 (2006) 1930–1934,https://doi.org/10.1289/ehp.8430.

[17] **Krishnan M and Narayanakumar R** Social and economic dimensions of carrageenan seaweed farming [Journal] // FAO Fisheries and Aquaculture Technical Paper. - 2013. - 580. - pp. 163–184.

[18] M.B. Hahn, A.M. Riederer, S.O. Foster, The Livelihood Vulnerability Index: a pragmatic approach to assessing risks from climate variability and change-a case study in Mozambique, Glob. Environ. Chang. 19 (2009) 74–88, https://doi.org/ 10.1016/j.gloenvcha.2008.11.002.

[19] **Rebours C [et al.]** Seaweeds: an opportunity for wealth and sustainable livelihood for coastal communities [Journal] // Journal of Applied Psychology. - 2014. - Vol. 26. - pp. 1939–1951..

[20] **Salehi S [et al.]** Gender, responsible citizenship and global climate change [Journal] // Women's Stud.Int. Forum. - 2015. - Vol. 50. - pp. 30–36.

[21] **Salehi S [et al.]** Gender, responsible citizenship and global climate change [Journal] // Women's Stud.Int. Forum. - 2015. - Vol. 50. - pp. 30–36.

[22] **Shannon Emer and Abu-Ghannam Nissreen** Seaweeds as nutraceuticals for health and nutrition [Journal] // Phycologia. - 2019. - 5 : Vol. 58. - pp. 563-577.

[23] **Sreya P.S [et al.]** Economic vulnerability of small-scale coastal households to extreme weather events inSouthern India [Journal] // Marine Policy. - 2021.

[24] **Sreya P.S [et al.]** Economic vulnerability of small-scale coastal households to extreme weather events inSouthern India [Journal] // Marine Policy. - 2021.

[25] **UN DESA** Blue Economy Concept Paper [Report]. - New York : United Nations Department ofEconomic and Social Affairs, 2014.