Advances in Bioresearch
Adv. Biores., Vol 6 (3) May 2015: 78-92
©2015 Society of Education, India
Print ISSN 0976-4585; Online ISSN 2277-1573
Journal's URL:http://www.soeagra.com/abr.html
CODEN: ABRDC3
ICV 7.20 [Poland]

Advances in Bioresearch

ORIGINAL ARTICLE

Classification and Prioritization of Negative Factors Affecting on Mangrove Forests Using Delphi Method (a Case Study: Mangrove Forests of Hormozgan Province, Iran)

Davood Mafi-Gholami[1], Jahangir Feghhi[2*], Afshin Danehkar[3], Nabiollah Yarali[4]
1-Department of Forestry and Forest economics, Faculty of Natural Resources, University of Tehran, Tehran, Shahid Chamran Blvd., Karaj - Iran
Email: davoody3817@yahoo.com
2*Department of Forestry and Forest Economics, Faculty of Natural Resources, University of Tehran, Shahid Chamran Blvd., Karaj - Iran
3-Department of Environmental Sciences, Faculty of Natural Resources, University of Tehran, Shahid Chamran Blvd., Karaj - Iran
4-Department of Forest Science, Faculty of Natural Resources and Earth Science, University of Shahrekord, Shahrekord, Iran

ABSTRACT
Generally, planning and prioritizing managerial operations and also providing appropriate tools for mitigating destructive consequences of stresses and disturbances affecting on forest ecosystems requires classification and prioritizing of these negative factors. Among different approaches for ranking and prioritizing, Delphi method due to its content validity, high flexibility, multidisciplinary nature and also using in the wide range of geographical area is an appropriate tool for prioritizing of multiple environmental stresses in various ecosystems. Thus, in this study, Delphi method was used for prioritization of stresses and disturbances affecting on mangrove forests. Results showed that based on current position and status of mangrove forests in Iran, stresses and disturbances resulting resulted from anthropogenic factors compared to other negatively effecting factors have higher importance coefficient. Results also showed that storm, drought and air temperature among meteorological factors placed in latest ranks, while sea level rise compared to other factors has more importance and priority. Finally it can be said that results of the this study could be used as decision making supporting tool for sustainable planning and management of mangrove forests in Iran and other similar mangroves in coastal areas of Persian Gulf.
***Keywords**: Stresses and Disturbances, Delphi method, Mangroves, Iran.*

Received 12/02/2015 Accepted 14/04/2015

How to cite this article:
Davood Mafi-G, Jahangir F, Afshin D, Nabiollah Y. Classification and Prioritization of Negative Factors Affecting on Mangrove Forests Using Delphi Method (a Case Study: Mangrove Forests of Hormozgan Province, Iran).Adv. Biores., Vol 6 [3] May 2015: 78-92. DOI: 10.15515/abr.0976-4585.6.3.7892

INTRODUCTION

Nowadays, world mangrove forests by about 137760 Km², originate more than 21 ecological services and 45 natural products 1 and have important role in human welfare at different levels including local, regional and worldwide 2. Regarding to great importance of these ecosystem services in providing human requirements, degradation of this unique coastal habitats during past three decades is intensified in all over the world so that until now more than 50 percent of world mangrove forests subjected to degradation and decreasing quality in a continues trend 3. Different coastal ecosystems, especially mangroves, almost permanently and simultaneously subjected to multiple environmental stresses and disturbances (geologic, physical, chemical and biological) which diverse in their temporal and spatial characteristics.

These stresses occurred by natural and anthropogenic factors such as storms, diseases, deforestation, changing the coastal landforms and extending croplands and residential areas, development of coastal recreational areas, aquaculture and destructive effect of oil pollution as well as wastewaters containing various chemical materials that intrusion into mangrove forests from near urban, industrial and agricultural environments 45,6,7. Direct result of these stresses and disturbances will include decreasing health and area of mangroves, intensification of global warming and other climatic changes, declining coastal water quality, decreasing biodiversity, coastal habitats destruction as well as destruction of major part of sources that human required 89,10,11.

Considering to this point that mangrove ecosystems always are subject to threats resulted from above-mentioned natural and anthropogenic hazards, planning and providing appropriate tools in order to reducing negative impacts of these hazards are inevitable 12,13. Achieving this goal and providing help for prioritizing management operations and providing optimal infrastructures for decreasing hazards or consequences from them, depended on sufficient and correct knowledge and information about vulnerability of these ecosystems to various hazards 1314. Recognizing vulnerability of mangrove to occurrence of multiple natural and anthropogenic stresses will guide managers and stakeholders for anticipating the effects and choosing the best appropriate adoptable options for decrease destructive consequences imposed to mangrove ecosystems and will result to solutions needed to achieve their sustainability 15. Thus, vulnerability assessment, by recognizing potential stresses as well as estimating degree of decrease and/or destruction in mangrove ecosystems due to destructive events, is the most important tool available for decision-making and presenting management strategies effective in decreasing adverse effects of various stresses and achieving to protection of mangrove ecosystems 16,17.

First step for conducting vulnerability assessment and obtaining management strategies and effective planning for sustainable management of mangroves is recognition, classification and prioritization of potential stresses (natural and anthropogenic) which these ecosystems faced with them. Results from this recognition and prioritizing, would be the base for vulnerability assessment which have important role in creating quantitative and qualitative scheme of processes and results related to vulnerability of mangrove forests 18. Among different ranking and prioritizing methods, Delphi method due to its content validity, great flexibility and multi-disciplinary nature could be used as appropriate tool to achieve consensus among experts of vulnerability area in the context of determination of importance scale and classification and prioritizing of environmental multiple stresses 1920,21,22,23. Therefore, the purpose of the present study is use of Delphi method for classification and prioritizing stresses and disturbances affecting on mangrove forests of Hormozgan Province in Iran.

LITERATURE REVIEW

Delphi method was used in a wide range of research areas such as Strategic Environmental Assessment (SEA), tourism and ecotourism , natural hazards, social management and national health 24,25,26,27,28,29,30 and this wide range use of Delphi method caused many changes in conducting way of this method 31,32. However, until now there are few studies has been done in prioritizing of various hazards and risks using Delphi method 3330. Olfert 33 studied the risk assessment of Dresden area in Germany. In their study, for assessing hazards, 14 hazards were recognized and classified in two natural and technological parts. Weighing and prioritizing results using Delphi showed that priority of natural hazards were as follow flooding, strong rainfall, storm, forest fire, drought, soil movement, earthquake and volcanic eruption and for technological hazards priority were as follow dams, factories, waste disposal, oil pollution and atomic plants. Results showed that anthropogenic stresses have much more weight than natural stresses. In a similar study by same authors for risk assessment in central part of Portugal, 15 hazards in mentioned parts recognized and classified. Weighing and prioritizing results of these hazards showed that natural hazards priority were forest fire, flooding, soil movement, drought, storm waves, earthquake, high temperature, winter storms and volcanic eruption and for technological hazards were as accidents, oil pollution, processes related to atomic plants and airways traffic, respectively.

Zhang 28 studied the vulnerability assessment of Guangdone coastal area in China to storm. In this study six socio-economic indicators (population density, population distribution in 100km marine diameter, local gross production in a Km^2, industrial exports, urbanites and villagers annual income per capita) were used for representing vulnerability of coastal area to storm. In this study weighing and prioritizing of indicators were conducted by combination of Fuzzy approach and Delphi method. Weighing results showed that gross production and population density have greatest weight and importance for risk assessment against storm waves occurring in coastal area.

Jun et al. 34 used multi criteria Fuzzy approach and Delphi method for vulnerability assessment in Korea to flooding events resulted from climatic changes. In this study, 21 indices in sensitivity, adaptive capacity and exposure parts were selected and evaluated. Indices in exposure part were included climatic hazards.

Results of using Delphi method showed that among evaluated criteria, run-off and summer precipitation had greatest weight and priority in vulnerability assessment of areas to flooding.

Wang et al. 30 conducted the risk assessment of coastal social-ecological systems in China. In this study, used criteria in risk assessment were classified in 5 parts including economic conditions, social development, living standards, and geomorphology and coastal natural risks. Then, importance and weight amount of each indicator was determined by Analytical Hierarchy Process (AHP) and Delphi method. Selected indicators in this study for coastal natural risks were coastal erosion rate, tidal effect, sea floated ice, tropical storms and ocean waves. Weighing results showed that total weight of economic conditions, social development, living standards, and geomorphology and coastal natural risks indicators respectively allocated greatest weights. Among indicators associated to natural risks, storms, Mediterranean cyclones and ocean waves totally had greatest weight compared to coastal erosion and tidal effect.

Lee et al. 29 used an integrated fuzzy multi criteria approach for vulnerability assessment to flood event in Korea. In this study, for weighing and prioritizing of evaluation criteria combination of Delphi method and TOPSIS and for selection of criteria pressure-status-effect-response framework was used. 24 economic, social and natural criteria were selected for weighing using Delphi method. Results of Delphi method showed that among all of considered criteria, annual number of floods and flooding area had the greatest weight and placed in first rank of priority in vulnerability assessment.

MATERIALS AND METHODS

Study area

Mangrove forests of Hormozgan province located in northern coasts of Persian Gulf and Oman Sea by 10025.55 ha (more than 90% of mangrove forests of Iran) and developed in 7 towns including Jask, Sirik, Minab, Bandar Abbas, Khamir, Qeshm and Bandar Lenge at different habitats. Mangrove forests of Hormozgan province have greatest area of these forests in the country and in the entire of Persian Gulf region and waters of ROPME[1] region and consisted of two species including Harra (*Avicennia marina)* and Chendal (*Rhizophora mucronata*). Natural mangrove forests of Hormozgan province distributed from east, Gabric habitat (Himan vegetative spot) in Jask town, to west, Sayeh Khosh habitat in Bandar Lenge town district which viewed as sparse spots with different areas along coastal areas of province 3536.

Natural mangrove forests in coastal areas of Hormozgan spread on 25° 34' 13'' N in Gabrig (Jask town) to 27°10'54'' in Koulaghan (Bandar Abbas town) and 58°34'07'' E in Himan (Jask town) to 55°22'06''E in Bandar Lenge town (Figure 1). In mentioned area, natural sites except Syric habitat, totally covered with unmixed, irregular and uneven aged Avicennia associations and just in Syric habitat, Rhizophora species are mixed with Avicennia species 37. Mangrove forests of Hormozgan province encompass wide range of ecological functions such as heavy metal fixation, sediment fixation, erosion control, carbon sequestration, supplying habitat for fish and shrimp as well as providing various ecosystem services such as supplying animal fodder, honey harvest, fisheries and coastal protection3738.

In spite of these services and vital functions, these forests are in exposure of destruction resulted from natural and anthropogenic hazards such as over-exploitation of twigs, illegal hunting, unplanned tourism, development of industries in the periphery (boat building, plaster and cement factories), introducing of non-native species (black rat), entry of urban and industrial wastewaters and oil pollution. Beside these factors, presence of some environmental stresses such as consecutive drought and reduction of flow of fresh water rivers, extreme heat of summer and even tropical storms (e.g. Gono) converted mangrove forests into sensitive and strongly protection-required ecosystems 3839.

[1] - Regional Organization for Protection Marine Environment (ROPME)

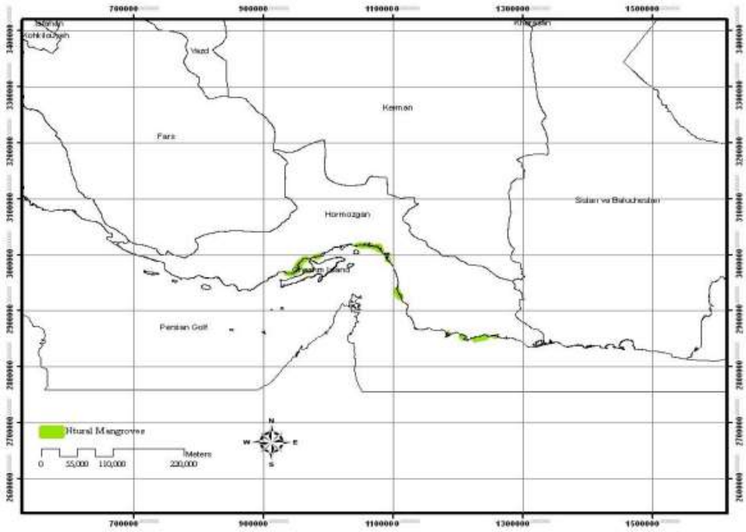

Fig. 1: geographical location of mangrove forests of Hormozgan province in Iran

Recognizing negative factors

Based on investigations, external environmental factors which have negative effect on plants were put into two classes including stresses and disturbances. According to definitions, stresses include all internal factors which have restrictive effect on plant photosynthesize (generally include light, moisture and/or nutrient deficiency as well as extreme temperatures) and disturbances include partial or major destruction of plant biomass by external factors e.g. herbivores, pathogens, and anthropogenic effects (cutting, plowing) or by wind destruction, freezing, drying, soil erosion and fire 4041. In fact, intensity of these factors determines amount of vulnerability, growth and surviving and also recovery and reestablishment rate of vegetation cover at different areas 42. From this view, different ecosystems, especially mangroves, almost permanently and simultaneously subjected to multiple environmental stresses and disturbances (natural and anthropogenic) which are vary temporarily and spatially 4344454647. Therefore, recognizing these stresses and disturbances has an important role in mitigating or compensating damages introduced into these forest ecosystems 18.

Generally, recognizing and classification of stresses and disturbances by extensive review of library resources and literatures, questionnaire setting for receiving decision-makers opinion and eventually analyzing findings using computer software, were the basic procedure of this study. Therefore, firstly with extensive evaluating library literatures, the most important external environmental factors (stresses and disturbances) which could have negative effect on structure and function of mangrove forests of Hormozgan province were recognized and classified at 4 main classes and 16 groups for building hierarchy structure (Table 1).

Table 1- classification of various negative effective factors for mangrove forests

Negative factor	Criteria	Reference
Meteorological	Sea level rise	48495051525354
	Storm	5551
	Drought	50,56
	Air temperature	57,50
Geological	Tsunami	58596061
	Landslide	62636465
	Erosion and accretion	6667
Anthropogenic	Unmanaged aquaculture	68697071
	Excessive fishing	7273
	Pollutants emission	74757677
	Unmanaged tourism activities	787980
	Changes in the freshwater inflow into the coastal environment	566181
	Engineering interventions in coasts	82838485
	Over-exploitation and Conversion of mangrove forests	8687888990
	Mining	9192
biological	Blooming of invasive species (pests)	9394959697

Application of Delphi method

In this section, stresses and disturbances which recognized in the previous section were screened by Delphi method and importance and priority of each was determined. In this study for conducting Delphi method, the procedure used by 9899100101 was implemented. Accordingly, closed Delphi method conducted in the following 6 steps:

Preparation of questionnaire

Generally, in Delphi method, questionnaires were designed as open-ended, closed-ended and semi-closed-ended. In open ones after analyzing responses and preparing collections of opinions, questionnaires again were sent to experts. This process repeated several times and final rankings were used as agreement among experts 102103. Although some authors criticized open-ended questionnaire, like that 104 and 105 expressed that open-ended questionnaires just provide partial information which could be obtained by reviewing previous studies. In closed-ended questionnaires, from the starting points, they contain a set of determined and recognized options collections and experts just say their opinion about presented options in questionnaires. In semi-closed-ended questionnaire in addition to determination of options importance, strictly experts have opportunity to expressing their opinion. In the present study, questionnaire for asking experts opinion was designed as closed-ended which recognized stresses and disturbances for determination of importance level gave to experts. Questionnaires were designed so experts could express their opinion for stresses and disturbances according to Lycert range by one of 5 degrees of important level (Figure 2).

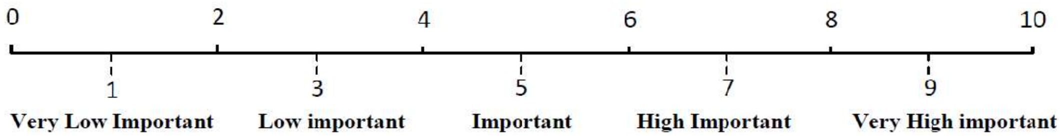

Fig. 2: Lycert range for determination of the important level of factors

Selection of the Experts

Generally, in Delphi method there no definite framework for selection method and number of experts (panelists) and various factors such as study purpose, decision quality, research team ability for handling study process, data collection time and available sources and also accepting for answering are effective in selection of group members 106107. Generally, number of participants in Delphi method varied from 5-20 individuals (usually less than 50 people) 106 but in uniform and homogenous groups, 10 to 15 individuals are enough and in ideal conditions even 4-people group could have appropriate performance 107. Finally, identifying and selection of experts were conducted by different methods such as judgment and decision making of major manager of project, organizational position of individuals and reviewing the paper authors 10820. In this study by the opinion of project manager, eight experts were selected exactly which have high scientific and operational experience (minimum 15 years) in area of conservation and restoration of mangrove forests and southern coasts of Iran and expressed their own opinions about importance level of mentioned stresses and disturbances in questionnaires.

Number of rounds

One of the challenging facts in Delphi method is the number of rounds. Iteration is a systematic process which conducted by questionnaire and with the aim of achieving an agreement 107. In this process, experts several times express their opinions about same question and by receiving the answers and responses; they have possibility to review their responses which results in improving group work and preventing from negative effect of personality and situational penetration in responses of others 109. But, there is no definite rule for number of rounds and what is determines number of iterations, is the level of consensus among panelists which accepted by supervisor group 110111112. So, In the study conducted by 113 it was stated that with precise and consciously selection of panelists by supervisor group, Increasing the number of rounds wouldn't results in considerable change in consensus level about considered options among experts and by presence of high consensus, questionnaires can be sent only at one round. Of course, panelists selection must be done correctly and based on activities area and number of studies and scientific papers published in considered field 107. For this study, the concept of consensus within a group was defined as a condition of homogeneity or consistency of opinion among the panelists. Cronbach's α is one statistical index, among others, that has been used to assess the reliability or internal consistency of a summation of entities, in this case, panelists 114115116 and has also been used in Delphi studies to measure the level of consensus among experts (Equation 1) 112:

$$\alpha_x = k/k - 1(1 - \sum \sigma_{y_i}^2/\sigma_x^2) \quad (1)$$

Where k is the number of panelists, $\sigma_{y_i}^2$ is the variances of each individual panelist responses, and σ_x^2 is the variance of the sum of responses for each individual panelist. Cronbach's α typically takes on values between 0 and 1. Values close to 0 mean that the ratings of the experts are completely unrelated to one another, while values close to 1 mean that the ratings are strongly associated. In this study, Cronbach's α in the first round was above 0.93, indicating substantial homogeneity and high level of consensus among the panelists from the beginning. Thus, in this study, questionnaires were sent to experts only at one round.

2.3.4. Questionnaire analyzing

In Delphi method, there are no definite way for analyzing and how to manage information which caused difference in strategies and procedures for reports interpretation and affects integrity of method 10924. But generally, analyzing methods applied in Delphi method were determined based on purpose, rounds structure, presented questions type and number of participants 24107. Main statistics used in Delphi studies include central tendency measures (mean, median and mode) and dispersion measures (standard deviation and inter-quartile range) which among them use of median, mode and mean gives more suitable results 107.

In this study such as the procedure used by 9899100101, mean statistic was used for collection of expert's opinions and calculation of weighted points of each affecting factor and eventually calculation of level and percentage of importance. Selections done for each importance level was considered as its point of importance level (n_i). Factors weight was considered between 0 – 10 and as already mentioned each importance level represent a range of weight. In fact, in weighting of factors, it was cared that sum of weights for every factor (according to importance level) had not to excess 10. For each factor, two statistical item including percent (P) and degree (D) of importance were considered so that based on factors importance diagram, effective factors screening could be possible. In order to obtain importance percent (P), initially maximum obtainable weight having point (A) was obtained from multiplying maximum expected point (equal to total respondents (N)) by maximum modulated weight (W=10) (Equation 2). Then, by dividing maximum amount of modulated weight (W) by sum of each factors weigh ($\sum x_i$), modulated weight coefficient (y_i) was calculated (Equation 3). Using modulated weight coefficient (y_i) and point of each factor (n_i), weighted point (z_i) was achieved (Equation 4). By dividing total weighted point of each factor in maximum weighted point (A), importance percent of that factor was obtained (Equation 5). Eventually, weighted mean of importance of each stress or disturbance was calculated by multiplying point in weight (importance degree) divided by total points and was considered as importance degree (D) of each effective factor (Equation 6).

$$A = N \times W \quad (2)$$

$$y_i = \frac{W}{\sum x_i} \times x_i \quad (3)$$

$$z_i = y_i \times n_i \quad (4)$$

$$P = \frac{\sum z_i}{A} \times 100 \quad (5)$$

$$D = \frac{\sum (x_i \times n_i)}{N} \quad (6)$$

Plotting of importance of factors and their screening

In this step, importance diagram was designed for selecting considered stresses and disturbances. In this diagram, importance percentage of each effective factor displayed in horizontal axis and importance degree in vertical axis and each factor displayed based on two items and finally for screening most important factor, best percent and degree amounts were used. So, diagram based on half of importance degree and half of maximum obtained importance percentage divided into 4 parts and stresses and disturbances bearing more than one half of numerical value of every axis or located in first quarter of graph, were selected for final prioritizing 9899100101.

Prioritizing of selected stresses and disturbances

In this step, Normalized Importance Coefficient (NIC) was calculated for each screened stresses and disturbances using importance diagram. NIC was obtained by multiplying of degree and percent of importance of each factor (importance coefficient) divided by total importance coefficient of all factors (Equation 7). Finally, based on NIC, prioritizing of stresses and disturbances affecting on mangrove forests was conducted.

$$NIC = \frac{P \times D}{\sum(P \times D)} \quad (7)$$

RESULTS

Among different ecosystem in earth, mangrove forests by having direct and indirect values at different ecosystem level and components providing various range of goods and services required for human communities such as production of marine and wood products, preventing from storms damages, flooding control and protection of shorelines and coastal erosion control, absorbing waste materials, recreation and transport 117118119. Thus for thousand years they have considerable contribution in human societies economy and living 120. Due to this dependency, mangrove ecosystems destruction by various natural and anthropogenic stresses and disturbances caused wide range destruction of goods and services provided by these ecosystems which eventually cause instability of dependent human societies. Therefore conducting conservation activities and improving efficient management strategies which protects essential ecological processes, biodiversity and ecosystem services of these forests, are inevitable. For achieving these goals and efficient planning for sustainable management of mangrove ecosystem, first step is recognition, classification and prioritizing of various negative factors (natural and/or anthropogenic) which these ecosystems encountered with them 121. Results from this recognition will be the base for conducting vulnerability assessment which have important role in creating quantitative and qualitative image from processes associated to ecosystems vulnerability 18.

Generally, in various studies for evaluating and prioritizing of stresses and disturbances affecting on ecosystems, opinion analyzing of experts and decision makers were used and different tools and methods were used so that required efficiency will be achieved 122123124. In this study like other studies by 2829303334 Delphi method were used to prioritizing and ranking of negative natural and anthropogenic factors. So, after recognizing of existed negatively potential and active factors and based on analysis of opinion presented by experts, a range of importance degrees determined and eventually by appropriate analyzing, all factors prioritized and ranked.

As mentioned before, 8 questionnaires which were completed by experts and include 5 scales of importance degree for each of negative factors were used for analyzing and determination of importance degree and percentage of each factor. Evaluation of obtained importance percent amount for each effective factor showed that pollutants emission have greatest importance percentage (31.7) among all factors and thereafter, unmanaged aquaculture and engineering interventions in coasts (both equal to 29.7) placed in second rank together. Results also showed that tsunami, mining, excessive fishing and landslide by importance degree of 11.5, 10.1, 13.26 and 14.46 respectively, placed in latest ranks. These results represent lower importance of geological factors in causing adverse environmental effects on mangrove ecosystems compared to other factors. Also, overall comparison between various effective factors showed that negative factors resulted from anthropogenic activities in comparison with stresses and disturbances resulting from meteorological and geological factors have more importance percentage and have considerable contribution in creating various negative effects and increasing mangrove ecosystems vulnerability. Comparison between various stresses and disturbances based on importance degree had a similar order with comparisons performed by importance percentage. So that pollutants emission, unmanaged aquaculture and engineering interventions in coasts have greatest important degree among all stresses (Fig. 3).

As mentioned before, screening of effective factors was conducted using two items importance diagram which consist of percentage and degree of importance (Fig. 4). On this basis that just factors located in first quarter are acceptable, four factors consist of tsunami, mining, excessive fishing and landslide due to locating in third quarter were removed from final list and other effective actors located in first quarter were used for prioritizing and final ranking.

Finally, by comparing NIC, prioritizing and ranking of stresses and disturbances affecting on mangrove ecosystems were conducted. Results showed that pollutants emission, excessive fishing and engineering interventions in coasts (with together) and change in freshwater inflow into coastal environment respectively by NIC of 0.109, 0.096 and 0.095 located in first to third rank in terms of importance level which represent great importance of anthropogenic stresses and disturbances compared to environmental ones in mangrove forests of Iran. Based on obtained results, air temperature and storm by NIC of 0.048 and 0.054 placed in latest rank (Tables 2 and 3). Among various effective factors, drought and blooming of invasive species (pests) both with similar importance coefficient (0.057) placed in 8th priority. Results also showed that among stresses and disturbances from meteorological factors (sea level rise, storm, drought and high temperature), sea level rise had greatest importance coefficient (0.075).

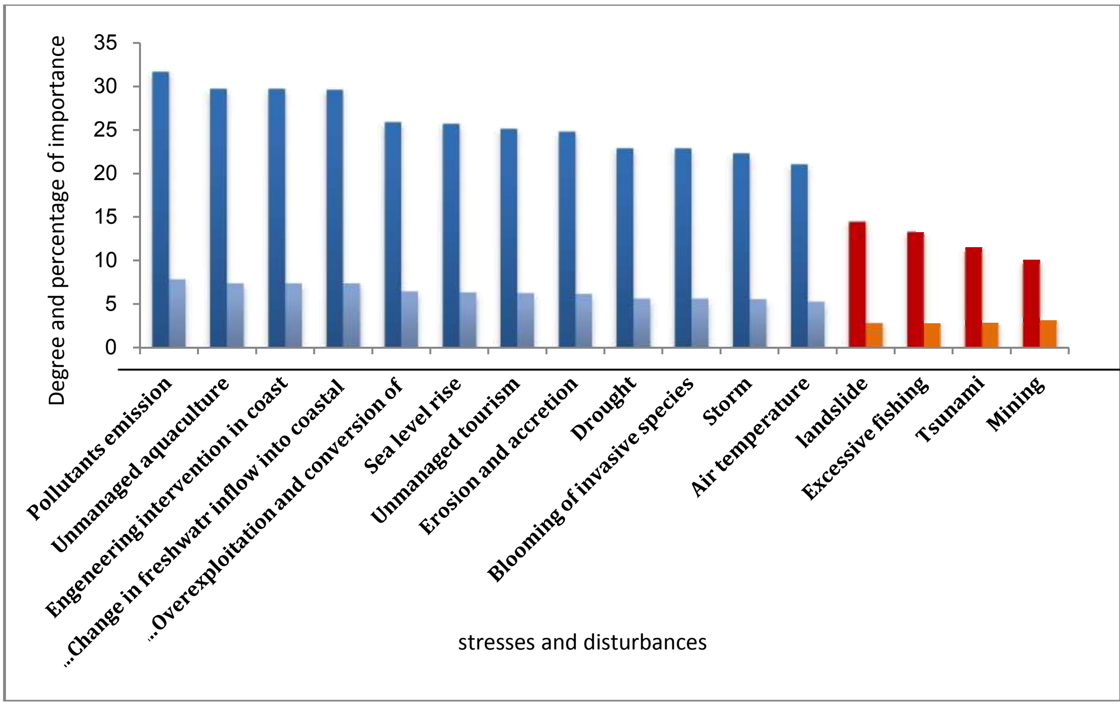

Fig. 3 Comparison of degree and percentage of importance of negative factors

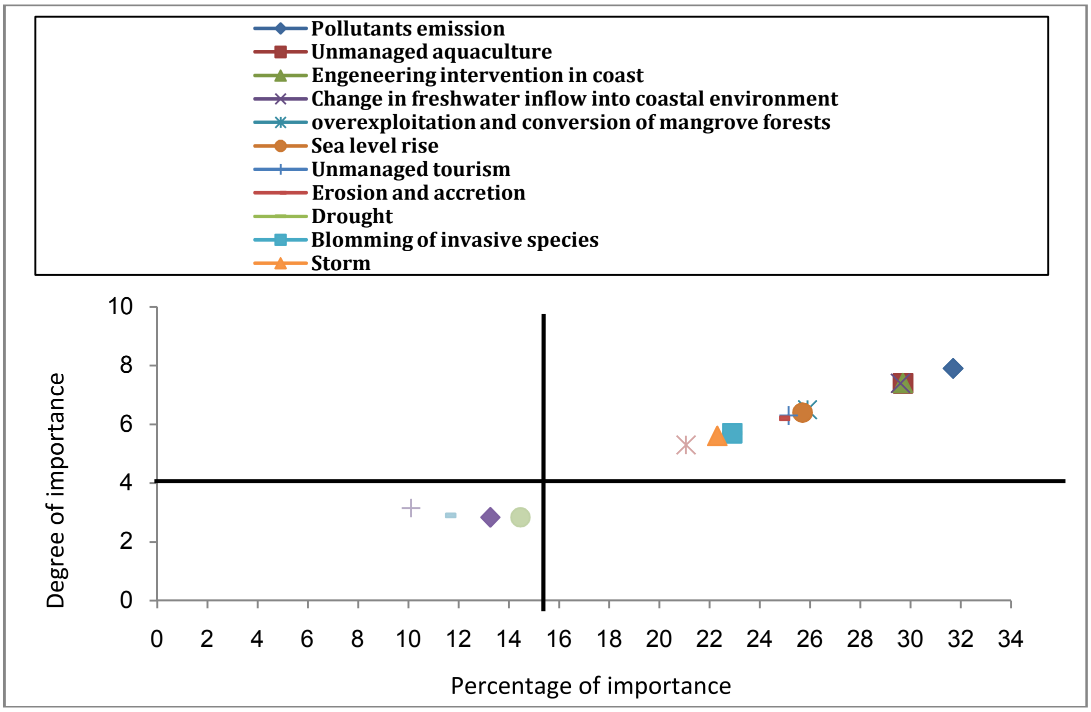

Fig. 4 Diagram of screening negative factors

Table 2 Normalized importance coefficients of negative factors

Criteria	Sub-Criteria	Percentage Of importance	Degree of importance	Importance coefficient	Normalized importance coefficient
Meteorological	Sea level rise	25.7	6.4	1.644	0.071
	Storm	22.3	5.6	1.248	0.054
	Drought	22.9	5.7	1.305	0.057
	Air temperature	21.06	5.3	1.116	0.048
Geological	Erosion and accretion	24.8	6.2	1.537	0.067
Anthropogenic	Unmanaged aquaculture	29.7	7.4	2.197	0.096
	Pollutants emission	31.7	7.9	1.504	0.109
	Change in freshwater inflow into coastal environment	29.6	7.4	2.190	0.095
	Unmanaged tourism	25.14	6.3	1.583	0.069
	Excessive fishing	22.9	5.7	1.305	0.057
	Engineering interventions in coasts	29.7	7.4	2.198	0.096
	Overexploitation and Conversion of mangrove forests	25.9	6.5	1.683	0.073
Biological	Blooming of Invasive species (pests)	22.9	5.7	1.305	0.057

Table 3 Final prioritizing of negative factors affecting on mangrove forests of Hormozgan province

priority	Sub-criteria
1	Pollutants emission
2	Unmanaged aquaculture Engineering interventions in coasts
3	Change in freshwater inflow into coastal environment
4	Overexploitation and Conversion of mangrove forests
5	Sea level rise
6	Unmanaged tourism
7	Erosion and accretion
8	Drought Excessive fishing Blooming of Invasive species (pests)
9	Storm
10	Air temperature

DISCUSSION

Studies about vulnerability assessment of some coastal environments of the world showed that natural stresses and disturbances have higher importance degree and priority than anthropogenic stresses and disturbances 2930. But results of this study showed that based on current position and status of mangrove forests of Iran, stresses and disturbances from anthropogenic activities have higher importance than other stresses which are similar to33.

Results of final ranking showed that among meteorological factors, storm, drought and air temperature placed in latest priorities; While sea level rise have more importance and priority which representing experts affinity to allocating more weight to this environmental stimuli than other meteorological factors. The results weren't unexpected at all; experts and authors stated among various meteorological factors, sea level rise is the most important factor in current and future decrease in area (10-20 percent decrease in total area of mangrove forests) and health of mangroves in all over the world 52535455126.

Results of various studies showed that pollutants, with operating in various spatial and temporal scales, are the most destructive factors affecting on mangrove forests which caused considerable sensitivity and vulnerability in mangrove forests 125127. In the present study results from analyzing of experts opinions showed that like other parts of world, pollutants by having highest importance coefficient among studied stresses and disturbances, are the most negative factors affecting on mangrove forests of Iran.

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Results of final prioritizing showed that after pollutants, unmanaged aquaculture and engineering interventions in the coasts due, together located in second priority. Unfavorable consequences from

unmanaged aquaculture in Iran are due to constructing of aquaculture ponds and physical destruction of coasts as well as wastewater intrusion of these ponds into mangrove ecosystem which results in decreasing of mangroves, disturbing natural hydrological regime and entering toxic waste in mangrove forests of the country 128. Studies conducted in other parts of the world showed that unmanaged aquaculture activities caused numerous unfavorable effects on mangrove forest and considerable destruction of these ecosystems all over the world 71.
Rapid and unplanned development of various infrastructures in coastal areas through changes in natural hydrodynamic system and sediments transportation caused uncompensated damages to the integrity of coastal ecosystems 84129130. Excessive constructions in coastal areas of Hormozgan province such as ship-building and chalk and cement factories caused destruction and fragmentation of habitats and reducing effective size of mangrove species population and converted them into vulnerable ecosystems 128. In fact, awareness about unfavorable consequences of industries and structures development caused experts allocate greatest importance degree to this factor after pollutants among various stresses and disturbances and introduced it as one of the most important negative factors affecting on mangrove forests of Iran.
Surface freshwater stream is one of the most effective landscape processes which having the seasonal, volumetric and biochemical unique characteristics, are affecting on structure and function of mangrove ecosystems 5354131. Activities such as canal building, dam construction, dredging, ground water exploitation, waste management, agriculture development, mining and removal of vegetation could cause destructive effects on mangrove forests by changes in salinity level, nutrients, sediments and soluble oxygen of surface freshwaters 6086. Based on this fact, results of this study showed that change in surface freshwaters inflow into mangrove forests of Iran by great importance degree, placed in the third rank in the final ranking.
It is important to say that lower importance coefficient of some stresses and disturbances don't imply that these factors ineffective on mangrove ecosystems; so some of these factors such as storm, pollution and air temperature which placed in latest priorities in terms of degree of importance, could have destructive effect on structure and functions of these mangrove ecosystems, while based on experts opinions they are not priority in management operations in Iran.
Finally it can be said that, although in different studies, existing of different opinions of experts and decision makers caused different classification and prioritizing of natural and anthropogenic stresses and disturbances, but results of this prioritizing, acting as supporting decision-making tool, play an important role in efficiency and success of natural resources restoration and management programs. Undoubtedly, taking effective management solutions in the context of environmental stresses and disturbances and strategic planning for protected areas including mangroves and other dependent ecosystems caused enhancement in adaptability and resiliency of these ecosystems to different environmental stresses.

ACKNOWLEDGMENT
We acknowledge the Iranian National Institute for Oceanography and Atmospheric Science' experts, who helped us in pair comparisons process

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