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# Executive management engineering plans for comparison with tsunami damage

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**ABSTRACT**

A tsunami is a sea wave of local or distant origin that results from large-scale seafloor displacements associated with strong earthquakes, major submarine slides, or exploding volcanic islands. A tsunami can strike any coast at any time and we cannot predict exactly when or where they will occur. Undersea earthquakes most often cause tsunamis but submarine landslides or volcanic eruptions can also cause them. A tsunami can move as fast as a jet plane across the Open Ocean and can hit land with waves as high as 20 meters or more. The water may wash inland for several kilometers in flat lying areas, and can move up streams and rivers, destroying everything in its path. Waves may continue to strike the shoreline for many hours, and dangerous currents can continue for days following the event. Coastal areas endure Clear changes in response to ocean changes. The tsunami and tropical storms are among those changes. These changes should be note, Failure to pay attention to them makes opportunities become a threat. Tropical storms are one of the most dangerous hazards. In the first table some costs are mentioned.
When a tropical storm occurs, the water level along the waves in the sea changes. In these storms, strong winds are generated that revolve around a central core.it can move from ocean to coastal areas. The Makran seduction is due to the mountain range from Iran to Pakistan. The most important of these are Taftan and Bazman in Iran and Sultan in Pakistan. In hence The coastal area and sea play an important role in the development of country. Tropical storms and tsunamis are one of the most destructive phenomena in the world.it occurred in1945 in Iran, Mokran. The reason for this phenomenon was the large earthquake of 8.25 on the Mokran fault. This tsunami caused a lot of damage That killed more than 4,000 people in Pakistan. Tropical storms are important phenomena in the ocean area. The proper investment in different sectors and special attention to marine hazards and tsunami and also implementation of prevention plans are so necessary. Coastal areas influence economy by the knowledge of the potential of energy, transport, fisheries and tourism in addition to their political, strategic and social importance in the country's economy. Some plans are designed to reduce costs. Some of these programs are for training and some are to prevent damage. Financial limitation causes the need of prioritizing plans based on the knowledge of economical engineering in different periods of time. . In this case we present a modeling for prioritizing plans in order to Reduce the amount of Economical losses .with use NPV index to do the task .we have to calculate the amount of cost reduction for each plan. To find the extent of the damage reduction, 100 experts and organizations are surveyed and the results are estimated and then the cost of implementation of plans was found.
Historical accounts describe an earthquake and tsunami on 21 July AD 365 that destroyed cities and drowned thousands of people in coastal regions from the Nile Delta to modern-day Dubrovnik. The location and tectonic setting of this earthquake have been uncertain until now.

## 1. Introduction

The uplift of the sea floor associated with such an earthquake would have generated a damaging tsunami. There are multiple levels of tsunami hazard assessment (THA), including studies to investigate and document the frequency and severity of prehistoric and historic tsunami events, and numerical modeling studies with varying degrees of complexity.

It is obvious that hurricanes can have a destructive effect on reefs situated on the leeward sites of islands. However, also minor storms passing at relatively great distance can cause severe damage. Marine hazards along with damages to buildings and facilities have Economic and social impacts on human communities and coastal resident's malicious tsunamis are likely to occur in Iran. [Ref. 1] Marine risk management is the main way to reduce losses. That may cause the fishery industry to collapse. It may cause Loss of fishing line and loss of raw materials industries. Some costs are estimated in the table 1.

**Table 1. costs of some type of hazards**

| Type of damage | Cost(dollar) |
|---|---|
| The amount of fish lost | 31715517 $ |
| The amount of shrimp lost | 941875 $ |
| Damage to boat and fishing boat | 82144400 $ |
| Damage to fishing boats | unknown |
| Production of canned fish | 16500 $ |
| Production of fish | 11718750 $ |
| Production of fish meal | 296737357 $ |
| Damage to other fishing infrastructure | unknown |
| Injuries to residents | unknown |
| Feeling insecure | unknown |
| Sum | 423274399 |

Some losses cannot be estimated. We estimated these values using a survey of professors, experts, and organizations.

To prevent these damages, several schemes have been put forward, each with its own repercussions. These plans are explained in the chart below

Explanation of each plan to reduce costs of marine hazards:

- Plan1 Workshop for students of school
- Plan2 work shop for student of universities
- Plan3 workshop for people
- Plan4 Preventing human casualties
- Plan5 schedule for crisis from tsunami and costal storm
- Plan6 Forecast plan for merchant ships
- Plan7 Timely forecasting and notification
- Plan8 Pre-crisis Zone Management
- Plan9 Fire Fighting and Damage
- Plan10 Environmental Health and Disease Prevention
- Plan11 Emergency Communications in Crisis
- Plan 12 Establishing Public Securities in Times of Crisis (After Emptying Houses)
- Plan 13 Implementation of insurance plans for urban and rural activities Project
- Plan 14 Protections of Drinking Water Resources and Power Transmission Lines
- Plan 15 Reconstruction of urban and rural buildings and the last plan is to protect the artifacts
- Plan 16 to protect the artifacts

The country's budgetary constraint makes it necessary to prioritize projects. This prioritizing is based on engineering economy. Economical Costs of Possible Tsunami Damaging Sistan and Baluchestan province accounts for 40% of fishing industry in Iran. Physical units are the first step to estimate the direct effects of the damage. [Ref. 2] Indirect effects last up to two years. Indirect losses are losses of production capacity and loss of income. It can continue up to 4 or 5 years. Balance of payments, Inflation, and total employment. Table 2 shows the implementation cost of each plan. [Ref. 3]

**Table 2. cost of each plan to reduce costs of marine hazards**

| Characteristic | Value |
|---|---|
| Workshop for school students | 16 $ |
| Workshop for university students | 16 $ |
| Workshop for people | 84 $ |
| Preventing human casualties | 58 $ |
| schedule for crisis | 58 $ |
| Forecast plan for merchant ships | 41 $ |
| Timely forecasting and notify | 84 $ |
| Pre-crisis Zone Management | 41 $ |
| Fire Fighting and Damage | 84 $ |
| Environmental health and Disease Prevention | 58 $ |
| Emergency Communications in Crisis | 58 $ |
| Establishing Public Security in Times of Crisis (After Emptying Houses) | 58 $ |
| Implementation of insurance plans | 41 $ |
| for urban and rural activities | 100 $ |
| Protection of Drinking Water Resources and Power Transmission Lines | 116 $ |
| Reconstruction of urban and rural buildings | 167 $ |
| protect the artefacts | 58 $ |

[Ref. 4] [Ref. 5]

## 2. Results and Discussion

### 2.1.method

The purpose of this study is to examine plans to reduce losses. In Researches by National Iranian Oceanographic Research Institute Several plans are presented. Then, by NPV method the model was designed and prioritized. The NPV model is one of the most powerful indicators of macro decision making. It states for net present value . At first cost reduction for each plan is estimated in tabel 3.

To find the extent of the damage reduction, 100 experts and organizations were surveyed and the results were estimated as mentioned.

**Table 3. Damage Reduction Due to Implementation of Each Project**

| Type of damage | Costs |
|---|---|
| • Plan1 Workshop for students of school | 2000000 |
| • Plan2 work shop for student of universities | 2000000 |
| • Plan3 workshop for people | 4000000 |
| • Plan4 Preventing human casualties | 3000000 |
| • Plan5 schedule for crisis from tsunami and costal storm | 2000000 |
| • Plan6 Forecast plan for merchant ships | 1000000 |
| • Plan7 Timely forecasting and notification | 5000000 |
| • Plan8 Pre-crisis Zone Management | 7000000 |
| • Plan9 Fire Fighting and Damage | 10000000 |
| • Plan10 Environmental Health and Disease Prevention | 5000000 |
| • Plan11 Emergency Communications in Crisis | 100000000 |
| • Plan 12 Establishing Public Security in Times of Crisis (After Emptying Houses) | 20000000 |
| • Plan 13 Implementation of insurance plans for urban and rural activities Project | 30000000 |
| • Plan 14 Protection of Drinking Water Resources and Power Transmission Lines | 40000000 |
| • Plan 15 Reconstruction of urban and rural buildings And the last plan is to protect the artifacts | 55000000 |
| • Plan 16 to protect the artifacts | 10000000 |

Then By calculating NPV, each project is prioritized .

Net present value tells us what a stream of cash flows is worth based on a discount rate, or the rate of return needed to justify an investment. The profitability index helps make it possible to directly compare the NPV of one project to the NPV of another to find the project that offers the best rate of returning.npv is used in economic calculations and engineering economics and micro and macro economics.

### 2.2. Economical analyze

The last tsunami in the Makran area was 65 years ago. On average, tsunamis occur every 70 to 100 years. So the probability of a tsunami per year is between 1/70 and 1/100. As a result, the probability of a tsunami per year (p) is between two numbers.

$$0.01428571 > p > 0.01$$

X=Decision variable
W= Cost of implementing the project
S= The amount of the cost including the savings created by the plan
TC=( 0.01428571x) si + wi
If yes $x = 1$
Otherwise x=0

Based on the figures presented in Table 1, with the implementation of the first plan and the second one it does not change the amount of costs widely but it can cause the reduction in psychological effects.

According to investment theories in the science of economic engineering, the following statements are defined:

Investments are called capital goods that increase the productive capacity of society.

In this discussion, the other can be said to be the implementation of a plan that empowers the region to face potential risks.

N.p.v net present value of any project is equal to the present value of project revenues minus the net cost of that project

If this indicator is positive, the project can be invested in. If N.p.v is negative, the investment will have a negative effect.

$$a = \frac{\mathrm{p}}{(1+i)} n$$

A= value of proceeds from the implementation of the plan at the present time
P= value of the proceeds of the project is the estimated interest rate per unit of project time
I= Interest rate per unit of project execution time
[Ref. 3]

n.p.v = TC – a

The larger the numerical value of the index above, the higher probability of implementation will be.
Since the inflation rate in Iran is 9.6, according to the report of the Central Bank of Iran, it is 0.8 monthly
The following calculations for the npv index are as mentioned (tabel4).

**Table 4. NPV index calculation**

| plan | NPV index |
|---|---|
| • Plan1 Workshop for students of school | 2499983300 |
| • Plan2 work shop for student of universities | 1/25E+11 |
| • Plan3 workshop for people | 9/83043E+14 |
| • Plan4 Preventing human casualties | 1/875E+12 |
| • Plan5 schedule for crisis from tsunami and costal storm | 4882812499 |
| • Plan6 Forecast plan for merchant ships | 2/44141E+15 |
| • Plan7 Timely forecasting and notification | 1/2207E+15 |
| • Plan8 Pre-crisis Zone Management | 1/70898E+15 |
| • Plan9 Fire Fighting and Damage | 2/44141E+15 |
| • Plan10 Environmental Health and Disease Prevention | 1/2207E+15 |
| • Plan11 Emergency Communications in Crisis | 2/44141E+15 |
| • Plan 12 Establishing Public Security in Times of Crisis (After Emptying Houses) | 4/88281E+15 |
| • Plan 13 Implementation of insurance plans for urban and rural activities Project | 7/32422E+15 |
| • Plan 14 Protection of Drinking Water Resources and Power Transmission Lines | 9/76562E+15 |
| • Plan 15 Reconstruction of urban and rural buildings And the last plan is to protect the artifacts | 1/34277E+16 |
| • Plan 16 to protect the artifacts | 2/44141E+15 |

At the result showed in table 5, First plan is a Workshop for students of school second is a work shop for students of universities
3rd plan is a workshop for people 4th plan is to prevent human casualties.5th plan is a schedule for crisis from tsunami and costal storm.
6th plan is a Forecast plan for merchant ships
7th plan Timely forecasting and notification.
Other priorities could be noticeable in special conditions.

**Table 5. result (plans are mentioned respectively by priority)**

| priority | plan |
|---|---|
| first priority | • Plan4 Preventing human casualties |
| 2th priority | • Plan11 Emergency Communications in Crisis |
| 3th priority | • Plan 15 Reconstruction of urban and rural buildings And the last plan is to protect the artifacts |
| 4th priority | • Plan 14 Protection of Drinking Water Resources and Power Transmission Lines |
| 5th priority | • Plan 13 Implementation of insurance plans for urban and rural activities Project |
| 6th priority | • Plan 12 Establishing Public Security in Times of Crisis (After Emptying Houses) |
| 7th priority | • Plan9 Fire Fighting and Damage |
| 8th priority | • Plan 16 to protect the artifacts |
| 9th priority | • Plan6 Forecast plan for merchant ships |
| 10th priority | • Plan8 Pre-crisis Zone Management |
| 11th priority | • Plan7 Timely forecasting and notification |
| 12th priority | • Plan10 Environmental Health and Disease Prevention |

| | |
|---|---|
| 13th priority | • Plan3 workshop for people |
| 14th priority | • Plan2 work shop for student of universities |
| 15th priority | • Plan5 schedule for crisis from tsunami and costal storm |
| 16th priority | • Plan1 Workshop for students of school |

## 3. Conclusions

As we have seen, a plan to prevent human casualties is at the top priority. In times of crisis, a high percentage of costs will be reduced by implementing loss prevention and loss plan.The project is implemented by the Port Authority of the Police. The project cost $ 58 million. The next priority is the communication plan in the event of a crisis under the authority of the governor. Implementation of plans to deal with damages in a complex situation seems to be more efficient. This result is justified by the fact that marine hazards occur with less probability. Training programs are also usually long term.

Tsunamis and tropical storms rarely occur. But they cause a lot of damage. They can cause damage to various industries. Like the fishing and tourism industry. [Ref. 6] And because the coastal areas have the highest income through fishing some of these damages are irreparable. There were numerous ways to reduce costs, including training for different groups and prevention plan. 16 plans were designed in this area. First plan is Workshop for students of school Second is work shop for student of universities .3th plan is workshop for people 4th plan is to Preventing human casualties 5th plan is schedule for crisis from tsunami and costal storm.6th plan is Forecast plan for merchant ships.7th plan Timely forecasting and notification. Plan 8 Pre-crisis Zone Management. Plan 9 Fire Fighting and Damage .Plan 10 Environmental Health and Disease Prevention .Plan 11 Emergency Communications in Crisis .Plan 12 Establishing Public Security in Times of Crisis (After Emptying Houses).Plan 13 Implementation of insurance plans for urban and rural activities Project .14plan Protection of Drinking Water Resources and Power Transmission Lines ,Plan 15 Reconstruction of urban and rural buildings And the last plan is to protect the artifacts. Due to budget constraints, not all projects can be implemented. According to studies the plan "to prevent human casualties in times of crisis" is the first priority to implement. But training plans are also needed. Although training plans are in the thirteenth and fourteenth priorities. It looks like it should be merged with the fourth plan. So by weighing the issue of education and awareness and The Impact of Content and its Quality on Planning Workshops and informing the general public, especially education in schools and universities all priorities are important. [Ref. 7] The plan of emergency communications is also a second priority in times of crisis. So it will economically comply with the following table but the above mentioned content should be notice. [Ref. 8] [Ref. 9]

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