

Climate Change And Its Impact On Marine Fish Production With Special Reference To Kanyakumari District

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Abstract: The primary sector is the most important in any economy in the sense that it provides food to its population and generates employment and income to a significant portion of the Indian rural mass. Production of salt, fish and milk are the important three allied activities of agriculture. Fish is an important source of food in Kanyakumari District. One of the most important factors affecting the production of fish is climate change. The exponential growth of marine fish production, rainfall, temperature and humidity shows the trend of climate factors and fish production. Also the impact of climate factors on fish production is analysed by using correlation and regression methods. The factors affecting fish production are identified by the views of both subject experts and field experts through primary data. In the district, climate change have some impact on the marine fish production.

I. INTRODUCTION

The primary sector is the most important in any economy in the sense that it provides food to its population and generates employment and income to a significant portion of the Indian rural mass. It provides employment to around 65 per cent of the total workforce in the country. Activities related to the production of salt, fish and milk are the important three allied activities of agriculture. India ranks second in the production of fish after China. Fish is an important source of many nutrients, including protein, retinol, vitamins D and E, iodine and selenium. The consumption of fish enhanced brain development and improves learning in children, eye health, protection from cardiovascular diseases and some cancers (FAO 2013).

One of the most important factors affecting the production of marine fish is climate change. It is a long-term change in the weather pattern in a particular region at any time. It is one of the burning issues in each country because of its adverse impact on various sectors particularly agriculture and allied sector. The climate change can easily be observed by the delayed monsoons, unexpected rain, unseasonal rain, heavy downpours, rise in temperature, heavy snowfall, floods, droughts, cyclones,

rise of sea level and uneven distribution of rainfall. Climate change is caused by the emission of green house gases, deforestation, urbanisation and other economic activities of human beings. Occurrence of both drought and rise in temperature above normal level create adverse impacts on the allied activities (Dar, 2009).

Heavy and unseasonal rainfalls affect fishing adversely. Increase in temperature creates adverse impact on fisheries and aquaculture. It affects breeding of fishes due to the adverse impact on corals. Many species of fish shift to other places where the weather condition is favourable for them (FAO, US, 2009). Other serious climate extremes like humidity, cold, snowfall, rise of sea level, melting of glaciers and ice sheets also affect fish production.

In the words of Adhya (2011), climate change affects the growth of animals both in land and in water. A rise of one degree Celsius in temperature leads to increase the metabolism rate by ten per cent and affects the growth of animals. In the ocean, tiny organisms like phytoplankton and calcium building creators are dwindling in size due to acidification and reduced water quality. Further, for every one degree rise in temperature, the size of fish is reduced to 6 to 12 per cent.

Ayyappan et al. (2010) reveal that natural disasters such as cyclones and huge waves along the coastal India often damage boats, fishing gears and landing of fishes. It causes huge loss to fishermen. In India, fishermen are vulnerable to natural disasters and it can be evident from the 2004 Tsunami, which damaged almost all the coastal areas.

According to Kumar (2010), climatic changes such as heat stress and sea level rise destroy the entire coastal ecosystem. Mangrove forests, coral reefs and sea grasses are affected very much. Many fresh water fishes migrate to other places and many species of fishes and cold water fishes are wiped out from the sea.

Sudakar (2010) points out that the coral reefs are the wealth of Gulf of Mannar. It is the main source of food and provides livelihood for millions of people. As the corals are very sensitive, global climate change and rise in temperature, threat the life of coral reefs and the population of fish, which completely depends upon corals. Wind flow, water current, rainfall, turbidity, temperature and depth of the corals are the factors affecting coral reefs. The corals were bleached up when the temperature was in between 29.1° Celsius and 33.6° Celsius during the 2010 summer. The most affected corals were in the shallow waters within the depth of 0.5 to 2 metres. The bleached corals were recovered only when the rising temperature level is controlled.

Ranade (2006) noted that fishing activity had been affected by Tsunami. It affected the socio-economic conditions of 90 per cent of the fishermen, because it damaged the fishing nets, boats and homes of extremely poor section of the society.

A southernmost tip of Indian sub continent with a long coastal line of 72 kms is Kanyakumari District. Kanyakumari district is famous for fish production due to both inland and marine fishing. There are six coastal blocks and 42 coastal landing centres in the district. People experience climate changes like failure of monsoon, high temperature and unseasonal rain. All these may adversely affect fish production. So it is necessary to assess the impact of climate change on fish production. The primary objective of the study is to estimate to what extent fish production gets affected by climate change in the study area. The study is based on both primary and secondary data. For collecting primary data 20 fishermen and 5 subject experts were selected for identifying the factors affecting fish production in the study area.

II. FISH PRODUCTION IN KANYAKUMARI DISTRICT

Fish production in Kanyakumari District is given in the following table.

Year	Fish (in metric tonnes)
1990-91	37281
1991-92	34009
1992-93	35267
1993-94	29235
1994-95	32178
1995-96	32291
1996-97	37740

1997-98	46440
1998-99	38316
1999-00	41652
2000-01	49716
2001-02	49951
2002-03	19643
2003-04	20395
2004-05	16308
2005-06	44698
2006-07	37521
2007-08	37409
2008-09	39628
2009-10	40064

Source: Various Issues of Tamil Nadu Fisheries Statistics from 1990-'91 to 2009-'10, Chennai.

Table 1: Production of Fish in Kanyakumari District from 1990-'91 to 2009-'10

The fish production data presented in table 6.14 bring to light that the marine fish production shows a lot of ups and downs. However, it was 37740 mt in 1996-'97 but in the next year it rose to 46440 mt. Similarly during 2002-'03 it showed a fall and reached 19643 mt. It reached the highest quantity of 49951 mt in 2001-'02. The year 2004-'05 shows the minimum quantity of 16308 mt. It indicates that fish production is not stable.

EXPONENTIAL GROWTH RATES

The exponential growth rates of both rainfall and humidity show a decline of 0.01 per cent, but temperature a rise of 0.002 per cent. In the study area, the exponential growth of marine fish production is -0.02 per cent.

III. CORRELATION AND REGRESSION ANALYSIS

The values of correlation coefficients calculated for various independent and dependent factors are given in table 2.

Factors	Fish Production	Sig. at
Rainfall	-0.055	0.408
Temperature	0.104	0.331
Relative Humidity	-0.308	0.094

Source: Calculated Values

Table 2: Correlation between Rainfall, Temperature, Humidity and Marine Fish Production

The table 2 reveals that there is a negative correlation between rainfall and total fish production though the value is not significant. The temperature does not affect fish production and humidity makes negative changes in fish production. But the values are not significant.

The following multiple regression equations with their respective R² values express the contribution of both rainfall, temperature and humidity on the production of fish in the study area.

$$MF_p = -15758 + 0.033X_1 + 0.20X_2 - 0.35 X_3$$

$$R^2 = 0.125$$

$$MF_p = \text{Marine Fish Production} \quad X_1 = \text{Rainfall}$$

X_2 = Temperature X_3 = Mean Relative Humidity

The regression equation meant for fish shows that if the rainfall increases by one unit, the marine fish production increases by 0.03 unit and the fish production increases by 0.20 unit as the temperature increases by one unit. However, one unit change in humidity makes 0.35 unit decrease in the fish production.

The R^2 values states that rainfall, temperature and humidity are the causes for 12 per cent of the variations in marine fish production. The results of the multiple regression state that, the impact of these climate factors on the selected allied activity is not significant. It means that the remaining variations in production are caused by some other factors that are not identified by the researcher.

IV. FIELD EXPERT'S VIEWS ON THE IMPACT OF CLIMATE FACTORS ON FISH PRODUCTION

For identifying the factors that affect the production of fish, the field experts were interviewed. They have informed that the following factors cause variations in fish production.

A. GARATTE RANKING

The following table shows the ranks of various factors affecting the production of fish in the study area.

Sl. No.	Fish Production	
	Factors	Score and Rank
1	Wind	72.1 (1)
2	Waves	62.95 (2)
3	Heavy Rain	56.5 (3)
4	High Temperature	47.2 (4)
5	Unseasonal Rain	33.25 (5)
6	Fog and Cold	27.9 (6)

Source: Primary Data

Note: Figures in brackets indicate rank

Table 3: Assigned Ranks To Various Factors That Affect Fish Production

As reported by fishermen, climatic factors also affect fish production. Speedy wind and high waves are major reasons for affecting marine fish production and so they are at the top in the rank list. If the intensity of wind is high, fishermen cannot go deep into the sea for fishing. Sometimes the heavy waves due to wind damage their boats and create financial and sometimes life loss. The fishing is difficult if it rains heavily. Hence, rain occupies the third rank. Fishermen feel that, higher temperature, unseasonal rain and fog and cold affect the fish production, but have only less impact when compared to other factors. Further they opined that after reaching their original fishing spots by travelling hours together, they sometimes returned without any catch as fishes migrated from one place to other places, where the climate is favourable to them. The poor fishermen don't know what is happening inside the sea. It happens during heavy rain and high temperature.

B. NUMBER OF DAYS UNEMPLOYED DUE TO UNFAVOURABLE CLIMATE

During heavy wind and high waves, as the fishermen cannot venture into the sea they are unemployed. The details of days of unemployment are given in the following table.

Sl. No.	Type of Fishing	Number of Days of Unemployment
1	Deep Sea	24
2	Off Shore	15

Source: Primary Data

Table 4: Number Of Days Of Unemployment Of Fishermen Due To Climate Change

The table 4 indicates that, on an average, the deep sea fishermen cannot go into the sea for 24 days and the offshore fishermen remain unemployed for 15 days in a year apart from the official fishing holidays.

C. PROBLEMS OF FISHERMEN

The fourteen deep sea fishermen and six offshore fishermen faced a number of problems in the sea while fishing. All the surveyed fishermen reported almost the same problems. The problems enlisted by them are portrayed in the table given below.

Sl. No	Deep Sea Fishermen (14 respondents)	Offshore Fishermen (6 respondents)
1	Insufficient government subsidies for fuel, maintenance and unexpected damages	Insufficient government subsidies for fuel, maintenance and unexpected damages
2	Wind and waves while sailing	Wind and waves while sailing
3	Quarrel arise when the mechanised boat collides with the catamaran	Quarrel arise when the mechanised boat collides with the catamaran
4	Migration of fishes towards the favourable places	-
5	Border problem with other countries	-
6	Facing a risk when the ships collide with the boats	-

Source: Primary Data

Table 5: Problems Faced By Fishermen

The problems listed in table 5 make the younger generation to move away from fishing. It is certain that in future, fishermen may opt for other jobs and it will affect the total fish production.

D. SUBJECT EXPERTS' VIEWS ON FISHERIES

The five subject experts interviewed expressed almost the same opinion as listed below.

- ✓ The most important factor deciding fish production is corals inside the sea. The corals are destroyed by higher

temperature and sea level rise. It affects the fish production adversely. Less availability of food leads to the migration of fish to other places. It happens if the corals are destroyed.

- ✓ Good rainfall is good for breeding. Less rainfall or late rainfall delays breeding of fishes.
- ✓ If it rains heavy inside the sea, it decreases the salinity of water. It is dangerous to fish because the bottom water temperature is high in this season.
- ✓ High sea surface temperature, water current, waves and tides are the other climate related factors affecting fish production adversely.
- ✓ The good time for fishing is the post-monsoon period. This season is the most apt for both good catch and good breeding. Both moderate temperature and moderate humidity are favourable for fish production.

V. SUGGESTIONS

- ✓ Coast guard can be strengthened by connecting the boats of all deep sea fishermen through a network. So that each and every incident can be informed to the coast guard and the problems faced by the fishermen in the sea can be solved.
- ✓ Risk of climate change can be reduced through insurance

VI. CONCLUSION

The analysis of data confirms that rainfall and humidity show a declining trend and temperature show a rising trend. All the three climate factors, rainfall, temperature and humidity lose their seasonality in recent time and they have some impact on marine fish production in Kanyakumari district. It is backed both by subject experts and field experts. As it is clear from the correlation and regression analyses carried out so far on the impact of climate change on the production of fish indicate that, climate change has adverse

impact to a limited extent on fish production. Wind and waves, high temperature, high sea surface temperature and high water current affect fish production. All these factors cause monetary loss to the surveyed respondents. As the mitigation cost is high, the nature cannot be controlled and the impact of climate change cannot be mitigated, government must come forward to reduce the climate changing human activities.

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