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PLANNING FOR DEVASTATING RIVERS FLOOD CONTROL TO MAINTAIN THE ENVIRONMENTAL BALANCE FOR SUSTAINABLE DEVELOPMENT: A CASE STUDY OF KARNATAKA STATE

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ABSTRACT:

Severe floods in the past as well as the recent floods in many States including Karnataka, which caused devastation and vast area submergence are warning us of inadequacy of flood management measures. Therefore, concerted efforts are required to make a critical review of the existing flood management measures, capabilities of managers and related guidelines and policies together with state of the art technologies. The main objectives of this paper are to demarcate the frequent flood occurrence region for planning to reduce the loss of lives (man & animals), public property and changing natural landscape. The necessary data is collected from secondary sources and published articles of daily news papers and applied GIS techniques to demarcate the frequent flood affected areas and calculated the loss.

*There are 07 major east flowing river systems in Karnataka which with their tributaries, drains 87% of the Karnataka state i.e., Godavari, Krishna, Cauvery, North Pennar, South Pennar, Palar and West –Flowing 4 major rivers are flowing in different direction (drains 13% of the state area). Out of the total 11 major rivers, 6 rivers create devastating flood occurs in Karnataka State. According to state disaster management agencies the flood affected the worst in 16 districts of Karnataka State in 2019 and other expose larger challenges of rehabilitation. The death toll by flood in Karnataka rose to 61 human deaths with 15 missing while at least 859 animals had lost their lives. Over 2,028 villages (27,028 inhabited and 2,362 uninhabited **villages**, 281 **urban centers**) were inundated and 6,97,948 people were evacuated, of which 3,96,617 are currently in the 1,168 relief camps across the flood districts. A total of 1,56,381 houses and 6,09,039 lakh hectares of crop loss has been incurred. In Karnataka state rivers flood occurrence due to heavy rainfall in the catchment areas of many rivers upper valley region (in the Maharashtra state), while in middle valley region of rivers catchment area (Karnataka State) having prone to flood in 30% of state geographical area (in between 01-08-2019 to 31-10-2019), 40% areas receives moderate rainfall and remaining 30% area affected by severe drought (130 taluks/238) due to rainfall scarcity. and estimated flood related loss in Karnataka is about₹ 33,000 crores (says CM - B.S.Yediyurappa). In this regard the researcher has suggested some strategies for flood management and regional specific issues would enable the decision makers and the Planning Commission in adopting appropriate policies and measures required for flood management for environmental balance towards sustainable development.*

Key Words : Devastating Rivers, Environmental Balance, Sustainable Development. River Basin Management, Flood Havoc and its Control.

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INTRODUCTION:

Water is necessary both for sustainable human development and for the healthy functioning of the planet's ecosystem. Availability of freshwater globally however, is limited. Out of the 2.7 per cent of a total amount of 1 400 million km^3 of freshwater, the major portion occurs in the form of permanent snow cover or deep aquifers and only a small fraction is available for use. Although India has to support 16 per cent of the world's population and 15 per cent of livestock, we have only 2.4 per cent of the land and **4 per cent of the water resources of the world.** Out of about 4 000 km^3 of precipitation in a year, as much as 3 000 km^3 comes as rainfall in a short monsoon period of three to four months from June to September. The distribution of the water thus available is not uniform and is highly uneven in both space and time. The average annual water resource potential of the country is estimated to be 1 869 km^3. Due to hydrological, topographical and geological limitations, however, only 690 km^3 of surface water can be utilized by conventional storage and diversion structures. The annual recharge of groundwater is 433 km^3.

In recent decades one major problem faced by the country is floods. Today floods are a common feature and their co-existence poses a potent threat, which cannot be eradicated but has to be managed at some extent. Transfer of the surplus monsoon water to areas of water deficit is a potential possibility. This would also help create additional irrigational potential, the generation of hydropower, as well as overcoming regional imbalances. Floods are recurrent phenomena in India as well as in Karnataka. Due to different climatic and rainfall patterns in different regions, it has been the experience that, while some parts are suffering **devastating floods**, another part is suffering drought at the same time. With the increase in population and development activity, there has been a tendency to occupy the floodplains, which has resulted in damage of a more serious nature over the years. Often, because of the varying rainfall distribution, areas which are not traditionally prone to floods also experience severe inundation. Thus, floods are the single most frequent disaster faced by the Karnataka state.

Flooding is caused by the inadequate capacity within the banks of the rivers to contain the high flows brought down from the upper catchments due to heavy rainfall. Flooding is accentuated by erosion and silting of the river beds, resulting in a reduction of the carrying capacity of river channels; earthquakes and landslides leading to changes in river courses and obstructions to flow; synchronization of floods in the main and tributary rivers; retardation due to tidal effects; encroachment of flood plains and haphazard and unplanned growth of urban areas. Some parts of the country, mainly coastal areas of Andhra Pradesh, Orissa, Tamil Nadu and West Bengal,

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experience cyclones, which are often accompanied by heavy rainfall leading to flooding. After 1980, **Rashtriya Barh Ayog** (National Commission on Floods) assessed the total area liable to flooding in the country as 40 million hectares, which constitutes one-eighth of the country's total geographical area. The Working Group on Flood Control Programme set up by the Planning Commission for the Tenth Five Year Plan put this figure at 45.64 million hactares. About 80 per cent of this area, i.e. 32 million hactares, could be provided with a reasonable degree of protection.

More significant than the loss of life and damage to property is the sense of insecurity and fear in the minds of people living in the floodplains. The after-effects of flood, such as the suffering of survivors, spread of disease, non-availability of essential commodities and medicines and loss of dwellings, make floods the most feared of the natural disasters faced by humankind.

STUDY AREA:

Karnataka is a state in the south western region of India, it covers an area of 1,91,976 sq. Kms, or 5.83% of the total geographical area of India. It is the sixth largest Indian state by area, with 61,130,704 inhabitants at the 2011 census, Karnataka is the eighth largest state by population, comprising 30 districts. The economy of Karnataka is the fourth-largest state economy in India with ₹15.35 lakh crore (US $220 billion) in gross domestic product and a per capita GDP of ₹210,000 (US$3,000). Karnataka has the twelfth highest ranking among Indian states in human development index and it has been divided into four Revenue divisions, 49 sub-divisions, 30 districts, 238 taluks and 745 hoblies/Revenue Circles for administrative purposes. The State has 27,028 inhabited and 2,362 uninhabited villages, 281 towns and urban agglomerations.

Karnataka witnesses three types of climate. The state has a dynamic and erratic weather that changes from place to place within its territory. Due to its varying geographic and physio-graphic conditions, Karnataka experiences climatic variations that range from arid to semi-arid in the plateau region, sub-humid to humid tropical in the Western Ghats and humid tropical monsoon in the coastal plains. More than 75 percent of the entire geographical area of Karnataka, including interior Karnataka, witnesses arid or semi-arid climate. Karnataka has about 15 percent of the total semi-arid or 3 percent of the total arid areas marked in India. The average annual rainfall in Coastal Karnataka is about 3456 mm, which is much more than the rainfall received in the other parts of the state. The north interior Karnataka receives just 731 mm average annual rainfall and the South Interior Karnataka receives an annual average of 1,286 mm rainfall. Karnataka experiences average high temperature during summer is 34^{o} C across the state. The average day temperature is 29^{o} C in the monsoon season and during winter season temperatures range from

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32^{o} C to below 20^{o} C. The highest temperature recorded in Karnataka was 45.6° C at Raichur on 23rd May 1928. The lowest temperature recorded was 2.8 °C at Bidar on 16th December 1918.

OBJECTIVES:

The main objectives of this paper are:

- to demarcate the frequent flood occurrence region for planning. to identify the flood prone area in the Karnataka state in 2019.
- to analyze the severity of flood and to estimate the loss in flood affected areas.
- To suggest the remedial measures to reduce the loss of lives (man & animals), public property and changing natural landscape in flood affected area.

DATA BASE:

The necessary data's are collected from secondary sources published by Govt of Karnataka and Many Non Govt. organizations, Daily News Papers, etc

METHODS APPLIED:

The **National Agriculture Imagery Program** (NAIP) acquires aerial imagery during the flood period in the Karnataka state. In 2009, most NAIP imagery will be acquired with digital sensors rather than film cameras and applied GIS techniques to demarcate the frequent flood affected areas and calculated the loss. A primary goal of the NAIP program is to make digital ortho-photography available to governmental agencies and the public within a year of acquisition.

ANALYZE THE FLOOD PRONE AREAS:

Torrential rains in many parts of the Karnataka state has created a flood scare afresh as many rivers are in spate, especially in north Karnataka. For the past few days, torrential rains in north interior Karnataka has wreaked havoc as many rivers, rivulets and small streams are in spate, reminiscent of the floods in the month of August and September in 2019. The affected taluks are located in 16 districts, they are : Belagavi, Bagalkot, Raichur, Kalaburagi, Yadgir, Vijayapura, Gadag, Haveri, Dharwad, Shivamogga, Chikkamagaluru, Kodagu, Dakshina Kannada, Udupi, Uttara Kannada and Mysuru districts, where water has gushed into houses and government buildings, including schools and banks in low-lying areas, yet to recover from the flood-fury four months ago, once again bore the brunt of the heavy downpour. Rainwater gushed into many houses in low-lying areas and some other places and it forcing people to take shelter on roof-tops. Many inter-village connectivity roads were inundated, causing the stoppage of traffic.

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There are 07 major east flowing river systems in Karnataka which with their tributaries, drains 87% of the Karnataka state i.e., Godavari, Krishna, Cauvery, North Pennar, South Pennar, Palar and West –Flowing 4 major rivers are flowing in different direction (drains 13% of the state area). Out of the total 11 major rivers, 6 rivers create devastating flood occurs in Karnataka State. According to state disaster management agencies the flood-hit 16 districts are Belagavi, Bagalkot, Raichur, Kalaburagi, Yadgir, Vijayapura, Gadag, Haveri, Dharwad, Shivamogga, Chikkamagaluru, Kodagu, Dakshina Kannada, Udupi, Uttara Kannada and Mysuru (August and September 2019) have been affected the worst and only likely to get worse as rains recede and other expose larger challenges of rehabilitation. The death toll by flood in Karnataka rose to 61 human deaths with 15 missing while at least 859 animals had lost their lives. Over 2,028 villages (27,028 inhabited and 2,362 uninhabited villages, 281 urban centers) were inundated and 6,97,948 people were evacuated, of which 3,96,617 are currently in the 1,168 relief camps across the flood districts. A total of 1,56,381 houses and 6,09,039 lakh hectares of crop loss has been incurred. In Karnataka state rivers flood occurrence due to heavy rainfall in the catchment areas of many rivers upper valley region (in the Maharashtra state), while in middle valley region of rivers catchment area (Karnataka State) having prone to flood in 30% of state geographical area (in between 01-08-2019 to 31-10-2019), 40% areas receives moderate rainfall and remaining 30% area affected by severe drought (130 taluks/238) due to rainfall scarcity. and estimated flood related loss in Karnataka is about₹ 33,000 crores (says CM - B.S.Yediyurappa).

Table: 1. Estimated Flood damage in India and Karnataka State – 2019.

Flood damage	India		Karnataka	
	Maximum	Average	Maximum	Average
Area affected	17.5 m. h.	7.63 m. h.	57.59 L. h	9.50 L.h
Crop area affected	10.15 m. h.	3.56 m. h.	6.90 L. h	4.32 L.h
Population affected	70.45 million	32.92 Million	19.63 L Pop	11.25 L.Pop
Houses damaged	35,07,542	12,34, 616	3,28,193	1,56,381
Heads of cattle lost	6,18,248	91,242	5,714	859
Human lives lost	1 1316	1 560	183	61
Damage to public utilities	US$ 705 million	US$ 126 million	US$ 118 million	US$ 21 million
Total damage	US$ 1,255 million	US$ 307 million	US$ 245 million	US$ 54 million

Flood rescue authority faces other challenges including recovering the dead, prevention of water borne diseases, de-silting entire, landslides, rehabilitation and resettlement submerged portion of many towns and villages. For rescue the people joint teams comprising of Fire and Emergency, SDRF, NDRF and the four Indian Air Force choppers have been deployed at

Belagavi, Mysuru, Raichur and one Indian Navy chopper in North Karnataka state. Hundreds of others from the army, state and central agencies have been working tirelessly since first week ofAugust-2019 to help rescue stranded people and livestock. In 2018 (29th September- 4th October 2009) floods and landslides in the Coffee-growing district of Kodagu was left crippled after most of the bread winning agricultural and plantation lands was lost. In Karnataka state heavy flood damage was inflicted during the monsoon of 1955, 1971, 1973, 1977, 1978, 1980, 1984, 1988, 1989, 1998, 2001, 2004, 2009. 1013, 2015 and 2019.

CAUSES FOR HEAVY RAINFALL IN KARNATAKA:

In 21 century, due to global warming, the climatic system in Karnataka has been changed drastically, because the areas near the earth equator receive high rainfall amounts because constant solar heating produces intense heating, large-scale evaporation, moist rising air that cools with altitude and forms convectional rainfall. In addition, air masses converge here which results in heavy rainfall. In a recent study of rainfall trends using remotely sensed satellite data and actual field data from the Indian Meteorological Department of the Western Ghats region over the past 15 years, it was found that during the monsoon months of June, July, August, September, the average rainfall was more over Karnataka than Maharashtra and Kerala. The Western Ghats run parallel to the Arabian Sea coast for approximately 1,600 kms from the Maharashtra-Gujarat border to the southern tip of Kerala.

Table :2. The following places recorded highest rainfall with respect to each year (2010-17).

Year	Place	Taluk	District	Rainfall (in mm)	Elevation
2017	Agumbe	Thirthahalli	Shimoga district	6,311	643
2016	Agumbe	Thirthahalli	Shimoga district	6,449	643
2015	Hulikal	Hosanagara	Shimoga district	6,035	614
2014	Kokalli	Sirsi	Uttara Kannada	8,746	780
2013	Hulikal	Hosanagara	Shimoga district	9,383	614
2012	Hulikal	Hosanagara	Shimoga district	8,409	614
2011	Mundrote	Madikeri	Kodagu district	9,974	585
2010	Amagaon	Khanapur	Belgaum district	10,068	785

Among the several reasons for heavy rainfall, the first and foremost reason is that the mountain topography in Karnataka is broader than the narrow topography of the Ghats in

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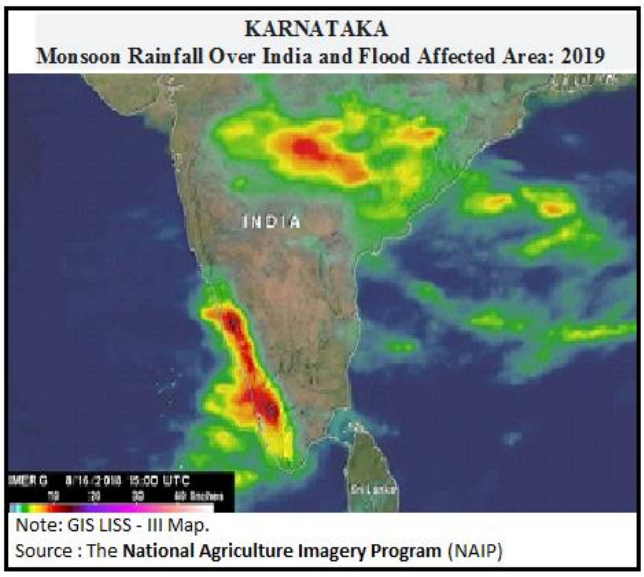
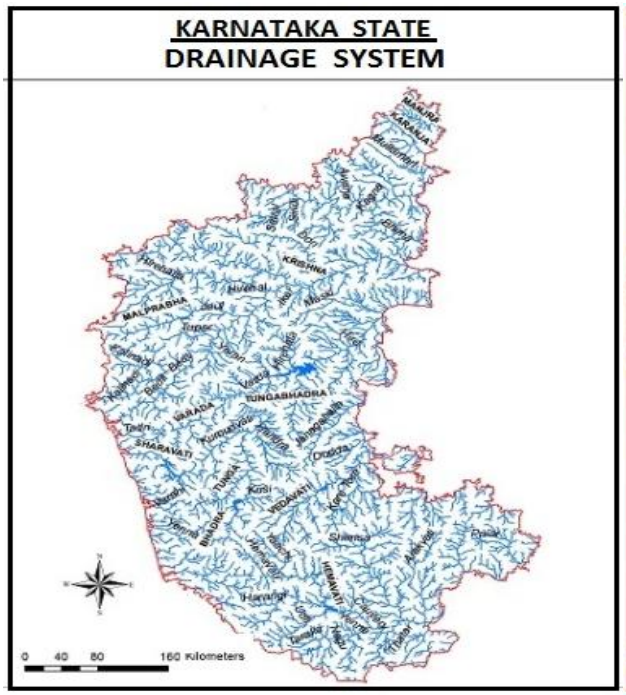
Maharashtra. Due to the greater width of the mountains, the rain bearing winds have to necessarily travel a longer distance and have more time for the drops to coalesce and precipitate as rainfall, resulting in higher rainfall. In contrast, the narrow width of the Ghats in Maharashtra allows the rain-bearing wind to cross over to the leeward side rapidly before precipitation can occur. As for Kerala, the Ghats there are in the form of isolated mountains, where the rain-bearing winds can easily cross over to the leeward side through the gaps in between without precipitation occurring.





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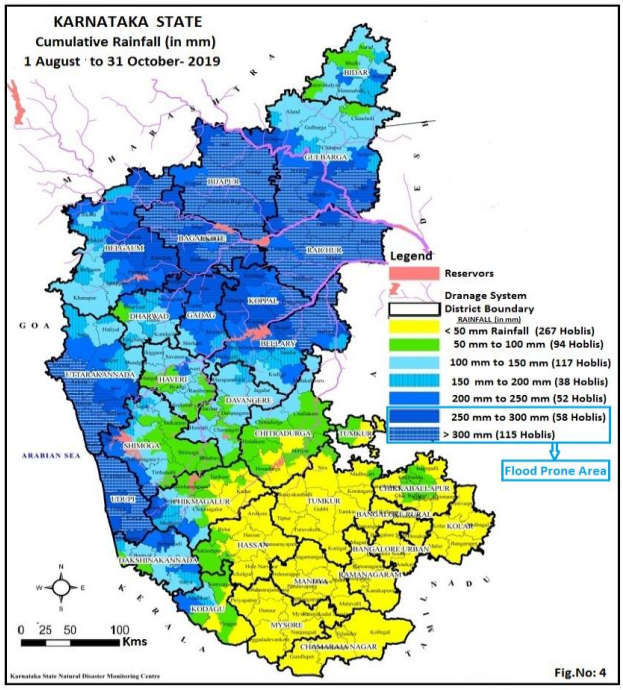

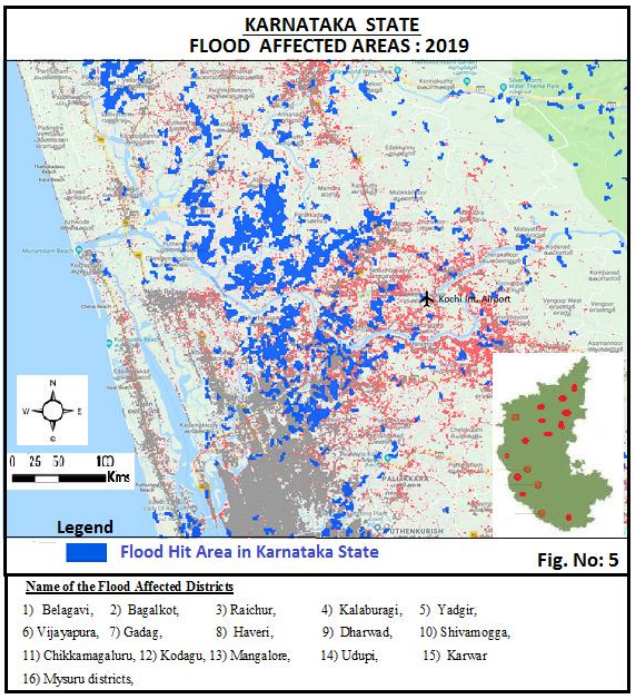

Flood affected 16 Districts of Karnataka State:

In Belagavi district NH- 4 was closed at night in many days and thousands of vehicles, including state transport buses, were stranded on both sides of the NH-4 in August & September - 2019. A Karnataka State Road Transport Corporation bus coming towards Belagavi from different parts was stuck on the road after it caved in due to heavy rains. The Belagavi-Goa route was also affected near Jamboti due to a landslide, which swept away many parked vehicles. In Belagavi district's Gokak town, water from the Ghataprabha river inundated many areas, creating panic among the residents. The town was badly affected by the floods in August and September months. Belagavi is said to be the worst hit district in the state. Six people were killed in rain related incidents, and 40,180 people have been evacuated. Crop loss in Belagavi was reported in 1,36,529 hectares of land. The district is likely to receive continued moderate rainfall over the next month and nine NDRF teams have been airlifted to the district. 1,410 kms of roads and 211 bridges have been damaged. The Air Force has rescued as many as 25 people from the district, some from treetops.

In Dharwad district, a stream at Bennehalla in Navalgund Taluk is raging, threatening to inundate the national highway connecting Solapur in Maharashtra.

In Kalaburagi district, a stream cut off connectivity between Anuru in Alanda Taluk and neighbouring Maharashtra. The Karnataka State Natural Disaster Monitoring Centre director G S Srinivasa Reddy said the intensity of rains and inflow in Krishna and its tributaries may increase

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in the next one to two months as two upper air cyclonic systems in the Arabian sea and Bay of Bengal were bringing rain in the interior parts of Karnataka. At present, Krishna and her tributaries are flowing below the danger mark but the intensity of inflow of water in these rivers may increase. Like-wise flood affected areas are very vast in this districts as per the PTI report.

Kodagu District: In Kodagu, villages along the Cauvery have witnessed major flooding. Electricity and phone connectivity is down. Two NDRF teams have been deployed, and rescue and evacuation is underway. Assistance from fire and emergency, police, army and home guards is also being provided.

Shivamogga District: At least 06 person has died in Shivamogga. An NDRF team has been deployed to the district, and rescue efforts are underway with the involvement of Civil Defense, fire and emergency and police officials.

Dakshina Kannada District: District Collector Sasikanth Senthil S told TNM that the situation was currently under control but rivers are in spate. "There is no major flooding. We are expecting flooding in 2nd week of August parts of Bantwal and Uppinangadi. So far 80 people have been evacuated. We are taking mitigation measures as required. We are prepared for any eventuality. There are no casualties," he said.

Uttara Kannada District: Four rain-related deaths have occurred in the district and one NDRF team has been deployed.

Malnad Region (Shivamogga, Uttara Kannada, Chikkamagaluru, Hassan, Kodagu districts): Heavy rain has pounded the region since 2nd week of August as villages witnessed major flooding and there is overflowing in lakes, tributaries and rivers. The area is expected to receive heavy rain over the next week.

Raichur District: An Indian Air Force chopper has been deployed to Raichur. Reports say that helicopters are being brought in to rescue families stranded on an island in the Krishna river.

Mysuru District: With heavy rainfall in the Cauvery basin, parts of Mysuru district has been flooded. "I am myself in HD Kote doing rounds along with the SP in HD Kote. There are two-three major developments. Lakshman Tirtha river which originates from Virajpet in Kodagu, that is seeing a historical flood. After 80 years, this is the greatest water flow.This is affecting one portion of Hunsur taluk. Since Waynad is flooded we are getting heavy inflows from Kabini as well and it is not abetting. There are two small reservoirs which collect water from the forest areas, they are also full which is unprecedented.." Mysuru DC Abhiram G Sankar told TNM. About 200 plus people have been evacuated from low lying areas, It is a continuous process, There is one casualty where a mud house collapse on the fringes of Nagarhole.

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In September-2019 due to heavy rainfall in the Monsoon season, severe flood affected the southern Indian State of Karnataka. As a security measure in the prevailing situation of heavy rains, India Meteorological Department issued **Red alert** to several regions of coastal and malnad regions of Karnataka state. Thousands of people were evacuated to safer places and relief camps. A total of 61 people have been killed and seven lakh have been displaced. As of 14 August 2019, Over 6.97 lakh people were evacuated. CM of Karnataka announced compensation of ₹5 lakh for the family members of those who died in the floods. The Karnataka government passed the order declaring the 80 taluks flood-hit taking into account the damage to the crop, human lives, livestock and basic infrastructure. State had undertaken an ariel survey of the other flood-hit areas in the state. Karnataka Chief Minister B S Yediyurappa said never ever a disaster of this magnitude had struck the state in the past 45 years.

EFFECTS:

Due to the heavy water discharge from the Maharashtra reservoir, the North Karnataka districts of Belagavi, Bijapur, Raichur, Kalburgi, Yadgir and Uttara Kannada were severely affected by the flood discharge. On August 8, Karnataka received nearly five times the rainfall it normally used to have, adding to the severity of the ongoing floods in 12 districts that had killed 20 people by August 9, 2019. Excess rainfall is the main possible factor that caused or intensified floods. According to government officials report any particular region can manage rainfall only up to a point, based on its land use and soil holding. Once that is breached, it floods.

IMPACT:

As of 14 August 2019, 61 people have been killed and 15 people missing due to flood-related incidents across 16 districts of the state as per the data released by Karnataka State Natural Disaster Monitoring Centre. More than 40,000 houses were damaged in Karnataka floods, while more than 2,000 villages were affected. North, coastal and Malnad districts were worst affected. Other affected districts include Bagalkot, Vijayapura, Raichur, Yadgiri, Uttara Kannada, Dakshina Kannada, Shivamogga, Kodagu and Chikkamagaluru. Landslides occurred in many places in Chikkamagaluru, Kodagu, Dakshina Kannada and Uttara Kannada districts due to heavy rains. Connectivity on 137 major roads (National Highway, State Highway and Major district roads) has been disrupted due to floods and landslides. There was extensive damage to critical infrastructure such as roads, pipelines, tanks, schools, and electrical infrastructure.

DAMAGE ASSESSMENT:

Damages due to Karnataka flood, data released by Karnataka Chief Minister's Office:

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- Human lives lost: 61.
- People Missing : 15.
- Animal death : 859.
- People evacuated: 6,97,948.
- Animals rescued : 51,460.
- Relief camps opened: 1,168.
- People in relief camps: 3,96,617.
- Houses damaged: 56,381.
- Flood affected Villages : 2,028.
- Flood Affected Taluks and Districts: 103 taluks of 16 districts affected.
- Agriculture and Horticulture crop loss: 6,09,039 hectares.

Flooding in Karnataka has now left 61 people dead and 6,97,948 displaced since it began earlier of August month. Further heavy rain has fallen over the last few days. Humchadakatte in Shimoga Distric recorded 390mm of rain in 24 hours on 10 August, according to India Meteorological Department (IMD) figures. Kammardi in Shivamogga District recorded 230 mm of rain in 24 hours to 11 August, 2019. India's Central Water Commission (CWC) said on 11 August that the Tungabhadra river is at "Severe to Extreme Flood Situation" in the districts of Shivamogga, Koppal, Davangere, Ballari. The Dudhganga river at Sadalga in Belgaum district is at a record high of 540.58 metres, beating the previous high of 538.9 metres set in 2005.




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RESCUE:

Karnataka State Disaster Management Authority, Karnataka police along with the Indian Air Force, civilians, volunteers, fishermen from coastal Karnataka are actively taking part in the rescue operations in flood-affected regions. A joint rescue team consisting of Fire and Emergency, State Disaster Response Fund, National Disaster Response Force and Indian Army evacuated 6.73 lakh people as of 14 August 2019. Nodal officers are tasked to camp in vulnerable villages.

RESPONSE:

According to the Ministry of Home Affairs, Disaster Management Division, from 1 June to 30 August, Karnataka received 698 mm of rainfall and because of this many people lost their lives.

RELIEF AND MONETARY:

On October 4, 2019, Central Government had released an amount of 1200 Crores for Karnataka in Last year 2018 Kodagu disaster for the request of former Chief Minister H. D. Kumaraswamy from the National Disaster Response Fund as flood relief. 1800 crores was released on Oct. 6th 2019 for 2019 floods (60 days after the floods).

APPROACH TO FLOOD MANAGEMENT:

Approaches to dealing with floods may be any one or a combination of the following available options:

- Attempts to modify the flood
- Attempts to modify the sus-ceptibility to flood damage
- Attempts to modify the loss burden
- Bearing the loss.

The main thrust of the flood protection programme undertaken in India so far has been an attempt to modify the flood in the form of physical (structural) measures to prevent the

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floodwaters from reaching potential damage centres and modify susceptibility to flood damage through early warning systems.

STRUCTURAL MEASURES:

The following structural measures are generally adopted for flood protection:

- Embankments, flood walls, sea walls.
- Dams and reservoirs
- Natural detention basins
- Channel improvement
- Drainage improvement
- Diversion of flood waters.

Of these measures, embankments are the most commonly undertaken in order to provide quick protection with locally available material and labour. The major embankment projects taken up after independence are on the rivers Kosi and Gandak (Bihar), Brahmaputra (Assam), Godavari and Krishna (Andhra Pradesh), Mahanadi, Brahmani, Baitarni and Subarnarekha (Orissa) and Tapi (Gujarat). These embankments play an important role in providing reasonable protection to vulnerable areas. Realizing the great potential of the reservoirs in impounding floods and regulating the flows downstream for flood moderation, flood control has been sought to be achieved as one of the objectives in multipurpose dams. Reservoirs with a specifically allocated flood cushion have been constructed on the Damodar system in Jharkhand and the Hirakud and Rengali dam in Orissa. However, many other large storage dams, e.g. Bhakra dam, without any earmarked flood storage, have also helped in flood moderation.

During the post-independence period, multi-purpose projects such as the Damodar Valley Corporation (DVC) reservoirs, the Bhakra-Nangal project, Hirakud dam, Nagarjuna Sagar project etc., have been constructed to increase food production, energy generation, drinking-water supply, fisheries development, employment generation, flood moderation, etc. These large dams have played a significant role in reducing damage by way of flood moderation. One of the important flood moderation examples achieved by dams is that of Damodar Valley, where four reservoirs were constructed with flood management as one of the objectives. During the 2000 monsoon, DVC reservoirs saved the life and property of people from a possible disaster through flood moderation.

Up to 2005, 34 398 km of new embankments and 51 318 km of drainage channels were constructed. In addition, 2400 town protection works were completed and 4 721 villages were

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raised above flood levels. Barring occasional breaches in embankments, these works gave reasonable protection to an area of some 16.5 million hactares.

NON-STRUCTURAL MEASURES:

Non-structural measures include:

- Flood forecasting and warning
- Floodplain zoning
- Flood fighting
- Flood proofing
- Flood insurance.

A brief description of the most important measure, i.e. flood forecasting, and the progress made so far is given below.

Flood Forecasting and Warning Network in India:

Of all the non-structural measures for flood management which rely on the modification of susceptibility to flood damage, the one which is gaining increased/ sustained attention of planners and acceptance by the public is flood forecasting and warning, which enable forewarning as to when the river is going to use its floodplain, to what extent and for how long. As for the strategy of laying more emphasis on non-structural measures, a nationwide flood forecasting and warning system has been established by the Central Water Commission.

Flood forecasting and flood warning in India commenced in a small way in the year 1958 with the establishment of a unit in the Central Water Commission, New Delhi, for flood forecasting for the river Yamuna at Delhi. This has now grown to cover most of the flood-prone interstate river basins. The Central Water Commission is currently responsible for issuing flood forecasts at 173 stations, of which 145 are for river stage forecast and 28 for inflow forecast. On average, about 6 000 flood forecasts are issued every year with a maximum of 7 943 forecasts in 1998. The forecasts issued by the Central Water Commission have been consistent with about 96 per cent accuracy as per the present norms of the Central Water Commission. A forecast is considered to be reasonably accurate if the difference between forecast and corresponding observed level of the river lies within ±15 cm. In the case of inflow forecasts, variations within ±20 per cent are considered acceptable, as a result of which the flood-forecasting and warning services have rendered immense benefit to those in flood-prone areas.

Modernization of Flood Forecasting Services:

The Central Water Commission is making a constant endeavour to update and modernize forecasting services on a continuous basis to make flood forecasts more accurate, effective and timely. initiatives being taken for modernizing flood forecasting services are:

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- The establishment and modernization of the flood forecasting network, including inflow forecast through automated data collection and transmission, use of satellite-based communication systems through very small aperture terminals; and improvement of forecast formulation techniques using computer-based catchment models.
- Development of a decision-support system for flood forecasting and inundation forecast model for the Mahanadi basin and flash flood forecasting for Sutlej basin.
- Development of a real-time flood-forecasting system for the Brahmaputra and Barak basin, envisaging data collection through automatic sensors and transmission through satellite and forecast formulation using a computer-based mathematical model.

India has traditionally been vulnerable to natural disasters on account of its unique geo-climatic conditions. Floods, droughts, cyclones, earthquakes and landslides have been recurrent phenomena. About 60 per cent of the landmass is prone to earthquakes of various intensities, over 45 million ha are prone to floods, about 8 per cent of the total area is prone to cyclones and 68 per cent of the area is susceptible to drought. In the decade 1990-2000, an average of about 4 344 people lost their lives and 30 million were affected by disasters every year. The loss in terms of private, community and public assets was astronomical.

Over the past couple of years, the Government of India has effected a paradigm shift in its approach to disaster management. The new approach derives from the conviction that development cannot be sustainable unless disaster mitigation is built into the development process. Another cornerstone of the approach is that mitigation has to be multi-disciplinary, spanning all sectors of development. The new policy also emanates from the belief that investments in mitigation are much more cost-effective than expenditure on relief and rehabilitation. Disaster management occupies an important place in this country's policy framework, as it is the poor and the underprivileged who are worst affected by calamities/disasters.

The steps being taken by the Government emanate from the approach outlined above. This has been translated into a National Disaster Framework (roadmap) covering institutional mechanisms, a disaster prevention strategy, early warning systems, disaster mitigation, preparedness and response and human resource development. The expected inputs, areas of intervention and agencies to be involved at the national, state and district levels have been identified and listed. There is now, therefore, a common strategy underpinning the action being taken by all the participating organizations/stakeholders.

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INSTITUTIONAL AND POLICY FRAMEWORK:

The institutional and policy mechanism for carrying out response, relief and rehabilitation has been well-established since independence. These mechanisms have proved to be robust and effective. At the national level, the Ministry of Home Affairs is the nodal ministry for all matters concerning disaster management. The Central Relief Commissioner in the Ministry of Home Affairs is the nodal officer to coordinate relief operations for natural disasters. The Central Relief Commissioner receives information relating to forecasting/warning of a natural calamity from the India Meteorological Department or the Central Water Commission of the Ministry of Water Resources on a continuous basis.

NATIONAL CRISIS MANAGEMENT COMMITTEE (NCMC):

The Cabinet Secretary, who is the highest executive officer, heads the NCMC. Secretaries of all the ministries/departments concerned, as well as organizations, are members of the Committee. The NCMC gives direction to the Crisis Management Group as deemed necessary. The Secretary, Ministry of Home Affairs, is responsible for ensuring that all developments are brought promptly to the notice of the NCMC. The NCMC can give directions to any ministry/department/organization for specific action needed for meeting the crisis situation.

Crisis Management Group (Cmg):

The Central Relief Commissioner in the Ministry of Home Affairs is the Chairman of the CMG, comprising senior officers (called nodal officers) from various concerned Ministries. The CMG's functions are to review every year contingency plans formulated by various ministries/departments/organizations in their respective sectors and measures required for dealing with a natural disaster, coordinate the activities of the central ministries and state governments in relation to disaster preparedness and relief and to obtain information from the nodal officers on measures relating to above. In the event of a natural disaster, the CMG meets frequently to review relief operations and extend all possible assistance required by the affected states to overcome the situation effectively. The Resident Commissioner of the affected state is also associated with such meetings.

Emergency Operations Centre (Control Room):

An Emergency Operations Centre (Control Room) exists in the nodal Ministry of Home Affairs, which functions round the clock, to assist the Central Relief Commissioner in the discharge of his duties. The activities of the Control Room include collection and transmission of information concerning natural calamity and relief, keeping close contact with governments of the

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affected states, interaction with other central ministries/departments/organizations in connection with relief, maintaining records containing all relevant information relating to action points and contact points in central ministries etc., and keeping up-to-date details of all concerned officers at the central and state levels.

CONTINGENCY ACTION PLAN:

A national Contingency Action Plan (CAP) for dealing with contingencies arising in the wake of natural disasters has been formulated by the Government of India and is periodically updated. It facilitates the launching of relief operations without delay. The CAP identifies the initiatives required to be taken by various central ministries/departments in the wake of natural calamities, sets down the procedure and determines the focal points in the administrative machinery.

STATE RELIEF MANUALS:

Each state government has relief manuals/codes which identify the role of each officer in the state for managing natural disasters. These are reviewed and updated periodically, based on the experience of managing the disasters and the needs of the state.

FUNDING MECHANISMS:

The policy and funding mechanisms for providing relief assistance to those affected by natural calamities are clearly laid down. They are reviewed by the Finance Commission appointed by the Government of India every five years. The Finance Commission makes recommendations regarding the division of tax and non-tax revenues between the central and state governments and also regarding policy for provision of relief assistance and their share of expenditure thereon. A Calamity Relief Fund has been set up in each state as per the recommendations of the 11th Finance Commission. The size of the Calamity Relief Fund was fixed by the Finance Commission after taking into account the expenditure on relief and rehabilitation over the past 10 years.

BENEFITS TO THE SOCIETY FROM RIVERS FLOOD:

Historically, many urban and rural settlements have been built on floodplains, where they are highly susceptible to flooding, for a number of reasons:

- access to fresh water;
- the fertility of floodplain land for farming;
- cheap transportation, via rivers and railroads, which often followed rivers;
- ease of development of flat land

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Excluding famines and epidemics, some of the worst natural disasters in history (measured by fatalities) have been river floods, particularly in the Cauvery rivers in Karnataka. The worst of these, and the worst natural disaster (excluding famine and epidemics) were the 1993 & 2009 Karnataka floods, estimated to have killed thousands of lives. This had been preceded by the 2019 Krishna River flood, which killed around one thousand people and is the second-worst natural disaster in history. The extent of floodplain inundation depends in part on the flood magnitude, defined by the return period. Even though, the flood plains are economically benifited to the society. In Karnataka States the Emergency Management Agency (FEMA) manages the National Flood Insurance Program (NFIP). The NFIP offers insurance to properties located within a flood prone area, as defined by the Flood Insurance Rate Map (FIRM), which depicts various flood risks for a community.

Cyclone forecasting:

Tropical cyclones are intense low-pressure systems which develop over warm sea. They are capable of causing immense damage due to strong winds, heavy rains and storm surges. The frequency of a tropical cyclone in the Bay of Bengal is four to five times more than in the Arabian Sea. About 35 per cent of initial disturbances in the northern Indian ocean reach tropical cyclone stage, of which 45 per cent become severe.

The India Meteorological Department is mandated to monitor and give warnings of tropical cyclones. The monitoring process has been revolutionized by the advent of remote-sensing techniques. A tropical cyclone intensity analysis and forecast scheme has been worked out, using satellite image interpretation techniques which facilitate storm surge forecasting. The meteorological satellite has made a tremendous impact on the analysis of cyclones.

POSITIVE IMPACT ON ECOLOGY:

Floodplains can support particularly rich ecosystems, both in quantity and diversity. The forest ecosystem is associated with floodplains, especially in himalay and western ghats region of India. They are a category of riparian zones or systems. A floodplain can contain 100 or even 1,000 times as many species as a river. Wetting of the floodplain soil releases an immediate surge of nutrients, those left over from the last flood and those that result from the rapid decomposition of organic matter that has accumulated since then. Microscopic organisms thrive and larger species enter a rapid breeding cycle. Opportunistic feeders (particularly birds) move in to take advantage. The production of nutrients peaks and falls away quickly, however the surge of new growth endures for some time. This makes floodplains particularly valuable for agriculture. River flow rates are undergoing change following suit with climate change. This

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change is a threat to the riparian zones and other floodplain forests. These forests have over time synced their seedling deposits after the spring peaks in flow to best take advantage of the nutrient rich soil generated by peak flow.

CONCLUSIONS:

India is a developing country which needs to take a balanced view of development and it has a long history of irrigation development. It continued at a slow pace until partition of India. Since independence, the Government has given highest priority to irrigation to offset severe food deficit and consequent import of food grains. Countrywide programmes were taken up for surface- and groundwater resources development through large and medium river valley projects. National water policy has been a good step in evolving national consensus on the planning, development and management of water resources in a comprehensive way.

There is an imperative need for harnessing and utilizing river water for irrigation supplies, generation of power and flood control on a sustained basis through these development projects. Reasonable protection has been provided to about one-third of the flood-prone areas of the country. Despite significant outlay on flood control, flood protection and catchment protection works, it has been found that there is no complete solution to providing total protection. Flood cushions in the reservoirs and flood embankments have provided good solutions for recurring floods and have provided relief to large-scale flood damage. Flood forecasting provided by the Central Water Commission has played a significant role in minimizing flood damage and saving human lives. For addressing natural calamities such as floods and drought, there is a need to make full use of existing schemes and priority needs to be given to the implementation of schemes that will help overcome the conditions created by the calamity. A major scheme, namely Bharat Nirman, to bring 10 million hactares under assured irrigation over a period of four years (2015-2019) through completion of ongoing major, medium and extension renovation and modernization projects, the repair, renovation and restoration of water bodies and groundwater development for irrigation has been taken up by the Government of India.

In this regard the researcher has suggested some strategies for flood management and regional specific issues would enable the decision makers and the Planning Commission in adopting appropriate policies and measures required for flood management for environmental balance towards sustainable development.

REFERENCES

1. Aggarwal, R.N. (1996) Environmental Concerns and Role of Dams in Development with Special Reference to Bhakra and Beas Project, Indian Water Resources Society.

2. Central Water Commission (2001) Ministry of Water Resources, Government of India: Report of the Working Group on Flood Control Programme for the Tenth Five Year Plan, New Delhi, India.
3. Central Water Commission (2006) Annual Report , New Delhi, India.
4. Central Water Commission (2006) Water and Related Statistics, New Delhi, India.
5. Chairman, Central Water Commission, Government of India, New Delhi, India (2006) Annual Report
6. Chaskar, D.S. and H.K. Varma (2007) Risk Management of Water Related Disaster, Disaster Management Congress, Nov- 2006, New Delhi, India.
7. Document of High Powered Committee (1981) Disaster Management, Govt. of India.
8. Goudie, A. S. (2004) Encyclopedia of Geomorphology, Vol:1, Routledge, New York.
9. Ministry of Irrigation, Government of India (1980) Report of the National Commission on Floods.
10. Ministry of Water Resources, Government of India(2002) National Water Policy.
11. National Disaster Management Division (2002-07) Ministry of Home Affairs - Disaster Management, The Development Perspective, Tenth Five Year Plan Document.
12. Powell, W. Gabe. (2009) Identifying Land Use / Land Cover (LULC) Using National Agriculture Imagery Program (NAIP) Data as a Hydrologic Model Input for Local Flood Plain Management, Applied Research Project, Texas State University.
13. Rangachari, R. (2007) Rising to the Challenges Posed by Floods and Droughts in India. Dr Kanwar Sain Memorial Lecture on World Water Day.
14. Rood, Stewart B., Pan, Jason, Gill, Karen M., Franks, Carmen G., Samuelson, Glenda M., Shepherd, Anita (2008) Declining Summer Flows of Rocky Mountain Rivers: Changing Seasonal Hydrology and Probable Impacts on Floodplain Forests, Journal of Hydrology, Vol: **349,** No: 3–4, pp. 397– 410.
15. Sinha, S.K. and R. Shrivastava (2006) Role of Large Dams in Flood Moderation : Case Studies, Disaster Management Congress, New Delhi, India.

DAILY NEWS PAPER PUBLISHED NEWS:

1. ANI News (2019-08-14) Karnataka Floods: Death Toll Mounts to 61.
2. Centre Approves Rs 1,813.75 Crore Financial Assistance for Flood-hit Karnataka and Bihar, News18. 2019-10-04.
3. Karnataka Flood Trigger: Rainfall 3000% above normal in a single day, downtoearth.org. 2019-08-09.
4. Karnataka Floods, C M Yediyurappa Announces Rs 5 lakh relief to those who lost houses, New Indian Express.
5. Karnataka: Incessant Rains Swell Up Water Levels, Cause Flood in Parts of State". India News, 2019-08-07.
6. Maharashtra, Kerala, Karnataka Flood Highlights, Nearly 200 Dead in Three States, NDTV, 2019-08-14.

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