Floods and Flash Floods in Himachal Pradesh: A Geographical Analysis

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ABSTRACT

The occurrence of water related natural disasters especially floods and flash floods are common in most of the hilly state including Himachal Pradesh. A flood can be defined as an excess flowing or overflowing of water, especially over land which is not normally submerged. The flow is markedly higher than the usual and this also cause inundation of lowland. The flood can be of various origins, but in a hilly area like Himachal they are the result of some typical reasons. They include cloudburst in the catchment's region, intense and prolonged rainfall, the downstream blocking of river channels by landslides or avalanches or the sudden breach or burst of artificial /natural lakes. In Himachal, the riverine flooding is mostly associated with the rivers having snow fed origin because in summer the snowmelt coupled with heavy rain often triggers a flood. The river Satluj and river Beas, which are being flooded almost every year, are of this type. Another form of flooding in this hilly state is flash flooding which is principally associated with hydro logically small regions. The duration of this phenomenon is short but can cause extensive damage.

The state of Himachal Pradesh has experienced a large number of incidences of floods since its inception in 1971. Though the state has also faced severe flood disasters in 1975 and 1988 but the last decade (1997-2005) has proved one of the worst decades as both the magnitude and frequency of floods have gone up. There were several incidences of floods/flashfloods during 1997-2005 and of which about five were really gigantic. These disastrous events have brought heavy toll to the state as the loss was estimated in several thousand millions of rupees and also killed several hundreds of people besides large number of cattle heads.

The present paper is based on the primary as well as secondary data and aims at giving an account of various incidences of floods and their multi-facet impacts on the state. The paper also tries to analyze the spatial similarities and differences in the flood prone areas to find out the policy imperatives for the sustainable development.

Introduction:-

The state of Himachal Pradesh is one of those 27 states and union territories in Indian union that faces one or the other disaster. The Himalayan state is prone to different kinds of disasters/hazards like floods, earthquake, landslides, snow avalanches, cloudbursts and forest fires etc. Of all the natural disasters that hit the state and cause damage to both life and property, floods are most widespread in the state. However the floods occurring in the state are often in the form of flash-flood and they are interrelated to cloudbursts and landslides.

Flood is a temporary inundation of large area/ regions as a result of an increase in reservoir or of rivers flooding their banks because of heavy rains or snow melting or dam bursts[1]. In other words flood is defined as "a relatively high flow or stage in a river, markedly higher than usual and thus inundating lowland. It is a body of water, rising, swelling and over flowing land, not usually thus covered"[2].

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1. ***Sharma, D.D. (2006), P. 121***
2. ***Tiwari, D.N. (1987), P. 131***

On the other hand, another type of flood which is most common in the state is flash-flood. The flash floods are extreme events that are sudden, severe and short lived. It is a sudden and often destructive surge of water down a narrow channel or sloping ground, usually caused by heavy rainfall[1]. In Himachal Pradesh, the flash-floods are mostly the result of cloudbursts or blockage of river channel due to landslides. Typical terrain of this Himalayan state provides a conducive environment for the cloudburst phenomena. The cloudbursts are the result of combination of different factors like deep valleys, steep gradient, vegetal cover and geology of area[2] The flood problem in the state is mainly during the months of June to August when the south west monsoon is in progress and snow is melting in the higher reaches. Flood not only causes huge economic loss in the form of damage to houses, industries, public utilities, and property but also many human lives and of cattle heads are lost.

Objectives of the Study:-

The present study aims to achieve the following objectives.

- **To present the spatial distribution of flood prone areas in the state of Himachal Pradesh.**
- **To present the Socio-economic impact of floods in the study area.**
- **To highlight the Geographical similarities and differences in the flood events as well as flood affected areas during the recent past.**
- **To analyse the major causes of floods and flash floods in Himachal Pradesh.**
- **To suggest some policy imperatives for the mitigation of flood disaster in Himachal Pradesh.**

Data and Methodology:-

Both primary and secondary data has been used in the present analysis. The study is first of its kind in Himachal and therefore documentation of various disasters and their impact has been done on the bases of govt. records and news appearing in various National and Regional Dailies. In addition to it, the proceedings of 'Vidhan Sabha', occasional reports of different agencies and National Disaster Reports and internet sources constitute the secondary source of data. The primary data has been collected through observation, discussion and interview methods in such areas. The areas for field study were chosen on the bases of replica of different disasters and also those areas which were affected in the recent past. The data has been systematically tabulated and flood prone areas have been mapped on the bases of available information and different physical maps have been overlaid for the geographic analysis.

Study area:-

The state of Himachal Pradesh constitutes the area of present study. The state predominantly, a hilly state, is located between 30º 22' 44" N to 33º 12' 40" N latitude and 75º 47' 55" E to 79º 04' 22" E longitudes in the north western part of India[3].(Fig. 1). Himachal extends over an area 55673 sq. km with a population of 6077,248 (2001).

1.www.ucar.edu/research/storms/floods

2. Satendra (2003), PP.128-130

3. Kayastha,S.L. (1989) Pp. 390-391

. The state of Himachal Pradesh has a complex physiography comprising hills and mountains with deep gorges that is cut in between these mountains by the majestic rivers. The altitude ranges between less than 300 meters to more than 6000 metres. Owing to the varying altitudes, the state has variety of climates. There are five main river catchments i.e. the Satluj, the Beas, the Ravi, the Yamuna and the Chenab. Administratively the state is divided into 12 districts and there are about 16997 inhabited villages of different sizes.

Causes and Effects of Flood:-

It is aptly said that floods are natural phenomena but the damage caused by them is the result of human actions. In majority of cases, heavy down pore of rain that brings down more water is responsible for causing a flood. The flash-floods are not always the result of heavy rains but it can be a sudden breach or burst of some lakes as well as reservoirs. It has been observed that floods/flash-floods in the state are creating havoc year after year and leading to massive destruction as a result of combination of natural and man made factors. After analyzing some of the recent incidences of flood in the state it may be said that the recurrence and socio- economic impact of floods has been on rise. The reasons for increase in social, economic and environmental losses have been the indiscriminate development, deforestation in upstream region and peoples' encroachment in flood plain area. In Himachal Pradesh, though the flood affected area may be fluctuating all time but as per the assessment made by Central water Commission (CWC) in 2000 the maximum flood prone area in the state is 3.9 million hectares[1]. This is extremely a huge area in respect of Himachal as it is about 70 per cent of the total geographical area of the state. The affected area has been so high because in certain regions the river channels have been also obstructed for one reason or the other. The impeded drainage channel is one of the anthropogenic factors that can be managed to reduce the flood impact in future[2]. In general the flood effects are more horrible than the flood itself. The whole economy gets shattered and developmental works come to standstill. The human, economic and technical resources are diverted to affected areas for rescue and relief as it becomes a priority area. The major causes that are responsible for floods and flash-floods in the state are as below:-

1. Cloudburst in the catchment's region of the river.
2. Heavy rainfall in the upper reaches of the river.
3. Sudden breach or bursts of man-made dams or natural lakes.
4. Landslides leading to obstruction of flow and change in the river course.
5. Tectonic movement leading to slope failure and landslides (e.g. earthquake, Jan.1975).

Floods are one of the worst disasters of the state, that not only causes huge economic loss in the form of damage to houses, public utilities, and property but also many human lives and cattle heads are also lost. Almost all rivers of the state carry heavy discharge during the monsoon when their catchments receive intense and heavy rainfall. The problem of flood varies from one basin to another and the magnitude of flood also varies. The most flood prone area in the state are in the Satluj and Beas rivers (Fig.-1). Yamuna River also faces flood problems.

1. *Kale, V.S.(2004) P.92*
2. *Munsi, Sunil Kumar (1998) Pp. 241-242.*

Major past Flash Floods in Himachal Pradesh:-

The state of Himachal has been facing flood problem, particularly flash-floods since very long. It was in September 1952 when about 350 people died as a result of monsoon storm but after the grant of full statehood to Himachal in 1971, many flood events have rocked the state. A brief analysis of some of these with their socio-economic impacts has been given here.

1. Flash flood of March, 1975:-

This flash flood was due to blockage on Parichu river by a massive landslide along the right bank which was created as a result of January. 19, 1975 earthquake. This blockage created a big lake of the dimension of 150m x 60m. Due to sudden breach of this lake it struck the Spiti valley by rising the water level of Spiti river in March, 1975. It also led to extensive damage in the lower areas of the river.

2. Flash Flood of December, 1988:-

It was the result of cloud burst incident that took place on September, 29, 1988 at Soldang area and then caused horrible flash flood in Soldang Khad. Due to this flashflood heavy loss occurred to both life and property. This flash flood washed away 15 houses, 35 bighas of agricultural land and about 600 apple trees in the Soldang village. Above all 32 persons and 35 cattle heads also lost their lives. In this flash flood, 2 Kms. stretch of NH-22 across Soldang Khad was also washed away. The hydro project work of Bhabanagar suffered complete damages. This flash flood also resulted into several landslides along the Soldang Khad and the road leading to Ponda was clocked. Not only was this but a Lake formed near the confluence of Soldang Khad and Satluj River. This blockage stopped the flow of Satluj river for about 30 minutes and created a temporary lake covering an area of about 6000 sq. km.

3. Flash floods of August, 1997:-

While the State Government was grappling with grim situation that had arisen as a result of the earthquake by providing relief to the affected people and repair/ restoration of damage works. At the same time flash floods gravely affected normal life, particularly in the districts of Shimla, Mandi, Kinnaur, Chamba, Kullu and Una etc.

The worst affected areas which had to suffer the wrath of the rain gods was Chirgaon in Chirgaon tehsil, Nogli and Manglad Khad areas of Rampur tehsil in Shimla district and Wangtu and Tapri areas of Kinnaur district. Andhra river had

turned extra-ordinarily violent on the 11th August, 1997 at about 8.25 P.M. due to cloud burst over its higher reaches. It entered in the Chirgaon village after changing its course near the power house of Andhra Hydel project. The river entered the fish farm, forest rest house, tehsil complex, Laxmi Narayan temple, School building, Police post, Panchayat Ghar and then found its way into the Chirgaon Bajar. Chirgaon Bajar was then divided into two portions and living aside the power house and some residential buildings, it washed away most of the other buildings. The building area of the village on the left bank of the river was strewn with and buried under a heap of debris and huge boulders as swirling flood waters ravaged the whole area and as a consequence 124 human lives were lost. The road between Rohru and Chirgaon had been completely washed away at a point about 1 k.m. ahead of Seema. Chirgaon-Manali bridge along with about 8 sheds was also washed away. Heavy boulders, deodar trees and mud expanded the river beds and changed the entire shape of Chirgaon Bajar replete with disaster. The road between Seema and Chirgaon and also Chirgaon and Dhamwari were damaged and breached at many places.

The impacts of floods was equally severe in various parts of Kinnaur district adjoining Rampur where hundred of houses were either flooded or destroyed in Nogil, Manglad, Sholdang and Wangtu. Nearly 3-4 Kms. of Indian Tibet Border Road (NH-22) the bridges at Wangtu on river Satluj and another over Bhaba Khad have also been washed away however bridge at Nigulsari was damaged. Heavy machinery of Hindustan Construction Company which was constructing the Nathpa Jhakri Project was also washed away.

Extensive damage has also been caused to the private and public properties in Chamba district. A portion of Mandi-Kamand road has been completely washed away. The Ratti bridge on the Mandi-Sarkaghat road had been washed away.

Due to unprecedented rain in Chirgaon area of Rohru tehsil of district Shimla on the night of the 11th August, 1997 followed by flash floods in Andhra/ Pabbar river extensive damage has been caused to a number of drinking water supply, irrigation and flood control works located on the left and right banks of these rivers. Most of the schemes have either been washed away completely or partly damaged. Many such schemes in Mandi and Kangra district have also been damaged. The natures of damage to these schemes are as under:-

A. Water Supply Scheme
Weirs, pumps-well percolation intake works, for example well etc. washed away.
Damages to pump houses due to heavy floods in the khads/ nallahs/ rivers, washing away of pumping machinery etc.;
Damage to treatment units including sedimentation tank and filter beds etc.;
Rising mains washed away/ damaged; and
Distributional lines have been damaged.
B. Irrigation Schemes
Washing away of intakes works;
Damage to feeder channels; and
Damage to pump houses due to floods or as a result of heavy rains/cloudbursts etc. &
Damages to Kuhls due to land slides or due to mud flow.

3. Satluj Flash flood of August, 2000- Natural calamities of gigantic magnitude struck the Satluj valley on the intervening night of 31st July, 2000 and

1st August, 2000. It led to an unprecedented rise in the water level of Satluj river from Tibetan Plateau though out the entire length of about 250 Kms. up to Gobindsagar Lake. The rise in the level of water according to eye witnesses was reported up to 60 feet above the normal levels. The flash flood was termed as the one that occurs once in 61,000 years. It is almost impossible to design technical specifications for all kinds of infrastructure to cater to such a rare incidence. It is obvious that such a natural calamites would cause unprecedented loss of human life, livestock, public and private property and would also erase the existence of any of physical infrastructure over the surface. The official records reveal that 135 human lives and about 1700 cattle head perished during the unprecedented flood. In addition to it, flood has led to extensive damage to about 200 kms. of roads length, washed away 20 bridges and 22 Jhulas (cable ways over the river) and badly damaged another 12 bridges. Apart from the damage to vital communication link, 1,000 irrigation, sewerage, flood protection and water supply schemes have been considerably damaged and some of these have been completely destroyed. Extensive damage has been done to the already executed hydro projects as well as to those under execution including the prestigious Nathpa Jhakri Project. This calamity has, in fact, turned the clock in reverse order of time by several decades in terms of the availability of infrastructure. The most of the catchment's area of the river Satluj remained cut off from the rest of the world. The availability of essential commodities was disrupted and the misery was added to the affected population as the teams to provide relief assistance to these worst hit areas could not reach to these locations. In certain areas firm knowledge about loss of human life and property could not be evaluated. The damage has been estimated at about Rs.1466.26 crore. Macro details of loss are shown in Table-1.

TABLE -1
DETAILS OF LOSS DUE TO FLASH FLOOD IN SATLUJ VALLEY IN AUGUST 2000

Item	Estimated loss (Rs.crore)
Roads, Bridges and Jhulas including national highway	261.18
Water supply, irrigation, sewerage and flood protection	17.77
Power projects and transmission lines	1883.50
Forest infrastructure	0.73
Cultivated area washed way (18887.50 bighas) in Kinnaur, Kullu and Shimla districts.	31.92
Human lives lost (number)	135
Cattle heads lost (number)	1673
Private houses damaged (number 5383) value	15.82
Standing crops and fruit crops lost over an area of 41,792 hectares.	55.34
Total	1466.26

Source: Compiled From Govt. of Himachal Pradesh, Revenue Department (2000).

3. Flash floods of July, 2001:-

The state had hardly been able to come out of the shock of colossal damages that occurred due to flash floods of river Satluj in August 2000, the intervening night of 29th July, 2001 and 30th July, 2001 witnessed a flash flood hitting the Chhota Bhangal and some areas of Baijnath sub division of Kangra district causing extensive loss of life and property both. This flash flood occurred in the Binwa khud and its tributaries which disrupted the normal life of the area and brought miseries to the affected population of Deol, Multan, Uttarala and Loharoli areas. Prior to this, district Kullu experienced a flash flood due to cloud burst on the 22nd July, 2001 at 1:30 P.M. which affected the villages of Siund, Saran, Shesher and Thachan. This cloud burst in the upper reaches of Sainj valley caused flash flood in two nallahs namely, Sainj and Jeeba and caused extensive damage to the habitation settled on the either side of main Sainj Nallah affecting nearly 40 families. The flood also washed away 2 bridges on Sainj and Jeeba Nallah and a lot of fertile land was also lost. The road connecting Suind and Sainj was also washed away at many places. In the flood two human lives and 5 cattle heads perished. Some other areas in Kullu district were also affected due to excessive rains in July and a population of 6355 was adversely affected.

The Baijnath sub-division of Kangra district was worst affected area because of the flash flood of 29th July, 2001. The flood took away the live of 12 persons. There were reports of missing of some nomadic Gujjars and Gaddis whose bodies have not been traced out they also are feared to have been washed away. The loss of 150 cattle heads has been reported from the affected areas. The public properties including one Mahila Mandal Bhawan, two Schools buildings, eleven foot bridges have been completely washed away. In addition to it Irrigation and Public Health also suffered the loss of about 2.52 crores because as many as 41 water supply schemes and 19 irrigation schemes had been badly damaged. The total loss to agricultural land and crops has been estimated at Rs.34 lacs and affecting about 262 hectares of area. The flood also washed away 50 cowshed and 5 commercial buildings have also been damaged causing a loss of about Rs.29 lacs. Similarly, 11 numbers of foot bridges constructed by rural development department has also been damaged and estimated loss is about Rs.100 lacs. The department of education also suffered a loss of about 70,000 as one primary school building has been washed away. Apart from this the flash flood has caused extensive damaged to many other works and the loss was estimated to the tune of Rs.1 crore. The wet land rises 20-25 feet above the normal.

The functioning of Binwa hydro-electric project at Utrala and Baner hydro-electric projects has been stopped and a loss of about Rs.2.5 crores has been reported to the project properties. The Himachal Pradesh State Electricity Board has assessed the loss to the property of hydro-electric projects of Gaj, Baner, and Binwas hydel projects to the tune of Rs.2.67 crores and in addition to it, the generation loss has been assessed at Rs.6.28 crores.

The total loss because of flash flood in Baijnath and Palampur sub-division has been estimated as high as Rs.18.27 crores. The department-wise details of the damages are presented in Table -2.

TABLE -2
LOSS DUE TO FLASH FLOODS OF JULY, 2001

Sr.No.	Department	Items	Estimated loss (in crores)
1	PWD	Road, bridges, path and civil structures.	3.95
2	IPH	Water supply scheme, and irrigation schemes	2.52
3	HPSEB	Power projects and its infrastructure	8.65
4	Forest	Forest infrastructure	0.45
5	Revenue	Cultivated and other area washed	0.34
6	Private Loss	Private properties, cowsheds and commercial building damaged	0.29
7	Education	Loss to education department	0.07
8	RDD	Loss to rural development department	1.00
9	General	Loss to different minor works	1.00
	Total		18.27
	Life loss	Loss of human lives	12 Nos.
		Loss of live stock	150 Nos.

Source: Compiled From Records of Different Departments, Govt. of Himachal Pradesh, (2001).

The estimated loss in district Kangra has been as high as Rs.18.27 crores while in other districts of the state loss of Rs.4.87 crores has been estimated. Thus the total loss in the state has been to the tune of 23.14 crores of rupees. The district wise detail of various losses has been given in the Table-3
The excessive rain and flash flood has brought lot of miseries to the state in terms of loss of life as well as the economic loss. The Table -3 accentuate that in the year 2001 about 850 hectares of geographical area was affected by flash flood and the population affected was more than 30,000. The flash flood and excessive rains resulted in the loss of about 25 crores of rupees. The fury of flash flood also took the toll of 18 human lives and around 200 cattle. The highest loss in terms of economic value and causalities has been reported from Kangra district and the second highest affected district was Kullu. Other districts affected during this period were Mandi, Hamirpur, and Una.

TABLE - 3
LOSS DUE TO EXCESSIVE RAINS/ FLASH FLOOD AS ON 31-07-2001

Sr. No.	District	Area affected (in ha.)	Population affected	Damage to crops (in ha)	Value (in lacs)	Damaged to houses	Value (in lacs)	Cattle lost Nos.	Human lives lost	Damage of public utilities	Total damage crops, houses, public utilities (in lacs)
1	2	3	4	5	6	7	8	9	10	11	12
1	Shimla	-	-	-	-	-	-	-	-	-	-
2	Solan	-	-	-	-	-	-	2	1	-	-
3	Sirmaur	-	-	-	-	-	-	-	-	-	-
4	Kinnaur	-	-	-	-	-	-	-	-	-	-
5	Mandi	-	-	-	0.05	116	12.87	11	1	10.25	23.17
6	Bilaspur	-	-	-	-	-	-	-	-	-	-
7	Hamirpur					8	0.67	-	-	14.72	15.39
8	Kullu	60	6355	50	198.00	39	11.00	5	4	160.00	369.00
9	L&S	-	-	-	-	-	-	-	-	-	-
10	Kangra	780	25000	262	34.00	55	29.00	150	12	1764.00	1827.00
11	Chamba	-	-	-	-	-	-	-	-	-	-
12	Una	3	530	3	0.50	13	0.77	-	-	78.00	79.27
	Total	843	31885	315	232.55	231	54.31	168	18	2026.97	2313.83

Source: Government of Himachal Pradesh, Revenue Department (2001).

5 (a) Satluj Flash Flood of June 2005: A flash flood of huge magnitude, due to sudden rise/breach of Parichu river in the Chinese territory struck the Satluj valley on 26th June, 2005. It led to an unprecedented rise of water level of Satluj River from Tibetan Plateau through out the entire stretch of National Highway-22. The rise in water level was reported up to 15 meters above the normal level at some places. It led to extensive damage to about 350 kilometers of road length at various places from Samdo to Govindsagar/ Bhakra Dam. A detail of damage due to flash flood in the Satluj valley has been given in Table - 4.

(a) 10 bridges, 11 Ropeways washed away
(b) 15 motorable bridges and 8 jeepable and foot bridges damaged/ affected
(c) 10 Kms. road between Wangtoo and Samdho washed away
(d) 15 Kms. length of various patches in road between Wangtoo and Samdho has been damaged/ affected
(e) Various link roads originating from National Highway including certain N.H./P.W.D. roads between Sainj and Wangtoo have been damaged.
(f) Electrical lines including poles and towers, OFC network, water supply schemes, sewerage system have also suffered serious damages.
(g) Generation in power projects has been affected.

The detailed list of the bridges that washed away or suffered heavy damages are as under:

Shilkhar
Leo
Khab
Akpa
Kharo
Karchham
Jagatkhana
Bajir Bauri
Nathpa
Bhabanagar

Apart from the above, the foundations and abutments and approaches of number of other bridges have been damaged, extensive damage has also been caused to National Highway-22 which was damaged at the following places:-

Kali Mitti}	
Nogli }	**District Shimla**
Cholling and Ralli }	
Poari }	
Pooh }	
Kharo }	**District Kinnaur**
Khab }	
Shilkhar }	
Samdho }	

The State Highway at Sainj and Luhri suffered heavy damage at several places and the foundation of National as well as State Highway has also been damaged. The major part of district Kinnaur i.e. from Wangtoo to Samdho remained completely cut off from rest of the world and intra district communication also got affected due to the breach of roads and bridges at various points in this stretch. Similarly, Spiti valley of Lahaul and Spiti district, which is mainly connected through this road, has also suffered connectivity problem. Flood has not only caused extensive damages along the river Parichu, Satluj and Spiti but has also affected the population living in the entire area of Kinnaur district between Wangtoo to Samdho and Spiti Sub Division of Lahaul-Spiti district as they faced accessibility problem to sell their cash crops and to send other farm produce to the market. Services like health, education, electricity and supplies of essential commodities have also been affected. This has also adversely affected movement of local people, employees and security forces especially student/ parent.

TABLE - 4
DAMAGE DUE TO FLASH FLOODS IN JUNE, 2005

Sr. No.	District	Area affected in Hectare	Population affected	Damage to Crops		Damage to Houses		Cattle loss (Nos.)	Human lives loss (Nos.)	Damage of public utilities like Edu. Rural Dev. Etc.(in lacs)	Total Damages Crops, house & Public utilities (Rs. in lacs) S.No.6+8 + 11
				Ha.	Value (Rs. lacs)	Nos.	Value (Rs. lacs)				
1	2	3	4	5	6	7	8	9	10	11	12
1	Kinnaur	-	62334	9848	11546.5	7	460	3	-	6	11712.5
2	Kullu	31530	150000	740	415	117	475	24	-	1690	2580.00
3	Mandi	48	226	48	210	261	4697	2	-	8650	13557.00
4	Shimla	20	50	8	27	59	110.5	-	-	5535	5671.5
5	Sirmaur	-	-	-	-	393	-	-	-	102.5	102.5
	Total	31598	213060	10644	12198.5	-	5442.5	29	-	15983.5	33623.5 say 336 crore

Source: Govt. of Himachal Pradesh, Revenue Department (2005).

5 (b) Flash Flood of July, 2005: State was not to come out of the shock of gigantic flash floods in the Sutlej and Spiti due to sudden burst or breach of artificial lake on Parichu river in Chinese territory on 26-06-2005, when excessive rains/ cloud burst in July 2005 again created flood situation in Satluj, Beas, Pabbar, Ravi, Parvati, Tirthan and Baspa rivers. Due to these floods extensive damage has been done to roads, bridges and other public/ private property in the state. Since many of the rivers and their major tributaries were in the state of flood so the impact was felt in different part of this Himalayan state. Some of the major consequences are as below:

Due to rise in water level in Beas river, National Highway-21 between Manali and Mandi had breached and submerged in many portions. Gates of Pandoh dam had to be opened due to excessive rain which caused damage to public/ private property in the low lying areas of Beas river.
Flash flood in river Pabbar in Rohru sub-division of Shimla district resulted in heavy losses as it damaged roads and bridges, public buildings, residential houses, cowsheds and private land. Chirgaon block of Shimla district remained completely cut off for several days.
There has been flash flood in Baspa river on 7th July, 2005 causing extensive damages. In all 6 bridges and 600 meter of link road had been washed away as a result of the flood. Sangla valley of Kinnaur district had been cut off from the rest part of the state. Among other structural damages, 39 houses, government

buildings, machinery and private lands have also been washed away. The numbers of total damaged houses in different parts of the state have been more than 2000. The flash floods in Parvati and Tirthan rivers of Kullu district brought extensive damage to houses, business establishments, orchards, roads, bridges and to many hydro projects. Above all these economic losses, the flash flood of July 2005, took away 8 human lives and more than 3000 cattle heads were also lost.

The macro details of the flash flood in the state have been shown in theTable-5 which shows that the loss of about 600 crores has occurred to the state. The author visited various disaster hit/ affected parts of the state and it has been observed that the damage in Kinnaur, Kullu and Shimla district was very high. The river Satluj, Beas and some of their tributaries like Tirthan, Palchan and Sarwari were in great fury during the monsoon of 2005. They have brought the large scale changes to the physico-cultural landscape of the state.

TABLE – 5
MACRO DETAILS OF TOTAL DAMAGES DUE TO FLASH FLOOD OF JULY, 2005

Sr.No.	Name of Department	Loss of damage assessed (Rs. in lacs)
1	Irrigation & Water Supply Schemes	1257.37
2	Fisheries	70.49
3	Horticulture	2718.69
4	Power, Distribution, Transmission & Generation	1547.00
5	Roads & Bridges	15406.26
6	Other Public Properties and private properties	34980.95
	Total	55980.76

Source: Govt. of Himachal Pradesh, Revenue Department (2005).

Floods and Geographic Factors in Himachal Pradesh:-

This has been indicated earlier also that Satluj and Beas rivers along with their tributaries are major flood producing streams (Fig-1) and it is really surprising to have large number of similarities in the two. The geological formation of the two river valleys has been quite similar as in the upper reaches both the rivers flow through Granites and in major impact area it is either Jutogh group or Vaikrita group with central gneiss[1]. The physiography of all flood affected areas has also shown a very high degree of similarity. On looking the flood map vis a vis relief map, one can easily conclude that the flood affected zone lies between 1500-3000 meters altitudes. In fact this is the area that receives a rainfall of 800-1400 mm. but other factors like cloudburst, slope and soils come to play here. The flood bearing areas of the state has a very high frequency of cloudburst. The upper Beas basin which brings maximum number of floods lies in critical zone and the Satluj basin is also in a highly vulnerable zone as for as cloudbursts are concerned[2]. The major part of flood prone area of the state lies in

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1. Sharma, D.D. (2005), P-68
2. Sharma, D.D. (2006), Pp, 114-115.

Lesser Himalaya and both the notorious river i.e. Satluj and Beas cut through the mighty Dhauladhar range of the middle Himalayas. The soils are shallow to medium and the slope in these areas is steep to very steep[1], thus even a little water makes a very high velocity. The soil drainage in the district of Kullu and Shimla where most of the damages have been visualized are well to excessive and the erosion status varies from moderate to very severe.

The river basins of Beas and Satluj have shown a large number of similarities but they differ in agro-ecological zones. The region drained by Beas and its tributaries falls in Warm and Per-Humid, Lesser Himalayas. On the other hand river Satluj pass through different kind of agro-ecological zones. The river Spiti which is a main tributary of river Satluj while entering to the state has Cold, Semi-Arid, Semi-Dry, Greater Himalayas as its Agro-ecological zone. It is this zone where river Parichu (instrumental in floods of 1975, 2000, 2005) meets river Spiti. The river Satluj is then joined by river Baspa on its left bank and Agro-ecologically it is referred as Warm, Dry, Sub-Humid, Greater Himalaya and in the western part of Kinnaur it is Lesser Himalaya, however the rest of the things remaining same. In Shimla district, the river passes through the similar conditions. Yet another similarity and of course a major factor in controlling the flood is the forest cover. The upstream regions of river Satluj and higher reaches lies in cold desert zone and therefore having no or negligible vegetal cover. However the river valleys in its middle course have a good forest cover. In the recent past it has been also observed that these areas have also suffered deforestation problem because of encroachment. The natural forest cover has been cleared for making a way to orchards[2]. There has been a close relationship between deforestation and natural hazards. The large scale deforestation have got a direct bearing on the peak discharge[3] and it is fairly proved in case of this Himalayan state.

Conclusions:-

On the basis of foregoing discussions and after analyzing the Flood map in its spatio-temporal context it may be concluded that

1. The magnitude as well as intensity of flood in Himachal Pradesh has gone up and therefore the socio-economic impacts of floods have been also increasing.

2. It is not warning only but the active response to warning that is essential to save the life and mitigate the flood

3. Physical factors like geology, relief, slope, soils, forest cover, rainfall and agro-ecological conditions are intimately related with that of floods in the state.

4. Floods have been recurring in the state and the same region has been affected more than once.

5. There was a massive shift in people's response to warning once they have seen the wrath of nature in their life time. The people have responded quickly at the time of replica of the flood disaster and thus declining the life loss.

6. The use of Remote Sensing and Geographic Information System (GIS) can prove vital for the monitoring and management of floods in the State.

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1. Sidhu,G.S.et al.(1997), Pp 4,12,&26-33.

2. Sharma, D.D. (2005), Pp. 105-107.

Policy Imperatives:-

It is natural for a river to overflow its banks in the event of a heavy rainfall or cloudburst in the upper catchments. There is no fool proof mechanism to combat the floods due to the multi-facet constraints. It is therefore neither possible nor perhaps required to control all the floods occurring now and then. Nonetheless it is necessary to suitably manage the floods, so that the damage to property can be reduced and loss to lives of human as well as livestock can be avoided. Following are some of the suggestions to mitigate the floods in the state.

1. The capacity building approach should be applied to mitigate the flood menace
2. Non-structural measures like land-use zoning in flood plain/river valleys should be applied.
3. The policy of the Govt. to mitigate disasters, hitherto has been reactionary, whereas Pro-active policy is required.
4. The network of information, education and communication (IEC) should be strengthened in remote areas.
5. Strict adherence to laws to identify prohibited, restricted and warning areas is needed.
6. No measures can succeed without the participation of local people, therefore the participation of local people should be ensured.
7. Structural measures like river embankments and diversion of river channel should be applied with enough drainage.

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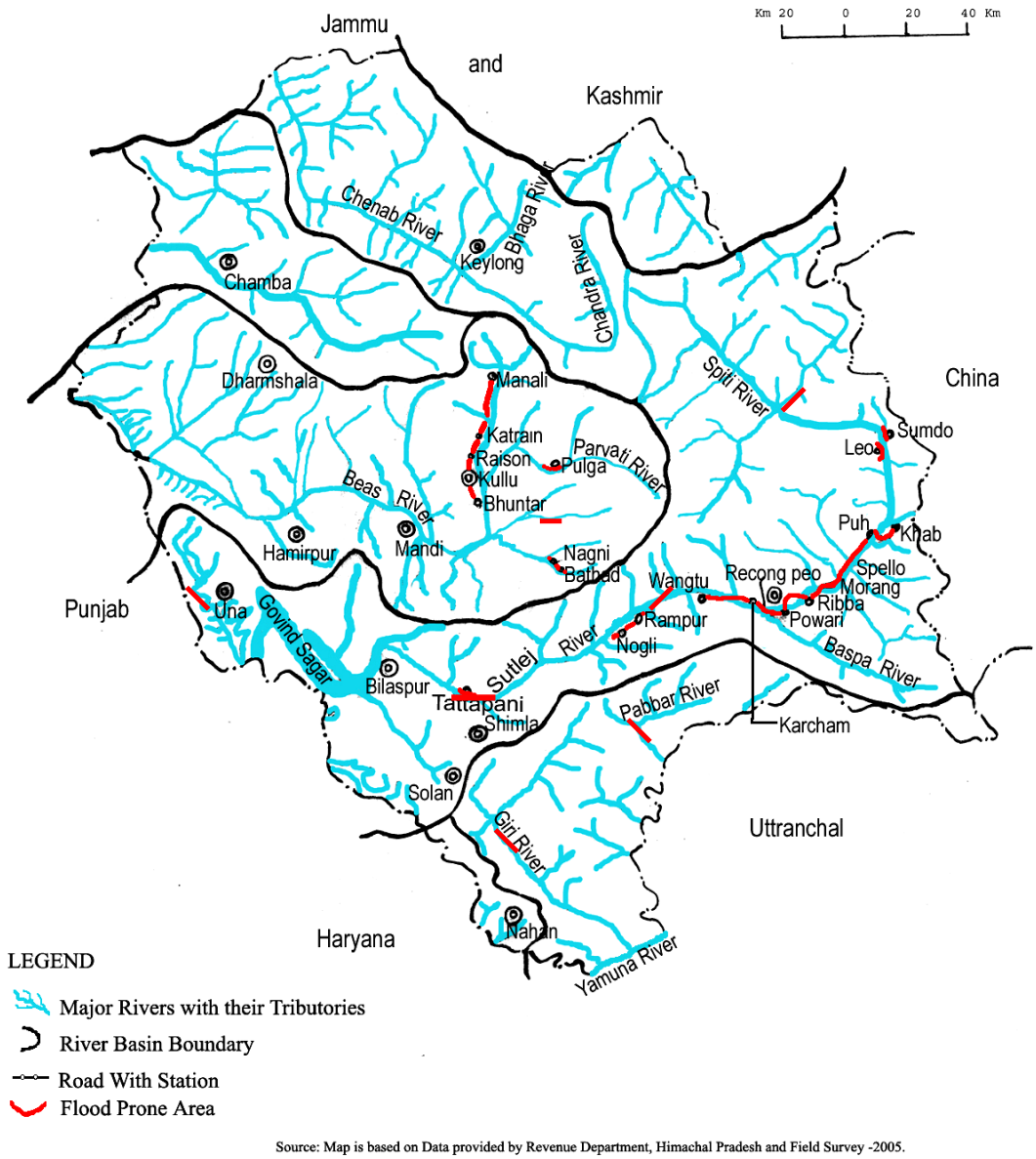
Himachal Pradesh
Flood Disaster Map
Km 20 0 20 40 Km
Jammu
and
Kashmir
China
Punjab
Haryana
Uttranchal
Chenab River
Bhaga River
Chandra River
Spiti River
Parvati River
Beas River
Govind Sagar
Sutlej River
Pabbar River
Giri River
Baspa River
Yamuna River
Chamba
Keylong
Dharmshala
Manali
Katrain
Raison
Kullu
Pulga
Bhuntar
Hamirpur
Mandi
Nagni
Bathad
Una
Bilaspur
Tattapani
Shimla
Solan
Nahan
Rampur
Nogli
Wangtu
Recong peo
Ribba
Powari
Morang
Spello
Puh
Khab
Leo
Sumdo
Karcham
LEGEND
Major Rivers with their Tributories
River Basin Boundary
Road With Station
Flood Prone Area
Source: Map is based on Data provided by Revenue Department, Himachal Pradesh and Field Survey -2005.

Fig: - 1

The aftermath of floods and flash flood was also horrible and it also showed a large gap in the theory and practice of disaster management (See Photo Plates)


Raging Satluj swamped NH-22 at Nogli near Rampur In Shimla District.
Mighty Satluj River in anger at Nogli in Shimla District .


River Spiti damaged Barley and other Crops in Ladhang in Kaza (L&S)
Flash-flood in Spiti River washed away about 15 houses in Leo village of Kinnaur District.
Flash-flood in Spiti disrupted the path of Satluj & the Vital Transport link at Khab washed out.
Satluj
Khab
The Apple orchards at Village Changi in Kinnaur has been ruined by the Flooding Spiti River.


Heavy damage to Buildings by Tirthan River at Balichowki in Mandi District.
Remnants of Trout Fish Farm Office at Village Nagni in June 2005
Conflict of Man & Nature in Beas Valley At Village Bahang finally proved the Supremacy of Nature.
Flood in River Beas (2005) questioned the Existence of Buildings on its left bank.