Floods in Punjab, India, Case Study 2010

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ABSTRACT: Flood is one of the major natural disasters in the state of Punjab. Punjab is the land of rivers and the rivers play an important role in the development of agriculture and economy of the state. But at the same time the rivers cause flood and the flood causes loss to human life and wide spread damage to property. This paper analyzes the occurrence of flood, reasons of occurrence, causalities and damage due to severe flood of 2010 in Punjab India. The study also presents the response mechanism and the lesson learnt. The secondary data from Department of Revenue Rehabilitation and Disaster Management, Punjab is used to cover the objectives. The study revealed that there is an important pattern emerged from floods since 1990 to 2010 and the causes of floods were due to heavy rain in the catchment area of the rivers after every 2-4 years. The canals in the state also cause of flood many time due to mismanagement.

Key Words: : Hazard, Disaster, Capacity, Flood, Rain, Catchment Area, Vulnerability,

Introduction
Flooding is one of the most frequent and widespread of all environmental hazards. Floods of various types and magnitude occur in the most terrestrial portions of the globe, causing huge annual losses in term of damage and disruption to economic livelihoods, business, infrastructure, services and public health. According to International Federation of Red Cross and Red Crescent Societies, in the 10 years from 1993 to 2002 flood disaster ‘affected more people across the globe (140 million per year on average) than all other natural or technological disasters put together’ (IFRC, 2003, p179).

United Nation Development Programmes’ global report on “Reducing Disaster Risk: Challenge for Development” observes that India is among the highest vulnerable country to floods, next only after China. There are many Indian State which are prone to floods; some of them witness flood as a routine phenomenon every year while some experience drought as well as flood in the same region in different year.

A flood is an overflow of an expanse of water that submerges land. Many states in our country are flood prone due to heavy rain, breaches in embankments, dams etc. or otherwise. The flood causes loss to human life and wide spread damage to property. Unimaginable damage to agriculture takes place affecting the States planning and upset the financial budgeting there by slowing down the whole economy of the country. Flood is not any unique phenomenon to our country. Floods come in different parts of the world. Floods are the biggest cause of loss of life every year throughout globe. Majority of countries do not document or map floods methodically because of various reasons. People are generally taken by surprise by the floods as they may come in the night when everybody is asleep, giving very little time for evacuation. Water remains stagnant after the flood recedes, sources of drinking water get polluted and the food gets spoiled. People are left with no resource to combat the natural calamity that has take place. The only way to fight the floods is to predict the flood, prepare for it, train and educate people, identify flood prone areas.

As a brief introduction of the State, Punjab is bounded on the west by Pakistan, on the north by Jammu and Kashmir, on the north east by Himachal Pradesh and on the south by Haryana and Rajasthan. Physically, the state may be divided into two parts, sub Shivalik strip and Beas-Sutlej-Ghaggar Plain. The sub-Shivalik strip covers the upper portion of Ropar, Mohali, Hoshiarpur and Gurdaspur districts. The Beas-Sutlej-Ghaggar Plain embraces the other districts of the State. Most of the Punjab is an alluvial plain, bounded by mountains on the North. Despite its dry conditions, it is a rich agricultural area due to extensive irrigation made possible by the extensive canal network and tubewells.
Research Methodology
The present research tries to cover the following objectives:

- To study and analyze pattern of flood in the state of Punjab.
- To evaluate the causality and damage due to flood in the study area in 2010.
- To draw the response mechanism and the gap analysis from preparedness to response and rehabilitation for flood hazard area in the state of Punjab.

The secondary data from Department of Revenue Rehabilitation and Disaster Management, Punjab, Directorate of Census Operation Punjab, State Disaster Management Plan, Punjab, Department of Agriculture, Department of Irrigation, Flood Report 2011, Punjab etc. is used to cover the objectives. The study cover the time period of May 2010 to September 2010. District is used as a unit of study.

Flood Scenario of 2010
Floods are a natural fact of life in river basins. It is an outpouring or overflow of water that submerges land. In the present context we are talking about the floods 2010. The main reason for flood 2010 was heavy rainfall in monsoon season in the state and in catchments of all the rivers. Monsoon reached in the state of Himachal Pradesh on 3rd July 2010. Though the Monsoons arrived in Punjab and Haryana seven days later than the predicted time but once the downpour started, it was heavy and aggressive. On Sunday 4th July 2010 the rainfall started at 08.35 pm and continued till morning hours of Monday. A total 117.6 mm rainfall was recorded in the Headquarters, Chandigarh. Rain water hit bridge no. 121 of Railway crossing in Zirakpur town of SAS Nagar on Monday morning. It was the first occurrence of floods by which Kalka- Delhi railway Track was affected.

Due to rains on 5,6-07-2010 in catchment of River Ghaggar in upstream reach of HansiButana, syphon aqueduct across river Ghaggar huge areas were flooded due to occurring of afflux. All its tributaries mainly PachisdharaNala, MiranPurChoe, Patiala Nadi, tagriNadi and Markandanda River were in spate at that moment. The free flow in River Ghaggar retarded substantially by this man made obstruction called HansiButana Canal resulting in abnormal afflux in upstream reaches. Resultantly areas of village SasiBrahama, SasiGujran, Djamheri, Hashampur mantha were submerged and prevented the free outfall of all above mentioned tributaries in River Ghaggar.108 villages of Patiala district adjoining all above mentioned tributaries were submerged including the area adjoining Tangri and Markanda. The Ghaggar River basin experienced massive flood disaster, its tributaries breached embankments one after another along its stretch and flooded vast areas. Over 2 lakh acres of crop area was affected in Punjab. Besides scores of people and hundreds of cattle had died. Houses, roads, bridges, railway lines and canals had been...
damaged. There were 30 breaches in canals, leading to the transfer of flood waters to other parts of the basin far away from the rivers, spreading floods to other areas.

On 6th July 2010, 80000 Cs. of discharge was recorded in river Ghaggar, upstream of syphon of Narwana Branch at RD 150000. The canal breach occurred due to rising of Ghaggar and entering the flood water into canal. Since the capacity of the Syphon at Narwana Branch was 50000Cs but volume of water was in higher magnitude, it caused breach in the SYL Canal which carried water to Haryana.

Simultaneously, heavy rains lashed Samrala area of District Ludhiana from 3rd to 7th July 2010. The rainfall recorded was 133 mm in just two hours. There was a virtual cloud burst like situation. The flood water got accumulated along the banks of Srihand Canal. Due to this the left bank of Canal got breached RD 799000. The total area which got flooded was around 13000 acre where 2 ft to 3 ft water got accumulated.

In the state of Punjab 14 out of 20 districts were affected in 2010 floods 1884 villages of 90 Blocks were affected. In the first spell of monsoon in the beginning of July 9 districts viz, SAS Nagar, Patiala, Sangrur, Mansa, Ferozepur, Moga, Fatehgarh Sahib, Roopnagar, Ludhiana, and the other five districts affected by floods in later monsoon period were Jalandhar, Tarn-Taran, Muktsar, Amritsar and Hoshiarpur. Floods took a toll of 29 human lives, 112 livestock, 937 houses and caused damage to crops in 100,000 hectares of land.

The State Government released relief of Rs. 321.19 crore for the people of Punjab. Out of this, Rs.113.64 crore came from the State Budget and the rest Rs.208.26 crore were from the CRF.

Source: Flood Document 2011
Flood Risk and Vulnerability of Punjab

FLOOD RISK

Punjab derived its name because of presence of five rivers, Satluj, Ravi, Beas, Jhelum and Chenab in the state. Punjab is endowed with rich water resources. Two major rivers Beas and Satluj traverse through the state and Ravi & Ghaggar touch its Northern and Southern borders respectively. Besides, three internationally important wetlands, several canals, drains, ponds, and reservoirs exist in the state.

Ghaggar

River Ghaggar is a nonperennial interstate river, originating from the lower Shivalik hills near Dagshai Himachal Pradesh, flowing through the Shivaliks in Haryana State and entering Punjab near Mubarkpur, in the Derabassi block of District Patiala. The river after entering into the plains flows in cris-cross manner, till it reaches Rajasthan, where it merges in sand dunes. About 165 km length of river Ghaggar falls in Punjab territory, out of which 102 km, 40 km and 23 km falls in district Patiala, Sangrur and Mansa respectively. Till date no Dam has been constructed on the river due to a variety of reasons. The river Ghaggar and its tributaries like TangriNadi, Jhambowali, choe, BhangaNadi, Markenda river, PanchisdaraNallah, Patiala Nadi, Jhambowalichoësetc, create havoc of food in adjacent areas. The carrying capacity of the river within cut section at Khanauri is about 15000 causes, where chances of flooding are very high.

Satluj River

Satluj rises from beyond Indian borders in the Southern slopes of the Kailash Mountain near Mansarover Lake from Rakas Lake, as LongcchenKhabab River (in Tibet). It rises in Tibet, crosses the Himalayas to flow...
east-southwest across the Punjab. It leaves Himachal Pradesh to enter the plains of Punjab at Bhakra, where the world’s highest gravity dam has been constructed on this river. The Bhakra-Nangal scheme irrigates 700,000 ha/1.7 million acres in the Punjab, Haryana, and Rajasthan, and generates 604,000 KW at Bhakra; the Sutlej is also linked with the Ravi and Beas rivers for irrigation purposes. In last week of August 2010 flood gates were opened due to heavy rainfalls which create havoc in some districts. The Black Bein and the White Beins, both the tributaries of the Satluj are important streams flowing on the surface of Doaba. The White Bein emerges out of the sub mountainous area near the Hoshiarpur. It courses towards Jalandhar cantonment and meets the Satluj nearly 10 km short of its confluence with the Beas. The Black Bein enters Punjab plains in the Northwest of Dusuya town in the form of Choe. It travels in a parallel bed to the Beas river and reaches Sultanpur Lodhi. Here it gains sufficient water and courses toward Satluj. Beas confluence where it falls in the combined waters of these two mighty rivers.

Beas
The river originates in the Rohtang pass of the Himalayas in central Himachal Pradesh in India at a height of 13,050 feet and flows for a length of 29 miles (470 km) before uniting with the Sutlej River at Harike Pattan south of Amritsar in Punjab. Finally the river drains its water into the Arabian Sea. Sometimes it is a placid mountain river while during the monsoon, when the water is maximum, it turn into a violent torrent. In actuality, the river Beas has two sources. The source to the right of the pass is the Beas Rishi. The second source of Beas lies to the south of the Beas Rishi and is known as the Beas Kund.

Ravi
The Ravi (Iravati of the Sanskrit- being name in the Puranic mythology of Indra’s elephant) is the least by far of the Punjab Rivers. It rises in the Kulu, in the low mountain of Bungall, a short distance west of the Rohtang Pass. Coming out of the Bara Bangahalmountains the river flows for about 158 km in Himachal Pradesh. Thereafter, it flows with the boundary of Jammu and Kashmir till Madhopur. At Madhopur Ravi enters the Punjab plains. Nearly six kms south of Kathua the river forms an international boundary between India and Pakistan. Then it enters into Pakistan.

List of Dams in Himachal Pradesh and Punjab
Flooding in Punjab is influenced by presence of various dams and reservoirs in the states of Himachal Pradesh and Punjab. A list of dams in these two states is given below:

- Bairasui on Ravi River near Chamba
- Bhakra Dam on Sutlej River near the border between Punjab and Himachal Pradesh
- Chamera Dam on Ravi River in the Chamba district of Himachal Pradesh
- Nathpa Dam on Sutlej River in the Kinnaur and Shimla districts of Himachal Pradesh
- Pong Dam Reservoir on Beas River in the Kangra district of Himachal Pradesh
- Pandoh Dam on Beas River in the Mandi district of Himachal Pradesh
- Ranjeet Sagar Dam on Raavi River in the Gurdaspur District of Punjab

Table 1: List of Main canals in Punjab

<table>
<thead>
<tr>
<th>Sr. No.</th>
<th>Name of Canal</th>
<th>Discharge in Cusecs</th>
<th>Length in Km</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Sirhind Canal</td>
<td>12622</td>
<td>59.44</td>
</tr>
<tr>
<td>2</td>
<td>NangalHydel Channels</td>
<td>14500</td>
<td>20.12</td>
</tr>
<tr>
<td>3</td>
<td>Combind Branch</td>
<td>7635</td>
<td>3.22</td>
</tr>
<tr>
<td>4</td>
<td>Sidhwan Branch</td>
<td>1751</td>
<td>88.01</td>
</tr>
<tr>
<td>5</td>
<td>Abohar Branch</td>
<td>3029</td>
<td>109.75</td>
</tr>
<tr>
<td>6</td>
<td>Bathinda Branch</td>
<td>2890</td>
<td>152.40</td>
</tr>
<tr>
<td>7</td>
<td>Ferozepur Feeder</td>
<td>11192</td>
<td>51.42</td>
</tr>
<tr>
<td>8</td>
<td>Sirhind Feeder</td>
<td>5264</td>
<td>136.53</td>
</tr>
<tr>
<td>9</td>
<td>Rajasthan Feeder</td>
<td>18500</td>
<td>149.43</td>
</tr>
<tr>
<td>10</td>
<td>Abohar Branch Lower</td>
<td>1692.50</td>
<td>46.37</td>
</tr>
<tr>
<td>11</td>
<td>Bikaner Canal</td>
<td>2720/3027</td>
<td>112.01</td>
</tr>
<tr>
<td>12</td>
<td>Eastern Canal</td>
<td>3929</td>
<td>8.02</td>
</tr>
</tbody>
</table>

Location of all rives, canals and drains in Punjab
Fig below shows the locations of all the rives, canals and drains alongwith districts in Punjab.
As per the hazard profile of the state, out of 20 Districts namely Patiala, Gurdaspur, Ropar, Sangrur, Mansa, and Ferozpur are the most flood prone districts. Flood prone zones in Punjab are shown in Map Below.

**History of Flood and Heavy rains in State**

The state has experienced floods in the year of 1988, 1993, 1995, 1997, 2004, 2006, and recently in 2010. In the year of 1988 Punjab experienced unprecedented flood due to release of water from the Bhakra Dam when the flood gates were opened apprehending the danger due to increase in the water level beyond the danger point.
The floods experienced by the state caused heavy losses to crops, property, livestock, human lives and industries falling in the low laying area. Though the government kept an eye on the day to day situation and tried its best to provide relief to the victims, even then the losses could not be fairly compensated as the relief amount provided by the government was far below the actual losses.

Table 2: Record of Previous Floods in Punjab

<table>
<thead>
<tr>
<th>Year</th>
<th>No. of village affected</th>
<th>Area affected in sq km</th>
<th>Population affected</th>
<th>Human lives lost</th>
<th>Cattle Heads lost</th>
<th>Damage caused to area under crop in hectares</th>
<th>% of damaged area to total cropped area</th>
<th>Value of crop damage</th>
<th>Houses Damaged</th>
<th>Damages to public utility</th>
<th>Total Damage (Rs)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1994</td>
<td>469</td>
<td>29451</td>
<td>41</td>
<td>369</td>
<td>33348</td>
<td>0.43</td>
<td>36730</td>
<td>6950</td>
<td>12178</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>1995</td>
<td>6585</td>
<td>2788</td>
<td>157</td>
<td>1310</td>
<td>275761</td>
<td>3.59</td>
<td>112653</td>
<td>1443</td>
<td>50219</td>
<td>154184</td>
<td></td>
</tr>
<tr>
<td>1996</td>
<td>-</td>
<td>-</td>
<td>1</td>
<td>-</td>
<td>15529</td>
<td>0.30</td>
<td>66872</td>
<td>2873</td>
<td>10337</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>1997</td>
<td>677</td>
<td>-</td>
<td>28</td>
<td>100</td>
<td>97930</td>
<td>1.24</td>
<td>366932</td>
<td>1311</td>
<td>77813</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>1998</td>
<td>-</td>
<td>128</td>
<td>176</td>
<td>22</td>
<td>6816</td>
<td>0.11</td>
<td>27584</td>
<td>654</td>
<td>1204</td>
<td>25766</td>
<td></td>
</tr>
<tr>
<td>1999</td>
<td>30</td>
<td>29</td>
<td>12</td>
<td>2764</td>
<td>-</td>
<td>12959</td>
<td>18</td>
<td>-</td>
<td>-</td>
<td>12959</td>
<td></td>
</tr>
<tr>
<td>2000</td>
<td>88</td>
<td>319</td>
<td>5</td>
<td>88</td>
<td>12630</td>
<td>0.16</td>
<td>77116</td>
<td>9</td>
<td>800</td>
<td>2700</td>
<td></td>
</tr>
<tr>
<td>2001</td>
<td>-</td>
<td>-</td>
<td>-</td>
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<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
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<td>-</td>
<td></td>
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<tr>
<td>2002</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>2003</td>
<td>43</td>
<td>47</td>
<td>25</td>
<td>-</td>
<td>14</td>
<td>0.06</td>
<td>16794</td>
<td>1296</td>
<td>3840</td>
<td>20724</td>
<td></td>
</tr>
<tr>
<td>2004</td>
<td>480</td>
<td>610</td>
<td>60157</td>
<td>511</td>
<td>46561</td>
<td>0.59</td>
<td>517010</td>
<td>1373</td>
<td>26529</td>
<td>539863</td>
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<tr>
<td>2005</td>
<td>480</td>
<td>610</td>
<td>60157</td>
<td>511</td>
<td>46561</td>
<td>0.59</td>
<td>517010</td>
<td>1373</td>
<td>26529</td>
<td>539863</td>
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<tr>
<td>2006</td>
<td>412</td>
<td>211</td>
<td>405913</td>
<td>10</td>
<td>23</td>
<td>0.27</td>
<td>172539</td>
<td>566</td>
<td>519</td>
<td>175208</td>
<td></td>
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<tr>
<td>2007</td>
<td>1033</td>
<td>1035</td>
<td>405911</td>
<td>7</td>
<td>3</td>
<td>0.67</td>
<td>582995</td>
<td>681</td>
<td>3425</td>
<td>5886400</td>
<td></td>
</tr>
<tr>
<td>2008</td>
<td>2001</td>
<td>500</td>
<td>399116</td>
<td>34</td>
<td>104</td>
<td>0.90</td>
<td>645004</td>
<td>1225</td>
<td>67909</td>
<td>713918</td>
<td></td>
</tr>
</tbody>
</table>

Source: State Disaster Management Plan Punjab,2011

Flood Hazards in Punjab

The high and very high areas of flood hazard are the buffer areas of the rivers in the state. After analyzing the fig. 2 it is revealed that the flood hazard is more severe in the northern part of the state as compare to southern past. In southern part of the state Ghaggar is the only river which cause flood hazards especially in the Haryana adjoining areas of Patiala and Sangrur district of the state. In the northern and central part of the state Gurdaspur, Amritsar, Hoshiarpur, Tarn Taran, Kapurthala, Firozpur, Moga, Jalandhar, Ludhiana, Rup Nagar and NawanShahr districts affects from flood due to Ravi, Beas and Satluz river. In other words the Manjha and Doad region of the state area more vulnerable than the Malwa region. The fig 2 describes the flood hazard area of the state.
Channel. Giving at least some have a database of all the resources available in the state in GIS domain. The GIS ge in the state of Punjab. More than e state. The buffer area of the rivers on like non

Floods 2010 were a natural and human made disaster. The main reasons for floods 2010 were:

1. Heavy rainfall in the catchments area of lower Shiwaliks as well as in the plain areas of State and the second reason was lack of preparedness.
2. Deforestation and soil erosion in lower Siwaliks caused siltation in river bed thereby reducing carrying capacity of the rivers attributing to floods in the state.
3. Punjab and Haryana inter-state disputes lead to inaction like non-strengthening of SYL canal and wrong designing of HansiButans Canal which aggravated the floods situation manifold.
4. Lack of Preparedness like not cleaning of drainages and non-strengthening of river embankments etc.

Conclusion
The study revealed that the cumulative impact of floods result in diversion of development funds to much needed relief and response efforts. More often than not it upsets the state's planning and finances cramping the development trajectory of state/nation’s economy. The flood is a major natural phenomenon cause for causalities as well as damage in the state of Punjab. More than 39 life lost, 112 livestock lost, 2068 houses damaged 264908 acres crops damaged and infrastructure of approx 262.58 crores washed away. The flood affects the northern part of the state more than the southern part of the state. The buffer area of the rivers Ghaggar, Ravi, Beas, and Satluj is the vulnerable most area from flood point of view. The Rajasthan adjoining districts are less vulnerable than the central and northern part of the state. The study also
revealed that the flood occurred mostly in the monsoon season (July-September). The main reason of flood is heavy rainfall in the catchment area as well as in the plain area of State.

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