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HYDRO-METEOROLOGICAL HAZARDSCAPE OF RIVER SWAN SORROW OF DIST. UNA, HIMACHAL PRADESH

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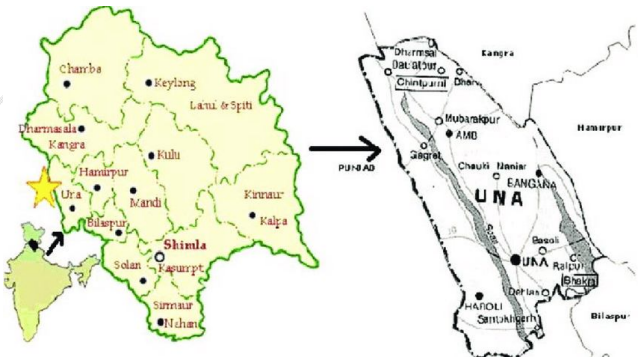
ABSTRACT :

Floods and flash floods are common water related natural disaster in the state of Himachal Pradesh. Flooding mostly affects large areas in the lower catchment region where as flash flood which principally occurs due to cloud burst in the upper catchment area. The study was conducted on hydro-meteorological vulnerability of river Swan and its associated hazardscape. Swan is a tributary of the Sutlej river and having total length of about 85 km out of which 65 km falls in Himachal Pradesh. River Swan experiences flooding every year and is known as "the sorrow of Himachal Pradesh". The objective of the study was to understand the nature of hazardscape and it's space time manifestations and to evaluate the physical susceptibility to flood and associated hazards and their degree of risk. An attempt has also been made to assess the scale of human vulnerability, resilience to hazards and disasters. Both primary and secondary data sources were used. Based on these data sources the study has attempted to understand the hazardscape in terms of spatio-temporal distribution, physical and human factor responsible for vulnerability of places and people and identification of potential spaces for disaster in the study area. Both qualitative and quantitative techniques namely observation, survey, measurement and visual representation were used for analysis. In this study we found that after the channelization of Swan river the frequency of floods become low and the forest department of Himachal play an important role in this area by planting trees in both side of Swan River. However, there is a need to strengthen and diversify livelihood.

KEYWORDS : *Hazardscape, Vulnerability, Resilience, Risk, Susceptibility .*

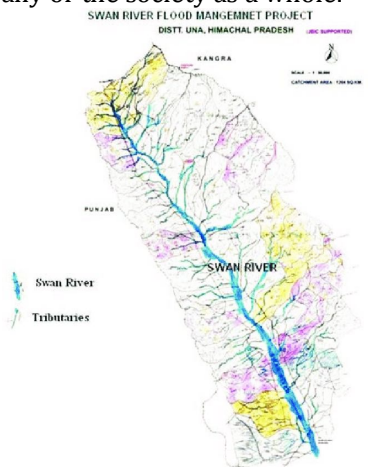


Swan River in Distt. Una of Himachal Pradesh

INTRODUCTION

Geographic research on hazards and disasters has a long history. Vulnerability, resilience, hazard, risk, damage, and loss are the key concepts referred to in the literature on natural disasters. Hazard "refers to the natural events that may affect different places singly or in combination (coastlines, hillsides, earthquake faults, savannahs, rainforests, etc.) at different times (season of the year, time of day, over return periods of different duration)" (Wisner et al., 2004, p. 45). Risk ought to be thought of as "a product of three major elements: exposure to hazards (e.g. that which is affected by natural disasters), the frequency or severity of the hazard and the vulnerability" (Birkmann, 2007, p. 21). **Hazards**: A hazard is a perceived natural event which has the potential to threaten both life and property. United Nations Disaster Relief Organization (1979) defines hazards as 'the probability of occurrence within a specific period of time and within a given area of a potentially damaging phenomenon'. The problem of hazards rooted in the physical susceptibility of mountain environment needs to be understood in terms of human use, overuse and misuse that creates spaces of vulnerability in such pristine landscapes. Therefore, the proposal bases itself on two significant aspects: (a) Exploring the physical dimensions of hazards, and (b) Human dimensions determining the disaster risk and vulnerability/resilience In light of above thinking, certain concepts need to be explained to have clarity on basic premises of hazard/disaster research.

Vulnerability: The term vulnerability is derived from the Latin 'vulnerare', meaning 'to wound'. Broadly, it refers to the exposure of a person, asset, good or activity to potential harm or loss. It is an imprecise term with no single definition and refers to the 'potential for loss' (Cutter 1996a). Turner et al. (2003) define vulnerability as 'the degree to which a system, subsystem, or system component is likely to experience harm due to exposure to a hazard'. It is a degree to which various socio-economic and institutional factors, and, to a lesser extent, political and cultural factors (Kasperson et al. 1998, Adger 2000, White et al. 2001, Fischetti 2001 and Cutter 2003), that determine the risk to which people are exposed and how people respond to and cope with natural hazards (Cutter 1993 and Alwang et al. 2001).Many recent reviews of vulnerability suggest that it must be understood as the product of changes in coupled social-ecological systems (Barnett et al. 2008). Therefore, vulnerability may be seen as the extent to which a community, structure, service, or geographical area is likely to be damaged by a particular hazard. It also represents the degree of susceptibility/lack of capacity to absorb the impact of hazard and recover from it. From another perspective it also defines the degree of resistance in a system to the impact of hazards. Thus vulnerability relates to not only the physical factors (biophysical vulnerability) but also to a range of social, economic, cultural and political factors that determines the susceptibility of humans either individually or the society as a whole.



Swan River Flood Management

Risk: In general, 'risk' in the context of disasters refers to the expected value of losses (deaths, injuries, property, etc.) that would be caused by a hazard. Risk is the probability of occurrence of a damaging event or circumstance (Mitchell 1990b) or exposure of something humans value to a hazard

(Smith 2009). It is the probability of harmful consequences or a measure of the expected loss (death, injuries, property, economic activity or environmental damage) due to a hazard of a particular magnitude occurring in a given area over a specific time period. It is therefore the product of hazard and vulnerability (Lewis 1999).Therefore, risk describes the measure of the expected losses due to a hazard and emphasize on estimation and quantification of risk probability in order to determine appropriate levels of safety.Thus the four critical factors which contribute to risk are (a) hazard (a potential threat), (b) location of hazard relative to the community at risk, (c) exposure (value of structures/lifeline system) and (d) vulnerability (degree of loss to a given element or set of elements). The disaster risk can be seen as a function of the hazard, exposure and vulnerability. i.e. Disaster Risk = function (Hazard, Exposure, Vulnerability).UNISDR (2015) explains risk as a probability of a disaster occurrence and the magnitude of the consequences of any given hazard, i.e. how likely is a hazard and what consequences will it have? The evaluation of a risk includes vulnerability assessment and impact prediction taking into account thresholds that define acceptable risk for a given society.

REVIEW OF LITERATURE

The review of literature is what others have analysed, observed, fond and studied? It is the foundation stone for the evaluation of any research. Geographers have long been concerned with natural hazards, with early research focusing on understanding physical processes (Goldthwait 1928), spatial distributions and patterns (Joerg 1912), and to some extent, the impacts of events (Lemons 1942) and mitigation (Reed 1916). Earlier works in the fields of hazards and disasters were of descriptive in nature (Banks & Read 1906, Everett 1913, Halstead 1900 and Tyler 1906) however with the passage of time the focus of hazards studies has shifted to applied aspects (Burton et al. 1968). A vast range 10 of theories have been developed by the researcher to study disasters and hazards from different perspectives such as human adjustments to environment (Burton et al. 1968, Ericksen 1986 and Smith 2009), the studies looking at vulnerability and focusing on weaknesses in the human systems (Bohle 2001 and Wisner et al. 2004), assessment of ecosystem sustainability (Mileti 1999) and place vulnerability (Cutter et al. 2000).

All these perspectives provide significant insight into hazards and disasters, but they are loosely connected and present a partial view of reality depending on their focus of attention whereas hazardscape is a holistic approach to study hazards and disasters. In recent times emphasis is being given to the hazards and disasters which are occurring globally. However, there has been growing interest in hazards and disasters which are taking place in the mountain environments (Gore et al. 2010 and Guhathakurta 2003) because these sensitive environments are more prone to hazards and disaster because of their physical settings. The impact of naturals hazards increases with the increase in elevation (Singh and Pandey 1995 and Sati 2006).

OBJECTIVES OF THE STUDY

1. To understand the nature of hazardscape and its space-time manifestations.
2. To evaluate the physical susceptibility to flood and associated hazards of Swan River.
3. To assess the scale of human vulnerability/resilience to hazards and disasters.
4. To identify the potential critical spaces of Swan River for disasters and their degree of risk.

RESEARCH METHODOLOGY

For the present research works both the primary and secondary data sources shall be utilized. Based on these primary and secondary data sources the study will attempt to understand the hazardscape in terms of spatio-temporal distribution analysis, physical and human factors responsible for vulnerability of places and people and identification of potential spaces for disasters in the study area.

DATA SOURCES

Secondary Data Sources	Primary Data Sources
• Geological Survey of India (GSI), Chandigarh • India Meteorological Department (IMD), New Delhi • National Remote Sensing Centre (NRSC), Hyderabad • Newspaper Archives: Times of India and The Tribune • State Departments of Himachal Pradesh: • Director of Land Records. • Department of Forest • Department of Revenue	• Field Observations • Field Survey and Measurements • Questionnaire and Schedules • Interviews and Discussions

Sources : District Disaster Management Authority, Una, H.P.

HAZARDSCAPE

The term 'hazardscape' coined by Corson (1999) with a focus on technological hazards, define it as 'the spatial distribution and attributes of human engineered facilities that contain or emit substances harmful to humans and environment'. Cutter et al. (2000) used the term "hazardscape" interchangeably with "riskscape" and explained hazard as an inherent complex physical and social phenomena (Hazard in context approach) strongly linked with public perception and policy response to risk and hazard (Social amplification of risk model). The thinking was in line with the 'Hazard-of-Place' model of vulnerability that visualizes 'place vulnerability' as an outcome of interaction between social and biophysical vulnerabilities (Cutter 1996a). The foundations to this thinking are rooted in the 'hazardousness of place' approach (Hewitt and Burton 1971) aimed at understanding the regional expressions in response to multi-hazards in an area. Gray (2001) used the word "hazardscape" to describe the collective areas of risks associated with hazards. According to Urry (2005), hazardscape manifests itself in physical space; the effects of humans are subtly and irreversibly woven into the very evolution of landscape. Mustafa (2005) used hazardscape as substitute for natural hazards, which connotes some external nature as the key causative element in the hazardousness and vulnerability of life. A hazardscape is defined as "a dynamic scope which reflects the physical susceptibility of a place and vulnerability of human life and assets to various hazards in a given human ecological system" (Khan 2012).

Hazardscape is not just an approach to assess the impact of hazard and the place of occurrence of hazard but it is a holistic approach to demonstrate the ecological perspective of hazards and consequent risks, which is built through the interaction of human beings with the environment in a particular spatio-temporal context. The present study will encompass the hazardscape on a regional to local scales through a geographical perspective to provide an understanding of:

A. Hazardousness: Physical susceptibility of the region.

B. Spaces of Disasters: Places and magnitude of the various hazard occurrences.

C. Human Vulnerability: Risk and resilience to various hazards.

A study of this kind will therefore, provide a framework to comprehend the totality of the hazardscape and places of disaster in the region. This framework of 'Hazardscape' has a holistic approach to contextualize varied aspects of hazard, risk, vulnerability, resilience and disaster, interacting and exhibiting complex human-environmental responses and their assessment in relation to each other within a geographic space.

STATUS OF SWAN RIVER

River Swan originates from Shivalik hills, flows in North-West direction to join river Sutlej near Anandpur Sahib in Punjab. Similarly, another limb of the river starting from same range of hills at Daulatpur Chowk flows along the North-East directions joining the river Beas down steam of Pong Dam near Talwara Daulatpur area in the Una District acts as a ridge separating two limbs of river Swan one joining river Sutlej and the other joining Beas. The total length of Swan River which joins Sutlej is about 85 km, out of which 65 km falls in Himachal Pradesh and total numbers of tributaries which joins the Swan river meeting in Sutlej are 55 km. This portion of Swan River including tributaries has been channelized/ proposed to be channelized in four phases named Phase 1st , phase 2nd , phase 3rd and phase 4th . Similarly the total length of Swan River which joins Beas River is 7.600 km in H.P. Territory and 10 number tributaries joins the Swan River in this reach. This portion of Swan River including tributaries has been proposed to be channelized under phase 5th.

Swan River was known as "Sorrow of Una District" as it created havoc during every monsoon during floods and as result the normal life of the public of Una District was thrown out of gear during every rainy season. Several acres of fertile land is washed away by floods in Swan and its tributaries and the inhabitants of the area have been feeling helpless. Thus proper conservation measures in an around Swan are required. The implementation of the Flood Control Project of Swan is one of the measures that need to be taken up on priority.

Keeping in view the heavy devastations caused by the Swan River during every monsoon season, the Government of Himachal Pradesh decided to channelize the Swan River in different phases:

Phase -1st (From Jhalera Bridge to Santokhgarh Bridge)
Phase – 2nd (From Gagret Bridge to Jhalera Bridge)
Phase -3rd (Down stream of Santokhgarh Bridge upto H,P, Punjab Boundary)
Phase – 4th (Daulatpur Bridge to Gagret Bridge in main Swan River.

DAMAGES CAUSED BY SWAN RIVER

Swan River is rightly called as Sorrow of Una District. During the year 1988 alone, this district was very badly hit due to excessive rains/flash floods. During the month of August and September 1988, there had been abnormally heavy rains causing damage to crops and public/private property. It is worth mentioning that 22nd to 26th September 1988, torrential rains had established historic record of Himachal Pradesh breaking all the previous records of rainfall data and this district was one of the most effected district in the state. The flash floods resulted in heavy landslides, destroyed crops totally and caused huge losses to public and private properly. 37 persons lost their lives and many more found missing. 45 cattle-heads were perished. All the roads were breached/ blocked due to landslides and floods.

TABLE - 1
DETAIL OF DAMAGES DURING PAST 11 YEARS DUE TO FLOOD IN SWAN RIVER

DETAIL		UNA SUB DIVN.	Amb Sub Divn.	Total
Villages effected		21	36	57
Land Damaged (in Ha):	Govt.	4887	67	4954
	Private	18730	2661	21391
	Total	23617	2729	26346
Crops damaged in Lacs.		14.02	785.00	799.02
Total loss of Swan River for last 11 years = 5341.95 lacs. Average loss per year = 485.63 lacs/year				

Sources : District Disaster Management Authority, Una, H.P.

It is evident from the table 1 that the detail of damages during last 11 years due to flood in Swan River. The total 57 villages effected due to flood in which 21 villages of Una Sub Division and 36 villages of Amb Sub Division. Due to flood in Swan River total 26346 ha land damaged and total 799.02 lacs crops damaged.

TABLE - 2
LOSS OF BUILDINS PAST 11 YEARS DUE TO FLOOD IN SWAN RIVER

DETAIL	NUMBER	RELIEF PROVIDED
Katcha	8643	5028033
Pucca	345	123850
Cow Shed	2740	2514016
Others	784	263670
Live stock losses	62	35500
Human losses	5	50000
	Total	8015069

Sources : District Disaster Management Authority, Una, H.P.

It is clearly shows from the table 2 that loss of buildings past 11 years due to flood in Swan River. The number of Katcha houses 8643, Pucca houses 345 and Cow shed 2740, which is effected due to flood in Swan River. The government provided total relief fund Rs. 80,15069 in last 11 years of effected people.

CONCLUSION AND SUGGESTIONS

Evaluating socio-economic losses due to natural disasters is a challenging task because of the combined complexity of the social and ecological systems affected. However, also under pressure from the expected effects of climate change, evaluating the socio-economic costs of natural catastrophes has become a vital need for policy makers, urban planners, and private agents (such as insurance companies and banks). The present study suggests a general framework encompassing all the important concepts which should be taken into account by the above agents in the assessment of natural disasters. In particular, we propose a simple and consistent set of relationships among vulnerability, resilience, hazard, risk, damage, and loss which can guide socio-economic assessment.

- Swan River flood protection and integrated land development project, on completion, shall confine the flow of Swan River to a width of 775 m between Santokhgarh and Jahlera bridges. This 2260 ha of land shall be put profitable use through integrated development like agriculture, horticulture, forestry and fishery.
- The total annual benefits on account of savings in annual flood damages and integrated development activities works out to Rs. 2402.68 lacs. Annual maintenance 2 25, depreciation@ and interest charges on the capital cost 2 10% works out to Rs. 1747.45 lacs. The benefit cost ratio for the project thus works out to 1.37 and is thus quite attractive.
- It is also necessary to take up watershed management works in the catchment area of the Swan river.

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