

B_RE_U_COM

Building **Resilient** Urban Communities



Co-funded by the
Erasmus+ Programme
of the European Union

Case Study-04

Climatic Resilient Planning and Design for Vulnerable Urban Hill Settlements The Case of Kullu region

Inderpal Singh, Puneet Sharma, Aniket Sharma

2019



Co-funded by the Erasmus+ program of the European Union

The European Commission support for the production of this publication does not constitute an endorsement of the contents which reflects the views only of the authors, and the Commission cannot be held responsible for any use which may be made of the information contained therein.

The views expressed in this profile and the accuracy of its findings is matters for the authors and do not necessarily represent the views of or confer liability on the National Institute of Technology Hamirpur.



© [National Institute of Technology Hamirpur]. This work is made available under a Creative Commons Attribution 4.0 International Licence: <https://creativecommons.org/licenses/by/4.0/>

[National Institute of Technology Hamirpur]
Email: [ipsingh@nith.ac.in]
Website: [www.nith.ac.in]

Suggested Reference:

[Inderpal Singh, Puneet Sharma, Aniket Sharma] (2019) [Climatic resilient planning and design for vulnerable urban hill settlements- A Case of Kullu region]. Report prepared in the BReUCom (Building Resilient Urban Communities) project, funded by the Erasmus+ Program of the European Union. www.breucm.eu

Contents

1 Introduction	6
1.1 Objectives of the Study	7
2 Research Methods	7
3 Geographical Area of the Study.....	8
4 Architectural style	9
5 Climatic disasters in the region.....	9
6 Study of development pattern - Bhuntar	10
6.1 Road network	10
6.2 Landmarks	10
6.3 Activity generator	11
7 Study of development pattern - Naggur	12
7.1 Road network	12
7.2 Movement intensity	12
7.3 Landmarks	13
7.4 Activity generator	13
8 Outcomes of the study.....	14
9 Planning approaches and methods	14
9.1 Existing resilience measures	14
10 Hill Settlement Flood Resilience Strategy	15
10.1 Prevention	15

10.2 Preparation	15
10.3 Response	15
10.4 Recovery	15
11 Implementation methodology.....	16
12 Conclusion	16
13 Way forward.....	17
14 References	17

Climatic Resilient Planning and Design for Vulnerable Urban Hill Settlements: The Case of Kullu Region

Inderpal Singh, Puneet Sharma, Aniket Sharma

Abstract: Recent Climatic disasters in hill areas due to uncontrolled and non-scientific growth have increased the need for making urban settlement resilient in nature. Demand for innovation, awareness and education for building culture towards safety and resilience in vulnerable urban hill settlements is major concern. Prevention of loss to life and property due to natural calamities and putting in place policy framework for disaster mitigation and management is an area where architects and planners input is vital.

Seismically, the study area lies in the great Alpine- Himalayan seismic belt. This region is prone to various natural hazards ranging from earthquakes, landslides, flash floods, storms to dam failures. The hazard which however, poses biggest threat is the land slide and cloud burst.

The project shall take up a detailed study of a few settlements in the hilly region of Kullu and Manali to demonstrate the level of current resilience. It should help in identifying the appropriate methods and actions to improve the present condition and reveal the appropriate traditional approaches used in past to survive the impacts of disasters. The study shall explore the new settlement regions with relation to disaster readiness through climatic resilient planning and design strategies.

The case study intends for disaster mitigation & recovery and making resilience community through preparedness and timely response. This work will also guide in a planned and systematic way to minimize losses in social & environmental sector by creating resilient communities in hill regions.

1 Introduction

Present scenario of rapid urbanization puts immense pressure on hill towns having limited scope of expansion. This extensive growth also imposes enormous burden on urban form, infrastructure facilities and environment and leading to overall degradation. Urban settlement

pattern of hill settlements is a by product of its topography, climate, culture, socio-economic conditions, flora and fauna along with accessibility and visual qualities. Natural processes along with complex geo and socio-ecological system evolved in recent times have increased the vulnerability of these regions [4]. In recent times, settlement development pattern has shifted from the traditional wisdom and

vernacular way to unplanned and economics driven development pattern. Consideration of various aspects like slopes, climate, landuse, urban form, energy consumption pattern, historical and religious importance, density distribution and movement connections have lost their role in planning decisions. Most of the development is market driven and result of political action. Urbanisation and climate change leading to high frequency and magnitude of precipitation increases the risk of floods and related damages[1]. Such scenario has not only changed the climatic conditions of the area but cities have become climatically vulnerable.

The hill state of Himachal Pradesh faces intense impact of climate change in recent years. Study area for this project, the Kullu region is one of the climatically vulnerable districts in Himachal Pradesh due to its topography and fragile eco system. Kullu district is on the eastern side of Himachal Pradesh with an area of 5,503 Km² as per Survey of India. It is surrounded by the Kangra in North and North-West, Mandi in West, Shimla towards South, Kinnaur and Lahaul & Spiti to the eastern side. River Beas, Parvati and Sutlej are the three major water channels in the district with distinct eco systems. Recent floods in 2018 impacted the Beas River watershed and highlight the lack of infrastructure and environmental damages. Floods are now widely recognised as one of the world's most serious natural hazards [9]. In India, national disaster management plans now focus on resilience, wherein people and communities are central to achieving disaster reduction [10]. The term resilience has been defined in many ways by the researches in past. Resilience is the ability of a community exposed to hazards to resist, absorb, and recover from the effects of a hazard in efficient manner. It also related with the efficiency to return to desired functional level [7]. Therefore, it is important for society to develop a better understanding of climate change and its relation with planning pattern in order to be

resilient to impending challenges in the future. There is demand for innovative responses to reduce both urban flooding by making cities more resilient in nature [14]. The aim of this research is to prevent/mitigate risks posed by climate change risk, and improve community preparedness through effective climatic resilient measures in the region. The rationale for the case study is to understand present conditions and suggest future strategies to improve resilience by identifying the roles and responsibilities of various agencies and stakeholders in what? process. The study is an attempt to achieve improved resilience for climatic change in hill settlements and minimize human, property and environmental losses in a planned manner.

1.1 Objectives of the Study

The objectives of the case study are set in a manner so as to reach the stated aims through a people centric approach. The first objective is to map and document various effects and occurrence of previous climatic disasters in the region in order to develop a basic understanding. The second objective is to study old and new development patterns in order to identify the vulnerable regions. The third objective is to learn from various existing approaches and methods (both local and global) to mitigate the adverse impacts of cloud burst, landslide, and earthquake. The final objective is to suggest context-based planning and design strategy to mitigate the adverse impacts of natural disasters in the study area.

2 Research Methods

The case study of the region was conducted through primary survey and interactions with different stakeholders. Available literature

and scholarly articles were reviewed. Data from secondary sources are used to develop strategies and action plan. Method of surveys and interviews with various actors were helpful in reconstructing the vulnerability of the area [12]. Analysis of data from census, reference of state and district level literature, documents on websites; consultation with stakeholders have been used to prepare the report and concluding remarks on the impacts of climatic change and resilience. The plan so produced outlines the need to develop community resilience to mitigate and reduce the adverse impacts of climate change risks.

3 Geographical Area of the Study

Himachal is one of the most vulnerable states in India due to its geographical and climatic conditions. The study areas selected for this casework are suburban developments in Kullu district. These settlements represent both rural and urban character of hill settlements. As per the objectives of this research, Bhuntar and Naggar settlements correspond as most appropriate locations where in resilience due to climate has some relevance. One settlement shows the right direction for growth and other one shows how human interventions have neglected the natural constraints and transformed into a vulnerable development zone.

Bhuntar is a town and a Naggar is a panchayat in Kullu district of Himachal Pradesh. Figure 1 shows the location of Bhuntar and Naggar in Kullu district map. Naggar was the capital of the Kullu Rajas for about 1400 years. It was founded by the Visudh Pal and remained as the State headquarters until the capital was transformed to Kullu by Raja Jagat Singh. Naggar was the capital of the Kullu-Manali

region in early period. The kings having a view of the Beas River Valley constructed castles and small palaces. The settlement is known for its vernacular built structures which adds to the richness of the settlement. The place is known for Naggar Castle, Roerich Art Gallery, Sun temple, Sati memorials, etc. The settlement and its Kath-Kuni constructed structures are untouched and beautifully survived the vagaries of time. The settlement comprises 0.87 km² of area with total population of 1556 and 340 households.

Bhuntar is river side township having 2 km² of area with total population of 4,475 and 1035 households. The settlement is strategically located as a connection with rest of the upper region. Area is highly vulnerable to floods and land slide due to its geographical location. In rainy season flood shuts off connection to whole valley ahead including Lahaul, and Leh. Runoff from two different valleys (Manali and Manikaran) leads to landslides along the roads.

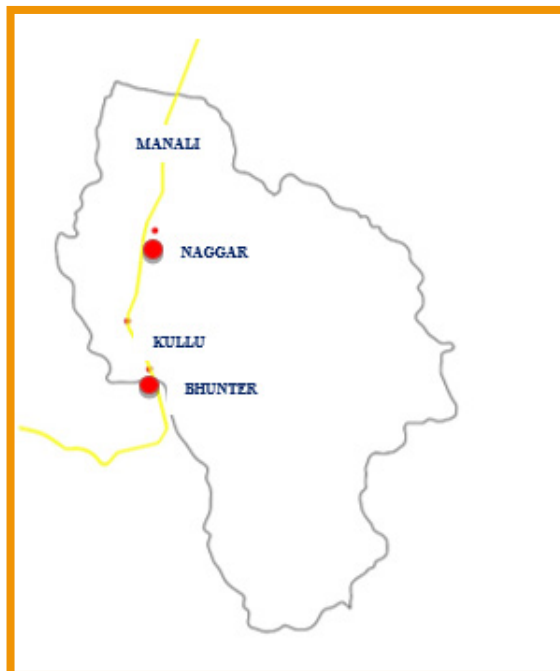


Figure 1 Map showing the location of Bhuntar and Naggar

4 Architectural style

Vernacular style construction known as ‘Kathkuni’ is not only observed in rural areas but similar structures are also seen in sub urban areas. This type of construction is wood and stone based and is typical Himachal architectural style. Lack of artisans and building material has forced the new generations in the valley to shift from this style. There is imminent shift in construction techniques and needs, due to the economic compulsions and life style demands. Lack of maintenance and knowledge for reinventing this construction type has led to the deterioration and destruction of many old structures [11].

5 Climatic disasters in the region

Urbanization is the main reason for flood related risks associated as an effect of climate change [3]. This situation demands a resilient planning approach to protect the environment and society. As the area is highly vulnerable climatically, most critical part of the project was to identify existing local knowledge of floods and landslides in the region. Figure 2 shows the Flash Flood area in the region indicating the high vulnerability in the study area [6].

In 2010 unprecedented flash missing word? caused havoc across Himachal Pradesh. Floods accompanied with cloudbursts, and landslides disrupted livelihoods in the mountains [5]. Huge losses in agriculture and animal husbandry industry were reported. Infrastructure was badly affected in most of the region. Understanding of such past disasters, their cause, location, and impacts helped in defining the need and magnitude of the study. Knowledge supplemented and enriched the overall understanding related to resilience that is otherwise fragmentary and incomplete. 2018 floods along the Beas River watershed infrastructure and development in Kullu district, Himachal Pradesh [8].



Figure 2. Flash Flood area in the region

Years	Economic Loss	Human Loss
1995	Rs. 759.8 million.	Killed 65 people
2001	15 houses, 70 livestock cows, 115 bighas of land	Killed 07 people
2003	Agriculture and horticulture land	Killed 21 people
2003	Agriculture and horticulture land	Killed 30 people

Table 1. Source: Vulnerability Atlas of HP, GoHP, 2009

6 Study of development pattern - Bhuntar

6.1 Road network

Bhuntar town is mainly a transit station that connects Kullu Valley and Manikaran Valley therefore, the main vehicular traffic is on these junctions of bifurcations. Figure 3 shows the road layout and sandwiched Airstrip along concave path of River Beas. Urban form and built mass all along the riverbank is quite evident from the aerial view shown in Figure 4. Movement intensity

Bhuntar Town has majority movement intensity due to Buses and Taxis. Figure 5 indicates the movement intensity of Bhuntar town is more on national highways and limited on local roads. Airport is a strategically important airport and is the only air connectivity for the region. The airport lies in the flood-prone zone and is most vulnerable. The road pattern is organic in nature and lot of roads have dead end for vehicular traffic and turn into pedestrian paths.



Figure 3 Aerial view of Bhuntar town

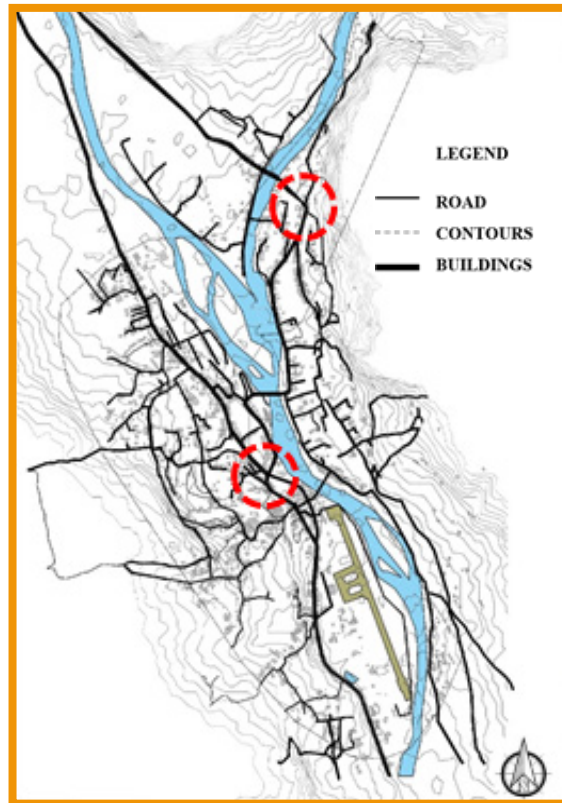


Figure 4. Map showing Road network

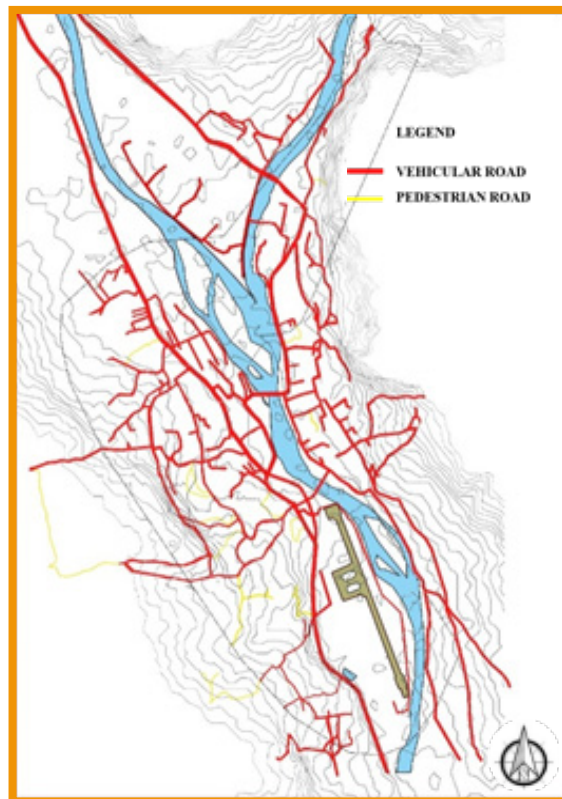


Figure 5. Map showing Movement intensity

6.2 Landmarks

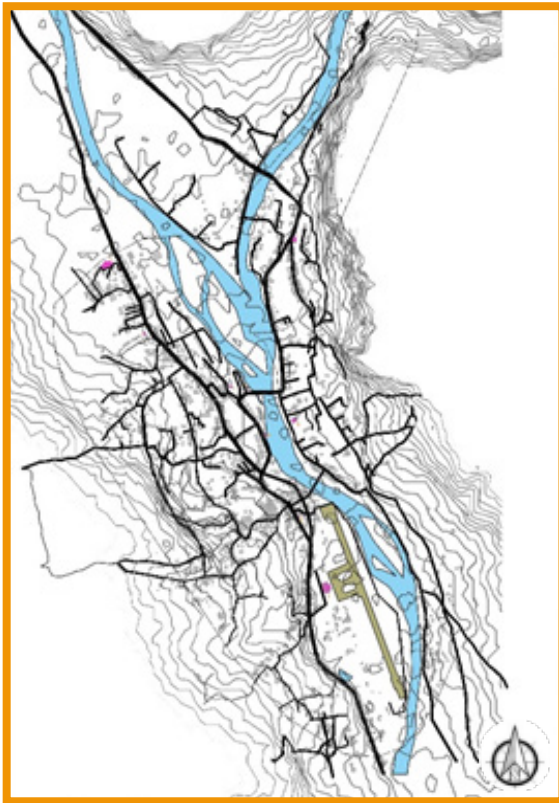


Figure 6. Map showing local landmarks

Various Temples, Parks, Gurudwara etc. are prominent cultural and social landmarks. Study reveals that there are no city level landmarks. Figure 6 indicates the location of prominent structures in town. Most of the structures are local in nature and have no distinct and identifiable local character.

6.3 Activity generator



Figure 7. Map showing activity generators

Temples, Parks and transport nodes acts as a major activity generator throughout the spine. Figure 7 shows that most prominent activity generators are transport nodes in Bhuntar town.

7 Study of development pattern - Naggar

7.1 Road network

Naggar is small settlement with limited roads and most of the houses have small paths for access. Road network caters the traffic effectively, with no prominent issues identified except for Naggar Bus stop junction indicated in Figure 8.

7.2 Movement intensity

Figure 9 gives the glimpse of narrow internal roads with two stories-built mass on both sides. Vehicular roads have low intensity of traffic due to absence of any industry. The main road connecting Kullu -Manali caters maximum traffic flow; Pedestrian circulation is prominent inside the building clusters. Figure 10 shows the vehicular access map of the settlement.



Figure 8. View of Naggar area

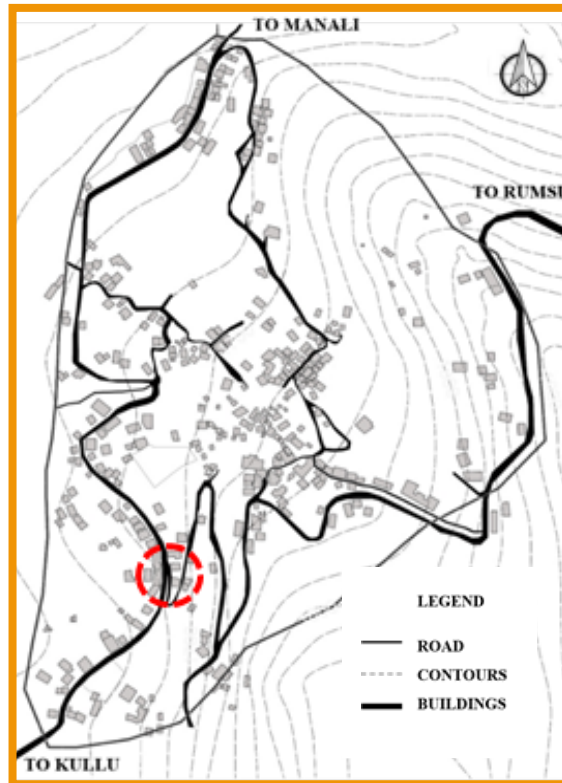


Figure 9. Map showing Road network

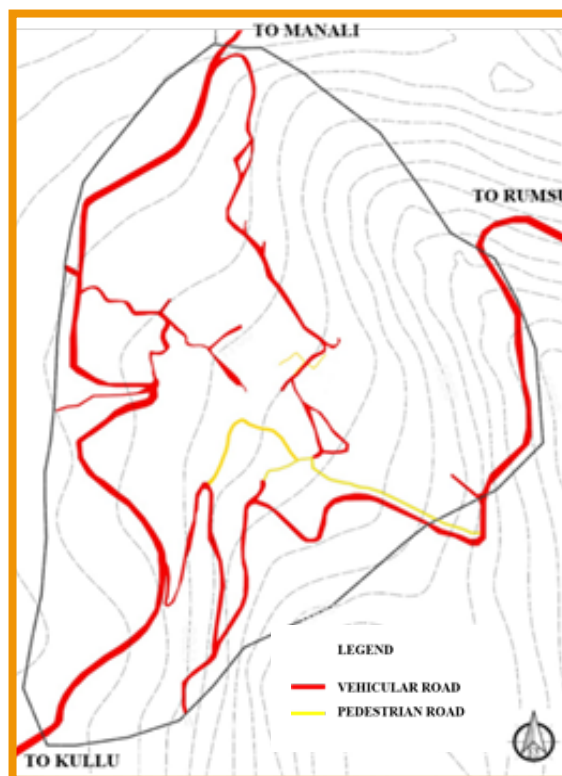


Figure 10. Map showing Movement in-tensity

7.3 Landmarks

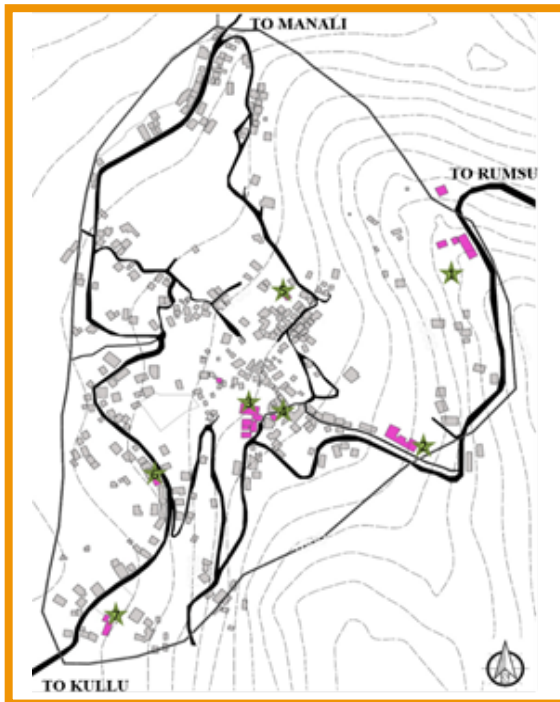


Figure 11 Map showing landmarks



Figure 12 Important landmarks of Naggar

Figure 11 shows the location of various landmarks. In Naggar town Castle, Temples and Museum are prominent cultural and social landmarks shown in Figure 12 Most of these built masses have vernacular touch and maintained nicely by the authorities. Naggar castle is

one of the famous tourist spot and is under conservation. Kath-Kuni architectural style of old Castle building is shown in Figure 13.

7.4 Activity generator



Figure 13 View of Naggar castle

Figure 14 indicates the main activity areas in the settlement. Temples, Castle & Museum acts as a major activity generator throughout the spine. Combination of buildings of different Era of timeline exposed to the different levels of maintenance.

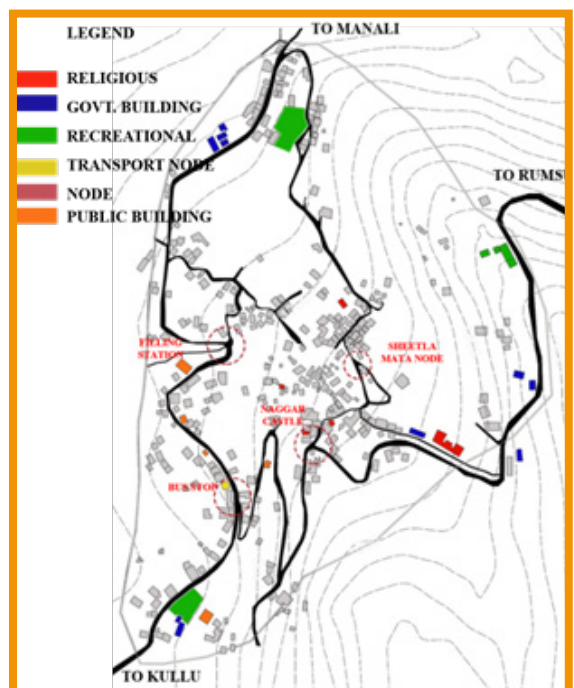


Figure 14 Map showing activity generator

8 Outcomes of the study

The study revealed that the area is highly vulnerable to climatic changes. In the past settlements along Beas river have experienced frequent floods (flash floods due to cloud bursting, excessive rains, excessive melting of glaciers due to heat). Non-implementation of Bye- laws has resulted in the development in the flood plain and made the Bhuntar town a high-risk zone. The flow pattern of the rivers has not been studied and uncontrolled development has resulted in the depletion of the townscape. Violations of building bye-laws, high tourist inflow, main route for supply of apples is resulting in excessive vehicular movement. There are various environment and community challenges of importance that include water supply, forest fire, health and education.

One of the major findings in the study is the fact that old settlements like Naggar still holds a character of a place. This is contrary to the case of Manali where character of place is lost due to the economic push of tourism. Exposure to tourist activities and uncontrolled construction activities have changed the image of the place to some extent which can still be regained. Urbanism and lifestyle of the people is demanding new typology of built masses which needs due consideration while building resilient planning. Land value, sprawl and market forces governing the form, size and shape the development and climatic and environmental issues are left behind. Lack of bye-laws, environmental awareness, and trained professionals is resulting in chaotic development leading to haphazard settlements. Change in the mobility pattern, infrastructure, services and the transformation from rural to an urban character has not been addressed by the urban local bodies. All such issues and concerns need to be integrated while developing resilience strategies for the region.

9 Planning approaches and methods

Naggar is a secluded settlement which rests along narrow road network with beautiful indigenous structures. The structures are constructed with locally available materials like timber, stones and slates which makes them climate responsive and comfortable for harsh winters. The structures are placed along the contours with minimum cut and fill. Slanting and sloping roofs maintain the visual character of the place with similar finishing materials on facades as a construction practice.

On other hand Bhuntar town lacks in maintaining the integrity of the place because of the haphazard construction along the main road network. This place acts as a major transport node for various roads approaching towards destinations like Kullu, Manikaran, Tosh etc. One of major reason of shift from traditional to conventional construction style is the growing need of shops, parking etc due to change in lifestyle and economic concerns. Major portion of Bhuntar town lies on flood plains of river Beas. This not only includes residential areas but few government buildings along the river bank. Most critical infrastructure is the Bhuntar Airport, which tends to face water logging in the rainy season. Till now no proper bye laws have been implemented to overcome the mentioned issues, which makes the place highly vulnerable to floods and climate change.

9.1 Existing resilience measures

The existing resilience measures are centred on traditional architectural styles, land use (avoiding streams and planting trees), and the

value of modern communications. Resilience requires approach complemented by traditional knowledge [13]. Most of the city dwellers were aware about Disaster Management plans but had limited understanding of resilience. Many concerns related to resilience planning are not recognized by the community. Henceforth revealing a need for further awareness and introducing various empowerment schemes for community [2]. There are few organizations like G. B. Pant National Institute, Bath Spa University, UK and Kullu district Government offices already working on improving the resilience awareness in the region. Table 2 indicates few implementation strategies.

10 Hill Settlement Flood Resilience Strategy

10.1 Prevention

The Prevention of flood risk involves the people who are at risk and educating them on minimizing risk collectively. The preventive measures is to minimize the chances of flooding and to reduce its impact. The development in the preidentified flood-prone areas should be strictly discouraged as a preventive measure by both structural and non-structural methods. The structural approach includes the construction of dams, embankments, levees, dikes and diversion channels whereas the non-structural approach is understanding of the hazards of flooding.

10.2 Preparation

The complete elimination of the risks of flooding is improbable and hence strengthening of preparedness to keep the consequences of floods

to a minimum is must. The measures include developing a system of flood warning and forecasting. Flood warning provides guidance in case of future flooding so that the people can take action to reduce the impacts of flooding.

10.3 Response

The flood emergency plan should be prepared and the feasible emergency plan will ease the process of emergency response. The resources and deploying of evacuation plans for the rescue, with minimum impact of flooding is required. These plans are thoroughly rehearsed so that the top to grass level and vice versa approach works seamlessly.

10.4 Recovery

It is the post flood scenario and the recovery of the city from the impacts of floods. This includes loss of human, (emotional and psychological recovery) physical (residential properties, commercial establishments, vital infrastructures), Socio-Economic: social (community) and Economic the financial loss which includes businesses and livelihoods.

Through this the cities, as per requirement are provided better facilities as was available earlier. Subsequently, the recovery measures include reconstruction and/or rebuilding plans of the physical loss. There is an opportunity to improve the city features to make it more resilient to such events in future. During the course of recovery, first, is to make that all the residents resume normal life at the earliest. Second, it is to optimize reconstruction time and reduce it as much as possible.

11 Implementation methodology

S. No.	Proposed Strategies & Recommendation	Supporting Agencies	Mode of Conduct
1	Information and dissemination for various hazards through community-based resilience plans.	Public administration, volunteers of schools and colleges, NSS, and NGOs.	Through public art, Newspaper, and workshops, etc.
2	Constitution of Community Based resilience Committees and Taskforces	District Administration, Members, Local Volunteers etc.	Through community level meetings
3	Capacity Building of Community Members.	District administration, Home Guards, NYKS, Ambulance and NGOs	Through mock drills, trainings and workshops
4	Trainings of public servants in various departments. Trainings for construction of resilient buildings to concerned stakeholders.	Revenue, Health, Police PWD, Private contractors, NGOs and Fire Departments	Trainings and workshops

Table 2 Strategies & recommendations for climate resilient action plan

12 Conclusion

The study concludes vulnerability of Bhuntar, major parts of the region falls under flood plains making it highly prone to floods due to river Beas. The haphazard construction makes the place visually unattractive and unsustainable to deal with the issues of climate change. In order to further develop and maintain the integrity of the place focus should be on the eco-sensitivity of the place. Development approach of Naggar can be replicated on Bhuntar for making the region overcome the issues. In order to be effective, stake holders need to translate such ideas into local development plans and deliver reduced vulnerability and increased resilience to climatic impacts.

The byelaws must be implemented strictly considering the eco-sensitivity of the place. Flood plain areas should be demarcated for the possibilities and impacts related with climatic resilience. Authorities need to prepare and implement Bye laws addressing the various concerns and issues. Along with such measures visual quality of the place must be maintained as this place acts as a major node while approaching famous destinations like Kullu, Manali, and Manikaran. Shift to conventional construction techniques should be minimised and traditional construction style should be encouraged.

13 Way forward

Citizen level awareness and respecting local knowledge is key for improving the climatic resilience in the region. Research findings and knowledge need to be delivered through community participation to residence of these areas. Examples showcasing local knowledge and local DRR development done at the similar locations (Phojal Nalla catchment) in the region should be shared with the authorities for developing resilience plan. Collaboration and coordination among residents, policy makers, and practitioners has to be enhanced to improve climatic resilience in the hill regions. A multidisciplinary, multi-national, and community-based collaborative approach has to be adopted to achieve desired results. International level partnerships and knowledge perspectives to this global challenge will provide opportunities meet the challenges related with climatic resilience in hill areas of Himachal Pradesh. Involvement of non-governmental organizations, academic researchers and common people are right way forward towards building climatic resilient community.

14 References

- Bates, B., Kundzewicz, Z.W., Wu, S., Palutikof, J., Climate Change and Water, Technical Paper. Intergovernmental Panel on Climate Change (IPCC), 2008.
- District Administration, Kullu District, "Disaster Management Plan, Himachal Pradesh.", p.1-234, 2017
- Driessen, P.P.; Hegger, D.L.T.; Bakker, M.H.N.; van Rijswick, H.F.M.W.; Kundzewicz, Z.W., Toward more resilient flood risk governance. Ecology and Society, 2016.
- Gardner, J. S., In Risk Governance: The Articulation of Hazard, Politics and Ecology (ed. Fra Paleo, U.), Springer, London, 2015, pp. 349–371;
- Hewitt, K. and Mehta, M., J. Alpine Res., 2012, 100(1), 1–12; <https://doi.org/10.4000/rga.1653>
- Himachal Pradesh, Vulnerability Atlas, 2009, <https://www.hpsdma.nic.in//admnis>.
- J. Cariolet, M. Vuillet, and Y. Diab, "Mapping urban resilience to disasters – A review," Sustain. Cities Soc., vol. 51, no. July, p. 101746, 2019.
- J. C. Kuniyal, R. Johnson, E. Edwards, Current science, vol. 117, no. 4, 2019
- Lawson, E.; Thorne, C.; Wright, N.; Fenner, R.; Arthur, S.; Lamond, J.; Kilsby, C.; Mant, J.; Smith, L.; Ahilan, S.; et al. Evaluating the Multiple benefits of a Blue-Green Vision for Urban Surface Water Management; UDG Autumn Conference & Exhibition, 2016, Chester, UK.
- National Disaster Management Plan, National Disaster Management Authority, Government of India. 2016.
- P. Rautela, G. C. Joshi, Y. Singh, D. Lang, "World Housing Encyclopedia Housing Report #150 : Timber-reinforced Stone Masonry (Koti Banal Architecture) of Uttarakhand and Himachal Pradesh, Northern India," pp. 1–16, 2008.
- Rebaï, Nasser. Vélez, Julio A. Alvarado, Trajectories of Vulnerability of Rural Territories in the Ecuadorian Andes: a Comparative Analysis. Revue de géographie alpine. 2018. DOI: 10.4000/rga.4969

Sendai Framework for disaster risk reduction
2015–2030. United Nations Office for
Disaster Risk Reduction [UNISDR], Geneva,
2015.

Wilby, R.L., Keenan, R., Adapting to flood risk
under climate change. *Progress in Physical
Geography* 36, 348-378, 2012.