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Author: Joshi, Neelakshi

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Caught Between a Rock and a Hard Place: Formal and Informal Urban Risk Knowledge in the Uttarakhand Himalayas

Neelakshi Joshi
joshi2@ualberta.ca
Leibniz Institute of Ecological Urban and Regional Development (IOER), Weberplatz 1, 01217 Dresden, Germany
Dresden Leibniz Graduate School, TU Dresden, August-Bebel-Str. 30, 01219 Dresden, Germany

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The mountainous state of Uttarakhand in the Indian Himalayas is experiencing population growth and undergoing a process of rapid urbanization. This is causing concern, because the Uttarakhand Himalayas are exposed to multiple natural hazards and are vulnerable to climate change extremes. Mountain municipalities in Uttarakhand are typically small and lack the human and financial resources to address risk in the rapidly emerging built form. This article takes stock of the current risk knowledge among formal and informal actors involved in the urban development process. It does this through document analysis, 150 household surveys, and 24 key informant interviews in the small but rapidly urbanizing town of Almora. Results indicate that formal knowledge, encoded in building bylaws and land use plans, do not sufficiently address risk and are not adopted by households. In practice, households rely largely on informal building professionals in determining their developmental decisions. However, informal building professionals lack the training and skills to address risk in the built form. This article makes a case for acknowledging informal building professionals and practices and provides recommendations for consolidating them in the developmental process through training and education.

Keywords: *risk knowledge; risk education; informality; Uttarakhand Himalayas; built form; urban.*

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Urban development in Uttarakhand Himalayas: an introduction

Globally, urbanization is known to bring access to services, education, healthcare, and economic prosperity (United Nations 2019). However, in the mountainous state of Uttarakhand in the Indian Himalayas, rapid urbanization is causing concern for 2 reasons.

First, urbanization is unfolding in a region that experiences multiple natural hazards, like earthquakes and landslides (BMTPC 2006). Climate change is complicating this problem. The region is experiencing a rise in mean temperatures and changes in precipitation patterns (Kohler et al 2014). Urban centers in Uttarakhand are highly vulnerable to the twin problems of disaster risks and climate change impacts (Government of Uttarakhand 2014).

The second cause of concern is the nature of the urbanization, which is inherently unregulated and unplanned (Tiwari and Joshi 2012; Tiwari et al 2018; Joshi 2019). Uttarakhand is undergoing a wave of urbanization driven by urban pull factors, like better access to education, employment, and healthcare services (Singh 1995; Singh and Sharma 2014), and push factors from rural areas, like limitations on subsistence farming aggravated by climate change (Tiwari et al 2018). The high pressure of urbanization has increased land prices, as well as unlocking unsafe areas for habitation (Anbalagan 1993; Rautela 2005; Hewitt and Mehta 2012; Tiwari and Joshi 2020).

Within the Indian urban development context, municipalities are identified as key actors at the local level to ensure that the urban development process addresses risk reduction (Ministry of Urban Development 2015). However, municipalities in the mountain areas of Uttarakhand are typically small and are severely constrained by financial and human resources (Sharma 2001; Hewitt and Mehta 2012; Joshi 2019). Furthermore, rapid urbanization has overwhelmed the existing capacity of municipalities as they struggle to provide even basic services like water and sanitation, leaving limited time and energy to regulate urban development and its associated risks (Rautela 2005; Tiwari and Joshi 2012; Joshi 2019).

The concept of risk governance (Tierney 2012; Renn and Klinke 2013) provides a useful entry point to re-evaluate the urban development process and its associated risks in the Uttarakhand Himalayas. Risk governance acknowledges that the powers and functions of disaster risk reduction, formerly understood to be the responsibility of government agencies, are shared among a diverse set of private and civil society members (Tierney 2012). This is particularly useful in the developmental context of the Uttarakhand Himalayas, where the limited capacity of the municipality prompts an exploration of all-of-society engagement to address risk.

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However, opening the concept of risk governance to multiple societal actors requires us to acknowledge that different actors bring varied conceptualizations and knowledge of risk. These include top-down scientific knowledge represented in municipal building regulations and bottom-up local knowledge embedded in contemporary development practices (Halvorson and Hamilton 2007; Gaillard and Mercer 2012). Existing research on urban risks emerging from Uttarakhand has largely focused on formal actors like the municipality and recommended improvement in building regulations and land use plans (Rautela 2005; Kumar and Pushplata 2013). However, in the urban development context of low- and middle-income countries like India, where informality is dominant in the urban development process (Roy 2005, 2009), focusing solely on formal actors like the municipality may leave out a large set of informal actors. These informal actors actively contribute to the urban development process and bring varied forms of risk knowledge to the table (Leck and Roberts 2015; Bhan 2019).

A deeper understanding of the multiple risk governance actors and the varied forms of knowledge they possess provides a platform upon which the broader concept of risk governance can develop. This article has 2 main objectives in this regard: (1) to develop a vocabulary for risk knowledge, positioning it within the current academic paradigm of risk governance, and (2) to illustrate the multiplicities of risk knowledge through a case study of the small but rapidly urbanizing town of Almora in the Uttarakhand Himalayas. This is done by taking stock of the existing formal risk knowledge possessed by the municipality and codified in land use regulations and building bylaws and comparing it with the prevalent practice of urban development unfolding in the town. Informal building professionals emerge as a dominant group driving the urban development process, albeit without access to formal forms of risk knowledge. The article concludes by making a case for the acknowledgment and consolidation of informal building professionals into the urban development process through training and education.

Risk governance and knowledge

Risk reduction scholarship has steadily moved from the top-down paradigm of risk management to an inclusive model of risk governance (Link and Stötter 2015). Risk governance pertains to the many ways in which multiple actors, individuals, and public and private institutions deal with risk (Renn and Klinke 2013). These include municipalities, nongovernmental organizations, building professionals, individuals, and community-based organizations. The idea of risk governance is echoed in the Sendai Framework and is described by the United Nations Office for Disaster Risk Reduction (UNISDR 2015: 23) as follows:

> *While States have the overall responsibility for reducing disaster risk, it is a shared responsibility between Governments and relevant stakeholders. In particular, non-State stakeholders play an important role as enablers in providing support to States, in accordance with national policies, laws and regulations, in the implementation of the present Framework at local, national, regional and global levels. Their commitment, goodwill, knowledge, experience and resources will be required.*

A renewed understanding of risk governance requires new ways of comprehending risk knowledge. The risk governance framework proposes step-by-step discussions and negotiations among risk actors to address the pluralities of risk knowledge (Renn and Klinke 2013). However, attempts must be made to understand the risk knowledge that actors prepossess and the source of this knowledge. Literature suggests that diverse risk actors bring in varied risk knowledge and sometimes conflicting priorities for addressing risk (Gaillard and Mercer 2012; Murray 2017). Understanding the roots of risk knowledge possessed by actors is an important entry point toward understanding their knowledge contributions toward risk governance.

Risk knowledge is defined as information and/or skills to address disaster risk acquired through education and experience (Gaillard and Mercer 2012). Scholars classify risk knowledge into 2 categories: top-down scientific knowledge and bottom-up local knowledge (Wyanne 1996; Mercer 2011). Risk knowledge encoded in land use plans and building bylaws is an example of top-down scientific knowledge, whereas vernacular knowledge embedded in local building practices represents bottom-up risk knowledge. Gaillard and Mercer (2012) warn that this binary presents problems, because top-down scientific knowledge might be disconnected from the lived social realities of people. Furthermore, bottom-up local knowledge might be overly romanticized and, in some cases, even exacerbate vulnerabilities (Gaillard and Mercer 2012). The idiom of coproduction offers an inclusionary definition and proposes that knowledge is a sum of "social practices, identities, norms, conventions, discourses, instruments, and institutions" (Jasanoff 2004: 3). To realize a functioning model of risk governance, we first need to understand multiple forms of risk knowledge and explore ways of coproducing it.

Research emerging from Himalayan urban centers is critical of the nature and quality of top-down risk knowledge represented in land use and building regulations, because it does not sufficiently address the local geographical, geological, climatic, and social development contexts (Kumar and Pushplata 2013; Masson 2015). Guidelines and recommendations to streamline local land use plans and building regulation to address disaster risk are typically the outcome of this research (Rautela 2005; Kumar and Pushplata 2013; World Bank 2015). Furthermore, most research on risks emerges from larger urban centers or state capitals. Most mountain municipalities are small and lack the human and financial resources to formulate and implement these plans (Rumbach 2016; Joshi 2019). Under such circumstances, alternative ways for the local municipality to address risk, within the means and resources that it has, remain largely unexplored.

Vernacular knowledge embedded in local building practices represents bottom-up risk knowledge. The traditional built form in the Himalayas presents a rich tapestry of indigenous knowledge on addressing natural hazards (Shankar 2014). This includes protecting against landslides by locating habitation sites on high ground and avoiding landslide-prone areas (Sudmeier-Rieux 2011; Rautela 2015). Earthquake safety is addressed by providing 60- to 90-cm-thick walls and by reducing opening sizes (Rautela 2015). Drainage is another important component in the equation and uses an intricate web of channels, both

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natural and artificial, to safely drain habitation areas. However, these studies draw examples from rural settlements built several centuries ago. Rural areas have not gone through massive waves of transformation like their urban counterparts and hence do not have the same stresses on land and resources.

Contemporary studies emerging from Himalayan cities have begun to indicate a shift toward modern construction practices. These include a rapid transition from traditional stone construction to reinforced cement concrete and brick construction (Kumar and Pushplata 2013; Anhorn et al 2015; Rumbach and Németh 2018; Joshi 2019). A large portion of contemporary construction does not take into account the seismic vulnerability of the Himalayas (Rautela 2010). Furthermore, working with reinforced cement concrete, an engineered material, requires specific training to which the building practitioners in mountain communities often do not have access (Joshi 2019). The shift from vernacular construction practices to contemporary construction practices without the transfer of risk knowledge is captured in the concept of "erosion of seismic culture" (Halvorson and Hamilton 2007: 326), which attributes it to 4 factors:

- Diminishing levels of local hazard knowledge;
- Demographic shifts;
- Gendered livelihood transformations;
- Lack of public access to information.

With limited access to applicable top-down risk knowledge and rapid changes in vernacular knowledge, what risk knowledge drives risk governance in Himalayan cities? I explore this question by including informal actors and informal knowledge in the equation. Informality includes actors and institutions beyond the regulatory boundaries of the state (Roy 2005; Watson 2009; Caldeira 2017). Research emerging from low- and middle-income countries indicates a dominant presence of informal actors and informal practices in the urban development and risk governance process (Dodman et al 2013; Murray 2017). However, numerous studies focus on formal actors, municipalities and disaster reduction agencies, overseeing the role and nature of the participation of informal actors (Murray 2017). This inclusion is particularly relevant to small- and medium-sized mountain towns in the Himalayas, where limited knowledge generation capacity among formal actors like the municipality may provide a point of entry for informal actors. The next section elaborates upon the methods of data collection and analysis undertaken for this research.

Methods

A case study method is appropriate to study a "contemporary phenomenon embedded in a real life context" (Yin 2015: 16). It is particularly relevant for urban risk studies, given their localized and place-specific nature (Fraser 2014). For example, a case study approach has been adopted in studying earthquake resilience in the Himalayas by bringing forth the local-level conceptualization of resilience and challenges in realizing it (Sudmeier-Rieux 2011; Anhorn et al 2015). This article adopts a case study approach to explore formal and informal risk knowledge in the real-life context of a rapidly urbanizing mountain town. To select a case to study, I considered the following: location in a mountainous setting (>600 masl), representative population size (less than 50,000), trends in urban population growth, and an absent or weak urban planning mechanism. Among 39 mountainous urban centers in Uttarakhand, the rapidly urbanizing town of Almora was chosen as a representative case because of its population growth and the absence of a formal land use plan.

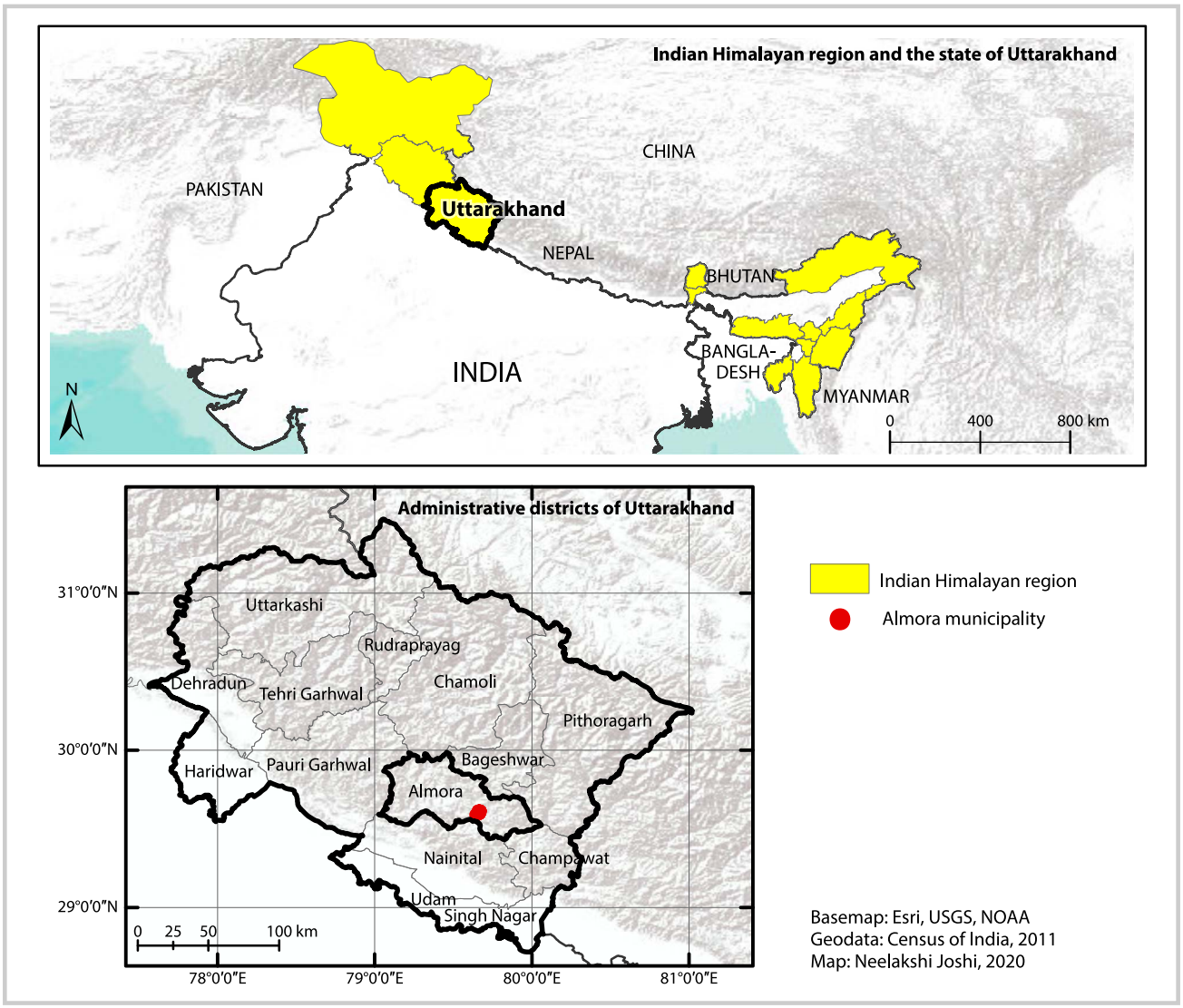
Almora is located at an average altitude of 1651 masl along a horseshoe-shaped ridge. The municipal boundaries extend between 29°05′16″N to 29°17′28″N and 79°24′07″E to 79°37′05″E, encompassing an area of 7.27 km^2 (Rawat et al 2013). The current population within the municipal boundary is 34,122 people living in 8014 household units (Census of India 2011). The steady increase in population in Almora is attributed to both internal growth and in-migration from surrounding villages, because the town provides better access to education, healthcare, and employment (Sah and Pande 1987; Kumar and Rawat 1996). A study mapping land use and land cover change between 1990 and 2010 indicates that the built up area in Almora increased from 2.3 km^2 in 1990 to 4.34 km^2 in 2010 (Rawat et al 2013). Much of this increase is attributed to increases in the number of houses to accommodate a growing urban population (Rawat et al 2013). A preliminary study (Joshi 2019) revealed that among mountain urban centers in Uttarakhand, Almora was the most populous one without a land use map, making it an appropriate choice for this study. Figure 1 shows the location of the state of Uttarakhand and the town of Almora, and Figure 2 illustrates the urban built environment in a neighborhood of Almora.

Because the objective of the study was to compare top-down formal and bottom-up informal forms of risk knowledge, a 3-step data collection and analysis process was adopted. First, top-down knowledge was collected through statutory documents available in the public domain. These included the land use plan and building bylaws collected from Almora municipality. These were compared with state guidelines (Government of Uttarakhand 2016) and national guidelines (Ministry of Urban Development 2015) to address risk in the built environment. International manuals for development in urban areas were also reviewed (Olshansky 1996; World Bank 2015). Local-level municipal documents were compared with state and national guidelines to identify the extent to which these were realized in local-level planning. Following the document analysis, semistructured key informant interviews were conducted at the local municipal level and state level to fill gaps in knowledge and develop a deeper understanding of the documents and their implementation status. The interviewees included municipal employees working in urban development, state-level town planners, disaster mitigation experts, and academics working in the field. A total of 15 interviews were conducted for this research. Interview data were manually coded to identify challenges in framing and implementing developmental regulations.

Second, to understand the nature and source of bottom-up knowledge, a survey of 150 urban households in Almora was conducted. Houses were purposively selected if they met one or more of the following unsafe conditions identified by the District Disaster Management Authority of Almora (DDMA 2017):

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FIGURE 1 Location of study area. (Map by Neelakshi Joshi)



- Located on a steep slope (>30°);
- No or poor earthquake safety measures;
- No or weak retaining or toe wall;
- Built or encroaching upon an existing drainage network;
- Situated in known landslide-prone areas.

Surveys were directed at homeowners who were actively involved in making developmental choices. The survey consisted of questions on developmental choices available to households in terms of land selection and building construction and on sources of associated risk knowledge. Households were also asked to identify the building professionals involved in the construction of their houses. The survey was concluded once a saturation of answers was achieved.

The third and final stage of data collection was through semistructured interviews with building professionals involved in construction of 1 or more of the surveyed households. A total of 25 building professionals were contacted, of whom 9 agreed to be interviewed. The initial plan was to interview formal building professionals (ie architects and engineers); however, it became clear during the household surveys that most households worked directly with informal building professionals like contractors and masons during the construction of their houses. The term "informal" is used to classify contractors and masons, because state-level guidelines explicitly state that construction in Uttarakhand must be led by a licensed architect or engineer (Government of Uttarakhand 2016). Hence, the research design was expanded to include contactors and masons. Building professionals were asked questions about their knowledge of building regulations, using the house that they had built as a reference. Their answers were compared with local-level guidelines. Figure 3 maps the formal and informal institutions and actors whose risk knowledge was analyzed for this study.

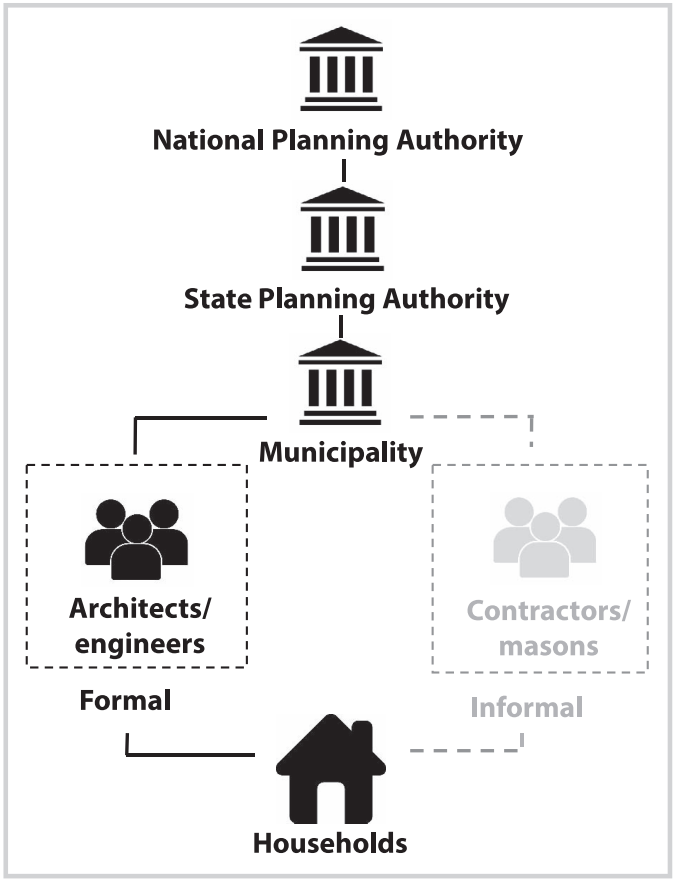
Preliminary data for the project was collected in February 2016, and the interviews and survey took place between February and April 2017 in Almora and Dehradun (the state capital of Uttarakhand, India, and the seat of the state-level planning authority). Results of this 3-step data collection and analysis are presented in the next section.

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FIGURE 2 Urban built environment in Almora. (Photo by Neelakshi Joshi)



FIGURE 3 Formal and informal knowledge sources: a diagrammatic representation.



Formal and informal risk knowledge

Municipal land use plans and municipal bylaws

The national-level guidelines for municipal land use plan preparation in India (Ministry of Urban Development 2015) recommend the inclusion of the following aspects in mountain areas:

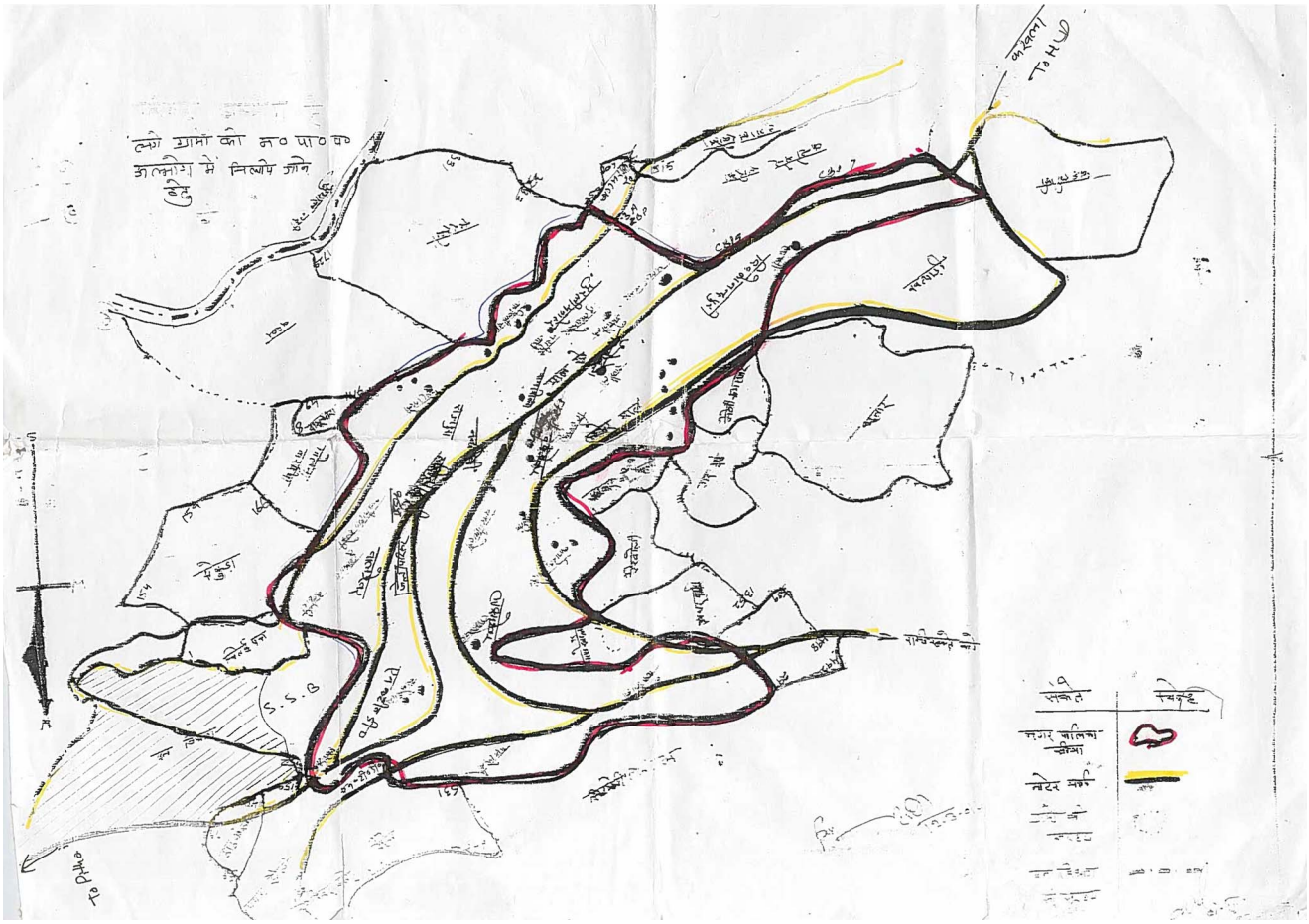
- Type of rock;
- Nature of soil strata;
- Estimation of sheer parameters;
- Drainage pattern;
- Slip zones, if any.

States are expected to elaborate upon these guidelines, given their geographical peculiarities. However, at the time of this research, the State of Uttarakhand's Town and Country Planning Department (TCPO) did not have guidelines in place for land use plan development in mountain areas. Furthermore, of the 39 mountain urban centers in the state, only 3 had valid land use maps (UHUDA 2018). The 3 existing land use maps provided multiple land classifications (residential, commercial, institutional, and green spaces) and density classifications (high, medium, and low). However, these land use maps did not provide information on microlevel hazard zonation, which is critical for homeowners making developmental choices (World Bank 2015). In addition, the plans do not comply with national-level guidelines for risk reduction for mountain urban areas. An interview at the TCPO attributed these gaps to lack of human resources:

Across local bodies there is no planning capacity. TCPO needs to strengthen itself. There are no town planners in the department. Staff strength is limited. This gets reflected in the output. There is no support

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FIGURE 4 Ad hoc land use map, Almora. (Photo by Neelakshi Joshi)



staff. There is only one town planner in the Kumaon region [eastern part of Uttarakhand where Almora is located]. He has administrative responsibility. He has several other things to look into. So, there is no team to make these [plans].

(*TCPO employee, personal communication, 17 April 2017*)

The gaps in capacity to create land use plans at the state level are reflected at the local level in Almora. Until April 2017, when this research was conducted, the Almora municipality did not have an official land use plan. In lieu, it was working with an ad hoc plan (Figure 4). The ad hoc plan indicated major roads and approximate neighborhood boundaries. However, this plan did not indicate any aspect of risk prescribed in the national-level guidelines. In the absence of a formal land use plan indicating risk areas, the municipality issues building permissions, positioning the potential building site on the ad hoc plan with a dot. The absence of a land use map indicates a critical gap in the formal risk knowledge possessed and disseminated by the local municipality.

With respect to building regulations, there are well-developed guidelines pertaining to mountain areas at the national level (Ministry of Urban Development 2016), as well as the state level in Uttarakhand (Government of Uttarakhand 2016). These serve as a framework for local municipalities like Almora to frame context-specific, legally binding building regulations. However, an analysis of Almora's building bylaws (Government of Uttarakhand 2015) revealed that despite being a mountain town, the bylaws did not have clear specifications for siting a building or for the construction of retaining walls. Earthquake safety measures were only partially discussed. Furthermore, no clear clause was included for a follow-up and compliance mechanism. Penalties were listed, but the amount was very low (INR 1000/ ~US$ 13.5). Building bylaws thus existed but failed to provide context-specific risk knowledge to potential homeowners or building professionals.

Table 1 summarizes the formal sources of risk knowledge and indicates the absence of critical land use planning regulations at the state and local levels. Absence of land use plans and guidelines and non-context-specific building regulations indicate gaps in the top-down dissemination of knowledge.

Household-level risk knowledge

Given the limited risk information communicated through the municipal land use plan and bylaws, it was important to know what risk knowledge households had and how they accessed this knowledge. This section discusses the household responses to 2 open-ended questions:

- How did you establish the safety of your land for construction?
- How have you addressed disaster risk in your building?

Figure 5 presents a compilation of answers coded into categories based on household-level responses. Most

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TABLE 1 Regulation framework for land use and building construction from national to local levels.

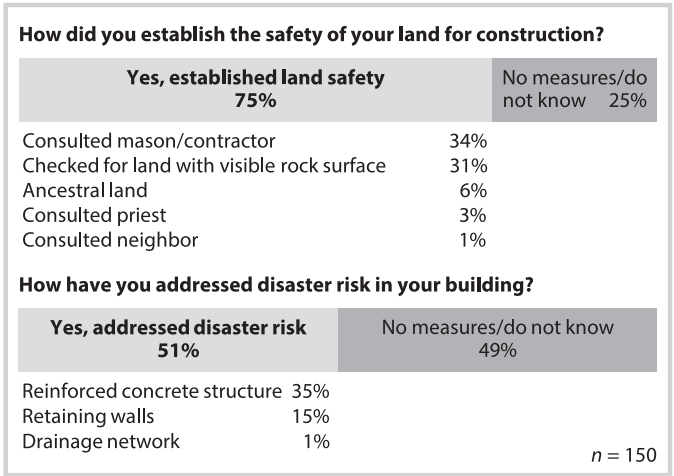
Framework	National (India)	State (Uttarakhand)	Local (Almora)
Urban land use regulation/guidelines	Urban and Regional Development Plans Formulation and Implementation Guidelines (Ministry of Urban Development 2015)	Nonexistent	Nonexistent
Building code	Model Building Bye-Laws, 2016 (national building code; Ministry of Urban Development 2016)	Uttarakhand Building Bye-Laws and Regulations—2011 (Amendment 2016) (Government of Uttarakhand 2016)	Almora Municipal Byelaws (building bylaws; Government of Uttarakhand 2015)

households sought land safety information from their building professionals (identified as contractors or masons). Furthermore, methods identified for establishing land safety varied from the ones set by the national-level standards (described earlier). There was great reliance on self-knowledge or the knowledge of priests and neighbors. The presence of a rocky base, known as *dal* in the local language, was often deemed a sufficient condition for establishing land stability. With no land use maps to indicate safe and unsafe areas or no requirement in the local building bylaws to conduct site analysis before construction, having a rocky base was an accepted rule of thumb for a large percentage of surveyed households.

In terms of addressing risk in buildings, building houses with reinforced cement concrete was mostly considered sufficient to ensure safety. Because reinforced concrete is an engineered building material, households relied on the skills and expertise of their building professionals to build with this material. However, although the use of reinforced cement concrete is prescribed in national and state guidelines, it is an engineered material that requires training and precision to achieve its desired strength (NICEE 2004). A smaller percentage of households considered measures like building retaining walls and providing site drainage to be important ways of addressing disaster risk.

Finally, when asked to identify the primary building professional involved in the construction of their houses, 93% of the surveyed households pointed toward masons and contractors. Similar trends have been observed in the mountainous town of Darjeeling in West Bengal, India (Rumbach and Németh 2018).

FIGURE 5 Household-level risk knowledge with regard to site safety and building construction.



Risk knowledge among building professionals

Because numerous households depended on building professionals when making developmental choices, rather than on municipal documents, it was important to know who these building professionals were and what risk knowledge they possessed. Building professionals in the context of Almora are a large and diverse group. A broad categorization of formal and informal building professionals is used in this article.

Formal building professionals, like architects and engineers, possessed a professional license, were registered at the local municipality, and had legal contracts with their clients. This ensured that in case of a liability, the households could hold the building professional accountable. Furthermore, they had access to the risk knowledge in national, state, and local land use plans and building regulations. Of the 9 building professionals interviewed for this research, 2 were qualified as formal building professionals.

Informal building professionals, like contractors and masons, did not have formal training or formal contracts with their clients. They derived their knowledge from experience on construction sites. Although the municipal bylaws indicated that households should only employ registered building professionals, there were no explicit penalties if the households chose to do otherwise. Interviews with informal building professionals revealed that they were not aware of national- or state-level developmental guidelines. Furthermore, they followed building bylaws to obtain approval of their plans by the municipality but then built as per their sensibilities.

The difference between formal and informal risk knowledge is captured in this example:

> *Few structures are engineered and around 99% contractors are masons. They take decisions based on convenience not structural design; for example, a contractor asked for the beam size to be reduced as he did not have shuttering material. Size is not related to structural design. Sometimes the owner also sides with the contractor.*
>
> (*local civil engineer, personal communication, 2 March 2017*)

Dissonance in vernacular building practices was also evident among informal building professionals. Among the 7 informal building professional interviewed, only 1 was a local mason who had learned his craft in the mountain areas. However, he no longer built with local stone and wood, because they were not in demand. Other masons were out-

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of-state migrants from plains areas, where reinforced cement concrete and brick are mainly used. They had learned to work with reinforced cement concrete, an engineered material, directly on construction sites and in designing structures followed rules of thumb rather than load or seismic calculations. With an increased demand for modern construction practices in mountain areas, they had found seasonal work in Almora. However, they were not trained to address mountain peculiarities like slope, drainage, landslides, and earthquakes, nor had they found opportunities to do so. Thus, there was a diminishing level of vernacular skill transfer and quick adoption of engineered material through onsite learning.

Conclusion, recommendations, and areas for future research

Urban communities in the Indian Himalayas are undergoing a rapid urban transformation. This article investigated how a formal institutions face multiple challenges in creating and providing risk-sensitive knowledge through land use and building regulations. The findings are illustrated through a case study of the small but rapidly urbanizing town of Almora in the Himalayan state of Uttarakhand. Although research exists on improving the nature and quality of developmental controls, an understanding of who has access to formal knowledge, and to what extent, needs further exploration. Through the case study of Almora, this article highlighted the dominant role played by building professionals in addressing risk in the urban development process. However, because building professionals are largely informal, they do not have access to formal knowledge or training to address risk in the built form. This article also highlights a departure from vernacular forms of risk reduction practices, particularly in the context of rapid mountain urbanization. Although building professionals could potentially be strong partners in cogoverning risk in mountain urban areas, supplementing municipal capacity, their lack of training and education in addressing risks acts as a barrier to the process.

To bridge the large gap in risk knowledge at the local level, this research recommends building on the concept of consolidation borrowed from southern planning theory (Bhan 2019). Consolidation involves first recognizing and acknowledging that a large segment of building professionals in the Global South are informal. Second, it advocates against policing and removing informal professionals; rather, it involves exploring ways of meaningfully including them and their skills in the urban development process. Cues can be drawn from the Uttarakhand State Disaster Management Authority (USDMA), which has made a headway in training and certifying masons for earthquake-resistant design in rural areas. USDMA has trained around 1400 masons and constructed 52 demonstration units (USDMA 2018). Similar projects of skill development and improvement can be attempted at the local urban level in Almora. Furthermore, information about certified building professionals must be provided to the households when they submit their building application to the municipality. This 2-pronged approach will ensure that informal building professionals will upgrade their skills and increase their employability by potential homeowners. Initially, the municipality should also consider providing house tax rebates as incentives for those who employ trained building professionals.

As the Himalayas prepare for an urban future, it is important to equip municipalities, building professionals, and residents with new skills and knowledge to address the challenges ahead. This article identifies 3 areas for future research in this direction. First, the interrelationship among formal, vernacular, and informal risk knowledge needs further exploration. The urban development context of the Indian Himalayas provides an interesting context for this study, given the fast pace of urbanization and rapid changes in developmental practices. Second, as Himalayan cities grow beyond their formal municipal boundaries (Rumbach and Follingstad 2019), areas beyond the city boundaries, the periurban areas and villages, are equally important sites of enquiry for access to and the nature of risk knowledge. Finally, methods of integrating top-down knowledge and bottom-up experimentation are needed to blur the rigid boundaries of formal and informal knowledge to cocreate a sustainable urban future.

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