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Progress on integrating climate change adaptation and disaster risk reduction for sustainable development pathways in South Asia: Evidence from six research projects

Reinmar Seidler[a,*], Katie Dietrich[b], Sarah Schweizer[b], Kamaljit S. Bawa[a], Shashikant Chopde[c], Farrukh Zaman[d], Anshu Sharma[e], Sumana Bhattacharya[f], Laxmi P. Devkota[g], Sarala Khaling[h]

[a] Department of Biology, University of Massachusetts Boston, 100 Morrissey Blvd., Boston, MA 02125, USA
[b] START International Inc., 2000 Florida Ave NW Suite 200, Washington, D.C. 20008, USA
[c] Institute for Social and Environmental Transition, 948 North Street 7, Boulder, CO 80304, USA
[d] World Wide Fund for Nature-Pakistan, 46/K, Block 6, PECHS, Karachi, Pakistan
[e] SEEDS Technical Services, 15-A, Institutional Area, RK Puram, New Delhi, India
[f] Intercooperation Social Development India, Delhi Office, ISS Building, 8, Nelson Mandela Marg, New Delhi 110070, India
[g] Nepal Development Research Institute, Shree Durbar Tole, Pulchowk, Lalitpur 8975, EPC 2201 Kathmandu, Nepal
[h] Ashoka Trust for Research in Ecology and the Environment, Khangsar Villa, Development Area, Gangtok 737101, Sikkim, India

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ABSTRACT

Due to natural vulnerabilities and human factors, losses and damages from natural disasters continue to rise in South Asia. There is also growing evidence for links between climate change and disaster risks. In response, there have been calls for bringing together climate change adaptation (CCA) and disaster risk reduction (DRR) policy development, in order to address the risks efficiently and to promote sustainable development pathways. However, progress toward such convergence in the policy arena has been uneven. We report on a group of six research projects awarded in three countries of South Asia to examine progress, research needs and potential mechanisms for improving implementation of CCA and DRR. Some significant localized improvements in CCA-DRR were generated, primarily through facilitating communication across administrative scales and with local communities. We observed a common tendency toward weak institutional coordination between agencies charged with disaster response and those charged with climate change planning (as well as development planning more broadly). The idea that sustainable development requires addressing combined natural and anthropogenic hazards does not yet appear to have penetrated to the institutional levels where disaster response planning commonly takes place. We close by identifying further knowledge needs and proposing recommendations for steps toward convergence of disaster risk reduction and climate change adaptation.

1. Introduction

By virtually any measure—whether in terms of number of events, lives lost, people affected or financial impacts—the global incidence and severity of natural disasters has been rising over the last decade or more [9,20]. The incidence rate of major natural hazards is distributed unevenly across the globe, depending upon geography, geology, history and other independent variables. Countries in Asia and the Pacific are four times more likely than those in Africa, and 25 times more likely than those in Europe or North America, to experience disasters [53]. Due partly to its strong seasonal monsoon pattern, the South Asian subcontinent is particularly prone to weather-related disasters including floods, cyclones, landslides, droughts and heat waves. The frequency and severity of such events are expected to increase significantly with climate change. Impacts will be felt both directly and through interactions with other drivers and stressors in coupled human-natural systems, including unplanned urbanization, high rates of population growth, persistent poverty, loss of critical environmental services, and land degradation. In addition to rapid-onset disasters, slow-onset crises—many linked to shifts in drought frequency and rainfall characteristics, interacting with widespread degradation of the natural resource base—further compound vulnerability to disasters. In 2012,

* Corresponding author.
E-mail addresses: reinmar.seidler@gmail.com (R. Seidler), kdietrich@start.org (K. Dietrich), sschweizer@start.org (S. Schweizer), kamal.bawa@gmail.com (K.S. Bawa), schopde@i-s-e-t.org (S. Chopde), fzaman@wwf.org.pk (F. Zaman), anshu@saferworld.in (A. Sharma), sumana.bhattacharya@intercooperation.org.in (S. Bhattacharya), lpdevkota@ndri.org.np (L.P. Devkota), sarala.khaling@atree.org (S. Khaling).

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UNISDR estimated that between 1971 and 2009, disasters affected over 2 billion people and caused over 800,000 deaths across the region, at a cost of $80 billion (UNISDR, 2012). Over the decade 2005–2015, a total of 481 disaster events were reported in South Asia, claiming 135,000 lives and heavy economic losses [5].

1.1. Convergence

Growing evidence for tight linkages between climate changes and increasing disaster risks presents fundamental challenges to sustainable development and poverty reduction in South Asia. A coalition of international development organizations pointed to the unavoidably cross-scalar and cross-sectoral nature of disaster reduction planning when they declared that "Development is never disaster neutral; it creates, exacerbates or reduces risk … Disaster risk reduction is a development issue. Making risk reduction a central component of the future development agenda is the only way to ensure that disasters do not derail development itself" [23]. This broad intersection of development with disaster risks is why effective planning absolutely must involve a wide range of government departments and agencies. Indeed, there have been numerous calls for CCA-DRR 'convergence' (e.g. [15,24,25,32,35,46]).

As yet, however, there have been few reports of successful integration of climate concepts into development planning or disaster risk policies, and on the ground, CCA and DRR frameworks have continued to evolve in isolation [11,17,34,38]. A 2012 special report by the IPCC emphasized the inherent interdependencies of CCA and DRR [20], and the most recent IPCC [21] describes DRR and CCA approaches as 'overlapping' and offering 'co-benefits' (pp. 26–27). However, the 2013 UNISDR report on national-level progress in implementing the Hyogo Framework's recommended DRR strategies warned that "nearly all countries reported having difficulty inserting climate change adaptation measures into national [DRR] policies" ([47] p. 8). The new Sendai Framework of 2016 is largely silent on convergence, though it recommends "Addressing climate change as one of the drivers of disaster risk" ([50] p. 11). A separate UNISDR declaration, however, calls more explicitly for 'coherence and mutual reinforcement' between the Sendai DRR strategies and national climate-adaptive initiatives [49]. The challenge inherent in implementing these calls is the theme of this paper.

1.2. Definitions

There has been some controversy about what exactly is meant by convergence, and whether disaster reduction, or climate adaptation—or neither—should take precedence in the process of converging [7,10,29]. How convergence relates to allied concepts such as *linkage* (UNISDR 2008 [3,38]), *integration* [3,6,17], *nexus* [17], *interface* [22] or *mainstreaming* [19,26,39] are other areas in which authors have taken contrasting positions [8,18,31]. There is no clearly defined or differentiated taxonomy here—nor, perhaps, does there need to be, since in every case on the ground, the particular pathway to successful implementation depends heavily on context.

Here, we treat 'convergence' as the process of bringing the imperatives, knowledge and practices of CCA together with those of DRR *in the policy arena*, so that the goals and targets of each endeavor are informed by those of the other. In essence, convergence demands that we *do no planning* for disaster management *without* taking into account the most up-to-date knowledge available on likely future impacts of climate change within the relevant political-administrative unit or landscape. Conversely, any policy designed to promote climate-adaptive activities should be coordinated with disaster reduction and management policies in order to minimize potential conflicts. We favor the term 'convergence' for its appropriately dynamic connotation: convergence is the result of bringing two or more ongoing streams or processes together, so that they merge or continue in parallel. The respective administrative apparatuses and policy streams of DRR and CCA conventionally proceed separately. This paper provides evidence for the need to guide the two onto converging trajectories.

1.3. Implementation

If the concept of CCA and DRR convergence is to become more than a normative statement of intent, an evidence-base in specific contexts needs to be rapidly built up. Convergence will often require significant changes in administrative frameworks: meaningful community participation in planning needs to be facilitated; technological and participatory approaches for capacity building need to be integrated; and coordination of governance at multiple levels need to be strengthened so that existing convergence-friendly policy directives are implemented on the ground. In order to better understand these issues, the Climate and Development Knowledge Network (CDKN) and START awarded six interdisciplinary research projects to pursue the challenge of integrating CCA and DRR into resilient development in India, Nepal, and Pakistan. These six projects were implemented between 2012 and 2014, and culminated in a general meeting in Delhi. The illustrative examples in this paper derive from this body of research.

This paper is structured along the following lines: First, we briefly introduce the research sites and socio-economic contexts (Section 2). We then examine lessons learned about CCA-DRR convergence using examples and conclusions from the six projects (factors *facilitating* convergence in Section 3; common *constraints* to convergence in Section 4). We conclude with a final section on research needs and future directions for policy makers, civil society and the research community to support further steps toward CCA-DRR convergence in South Asia.

2. Research sites

The six research projects were located in a wide variety of biophysical and administrative environments in South Asia (see Table 1). These included coastal sites (eastern Odisha state), riverine floodplains (Gorakhpur), hot and cold deserts (Barmer and Leh), monsoon-affected montane regions (Darjeeling/Sikkim), semi-arid coastal plains (Sindh, Pakistan) and a major Himalayan watershed (Koshi River, Nepal). Focal administrative units ranged in extent from single villages (Sobara village in Odisha) to districts (Darjeeling, North Sikkim and Gorakhpur) to ecoregions (coastal Odisha and Koshi watershed) and entire provinces (Sindh, Pakistan).

Activities and engagements were similarly diverse, both in kind and in scale. Table 2 summarizes each project's problem analyses (diagnoses), research methods and approaches employed, specific implementation challenges faced, and results and outcomes communicated. Problem diagnoses, methods and approaches were developed and the work was performed independently by the respective research groups; challenges faced, results and outcomes were communicated by them and were subjected to questioning, analysis and refinement in the *post hoc* group meeting.

In the sections that follow, we discuss these experiences in detail, contextualizing them with reference to the wider literature.

3. Institutional and community linkages for convergence

The most obvious obstacles to CCA-DRR convergence are organizational and administrative. Disaster management and climate analysis have historically been the purview of quite separate branches of government, and government agencies have often overlooked the input of local communities at the forefront of disaster response and adaptation. Achieving convergence between CCA and DRR is thus likely to demand substantial institutional changes. The research projects investigated and facilitated linkages among local and regional administrative units. They identified three basic categories of needs for convergence: 1) in coordinated planning and communication across scales (i.e., information-

Table 1
Research site characteristics of six projects.

Group(s)	ICSD-AIDMI-IDS	ATREE	SEEDS India-IIT-KU		GEAG-ISET-NIDM	WWF-Pakistan	NDRI
Site/State	**East coast, Odisha**	**Northern W. Bengal & Sikkim**	**Leh, J&K**	**Barmer, Rajasthan**	**Gorakhpur, UP**	**Sindh province, Pakistan**	**Koshi River Basin, Nepal**
Scalar unit of study site(s)	State & district (Ganjam, Gajapati, Puri & Khurda dists.)	District (Darjiling & N. Sikkim dists.)	Community	Community	District (Gorakhpur, incl. Gorakhpur city)	Landscape (Indus ecoregion)	Region (major river basin)
Landscape traits							
Topography	Coastal plain, eastern India; rolling hills & plains	Mid-montane to montane (1800–4000masl)	Ladakh Range, W. Himalaya; high mtns (3500masl)	Thar Desert, W. India (114–218masl)	Floodplain (Rapti & Rohini Rivers); rolling hills	Indus Delta; coastal floodplain	Extreme variation in altitude: 95–8000 m
Land cover	Forest cover > 50% (Ganjam & Gajapati districts)	Species-rich mid-montane forest; rhododendron-oak forest; alpine pasture	Cold desert; sparse vegetation cover, low ground water availability	Hot desert; sparse vegetation cover, low ground water availability	Species-rich *sal* forest remnants; agriculture; riparian & wetlands	Riparian *Acacia* forest; Indus valley is irrigated	599 glacial lakes; forested hills; agriculture
Climate traits	Tropical savanna	Subtropical montane	Cold desert	Hot desert	Humid subtropical	Arid sub-tropical	6 climatic regions
Max & min temperatures	Max 45 °C, Min 10 °C.	Max: 16 °C, Min: 9 °C	Max: 35 °C, Min: − 40 °C	Max: 50 °C, Min: 0 °C	Max: 32 °C, Min: 20 °C	Max: > 46 °C, Min: 2 °C.	Max: 35 °C, Min: 0 °C
Annual precip	1200–1500 mm	ca 3037 mm	ca 102 mm	ca 287 mm	ca 1228 mm	177–203 mm	882–4450 mm
Prevailing seasonality	75–80% rain June-Sept	Strong monsoon June-Sept; dry winters	Severe winters, some snow; mild summers	Seasonal temp extremes	Strong monsoon: 80% rain during June-Sept	Weak summer monsoon	Strong monsoon June-Sept
Primary livelihoods	Agric (rice, vegetables, fruits, cashew); small-scale livestock; artisanal fishery	Agric (potato, pea, radish, maize, etc.), small-scale livestock	Agric (1 annual barley crop); livestock	Livestock; small-scale agriculture	Paddy, wheat, pulses, sugarcane	Agric (cotton, rice, wheat); small-scale livestock, fishery	Agriculture and some industries
Prevailing disaster risks addressed in project	Cyclones, floods, drought, heat waves; severe cyclone with flooding in 3–4 year cycle	Cyclones; flash floods; heavy snowfall at high elevations; earthquake & landslide; winter drought	Flash floods; landslides; temp extremes; glacial recession	Flash floods; drought conditions	Flooding, water-logged soils	Floods; drought; soil salinization; coastal erosion	Floods; drought; glacial lake outburst flood (GLOF); landslides

Table 2
Summary of key challenges, approaches and outcomes for each project.

Project	Diagnosis: main problem	Methods, approaches	Specific challenge(s) faced by project during implementation	Results, outcomes
ICSD-AIDMI-IDS	Water vulnerabilities at several levels; chronic flooding associated with cyclones; inadequate housing design and construction; budgetary resources inefficiently allocated	Watershed mapping and regional modeling of projected climate change	Poor communication and vertical coordination among communities and government agencies	Suggested re-allocations of water resources
		Multi-stakeholder meetings to understand climate impacts on water security and improve management plans	Communities lack voice in climate discourse	CSDRM framework adopted by local group
		Promotion of CSDRM approach to cyclone-resilient development	Future cyclone recurrence frequency analysis inadequate for planning	Identified stormproof housing as the preferred social investment over 50 years
ATREE	Rapidly changing agricultural and agropastoral economy; growing rural-urban linkages; rapid growth of road network and other infrastructure development; poor history of organized response to disasters	Regional workshops to establish a new Eastern Himalaya Climate Awareness Forum (EHCAF)	Incomplete institutional buy-in and difficulty scaling up from pilot projects	Developed a platform for improved networking across regional political powers to push forward climate-conscious development
		Documentation of community-organized adaptation through *Dzumsa* in Sikkim	Center-based disaster response teams not trained or equipped for mountain conditions	Opened discussions with district officials on climate change and disaster risk
		Rural livelihood diversification for resilience	Lack of regional climate data	
SEEDS India-IIT-KU	Leh, J&K: Infrastructure vulnerable to destructive flash flooding; livestock vulnerable to extended cold spells; uncoordinated disaster response system	Delivery of resources across village, district, and national administrative levels;	Poor vertical coordination among administrative agencies due to intra-institutional dynamics	Reduced community vulnerability to flood & drought
		Repair flood-damaged streambeds and expand irrigation & water storage systems	Lack of community awareness and participation in disaster preparation	Highlighted role of 'bridge organizations'
		Community weather station and disaster-response schools to disseminate climate information	Challenges in assessment of traditional knowledge & local innovations for climate resilience	Worked with a IIPA to disseminate research findings to state and national policy makers
	Barmer, Rajasthan: Communities unprepared for increasing pattern of drought; little public participation in adaptation planning	Girls' community groups produce radio programs exploring climate change and climate disasters	Lack of community awareness and participation in disaster preparation	Improved public participation in the development discussion
GEAG-ISET-NIDM	District disaster management planning and compilation process fundamentally weak	Shared Learning Dialogues (SLDs) with district agencies to discuss climate projections	Weak 'data maintenance culture' and institutional memory within district disaster management authorities (DDMA)	SLD approach adopted by UP SDMA for improved DDMP development
		Proposals for climate-sensitive district disaster management plan (DDMP)	Limited ability of state disaster management authorities (SDMA) to implement effective state-wide management plans	Analyzed a climate dataset to provide regional climate projections
				Analyzed extreme-events on climate projection time-series
WWF-Pakistan	Climate-related losses of freshwater fish stocks and livestock	Fisheries and livestock cost-benefit analysis (CBA)/ productivity study	Poor access to data on the fresh-water fisheries sector	CBA showed need for district and provincial support to offset climate-related livestock and fisheries losses
		CBA of flood- and storm-resilient shelter designs in India & Pakistan	Administrative powers not transferred to provinces	
			Local decision-making limited by federal budget cuts & restrictions	Housing CBA showed resilient designs repay investment -fold
NDRI	Infrastructure development proceeding without attention to emerging climate risks (inadequate EIAs, unclear financing procedures, non-adherence to scientific construction codes, etc.)	Quantification of historical and future risks to watershed under IPCC climate change scenarios	Duplication of research efforts & generation of ambiguous data Lack of access to data	Simulations demonstrated clear need for updating design flood values and 'dead storage' capacity for Koshi High Dam

sharing among administrative levels); 2) in facilitation of institutional learning and memory (i.e., information-sharing over time); and 3) in the interaction of community-based organizations with government agencies (i.e., cooperation and information-sharing across disjunctions of power relations). Each of these themes is illustrated in the following sections.

3.1. Cross-scalar communication and planning

Effective planning for CCA-DRR convergence must often be coordinated across multiple spatial and administrative scales [31]. The impacts of environmental hazards are felt locally, and the first (often most effective) response often comes from local communities and institutions. But the legal and regulatory frameworks which assign clear responsibilities for acknowledging inherent risks in advance and integrating them into development planning, crucially involve higher levels of public administration. Communication up and down administrative hierarchies often entails significant short-term transaction costs. Thus, convergence demands that institutions and administrative agencies rethink some of their business-as-usual patterns. Several of the research projects were able to facilitate communication among stakeholders for improved planning.

The project conducted by SEEDS India and partners in Leh helped coordinate delivery of resources from village, district, and national administrative levels to manage the impacts of flash flooding. Communities worked with the district government to access funds from the national watersheds management scheme and to repair local flood-damaged fresh water streams by building proper drainage channels, clearing blockages and creating overflow storage ponds. This reduced community vulnerability to future flood damage, while also expanding irrigation and water storage systems, thus building resilience to the increasingly frequent winter water shortages in this arid region.

In Ganjam district (Odisha), the ‘Getting Climate Smart for Disasters’ project—conducted by Intercooperation Social Development India (ICSD) together with several national-level partners—analyzed the Water Use Master Plan for Sobara village. ICSD-AIDMI-IDS found opportunities for interaction between village-level institutions, academia and government departments in understanding climate impacts on water security and improving management plans for the future. Watershed mapping and projections of climate change were provided by educational institutions (universities) to district-level departments; these were also shared with villagers. Familiarity with plausible climate scenarios will help villagers and district agencies allocate their resources for water use under changing conditions, while the sharing of basic climate information and scenarios meant that stakeholders were on the same page with planning.

Inadequate information flows remain a distinct challenge to CCA and DRR convergence among administrative agencies in South Asia, where many of the institutional mechanisms and attitudes that foster information-sharing are still under development. The project in Sindh province, led by WWF-Pakistan and the London School of Economics, found it a challenge to get adequate data on the fresh-water fisheries sector. The Fisheries Department and the Bureau of Statistics do not make information on government-run hatcheries public, while centralized information on privately-owned hatcheries is lacking. Where baseline information is deficient and data collection methods unreliable, assessment and tracking of sectoral contributions to vulnerability reduction remains tentative. Poor information flows can then have significant policy implications. The Benazir Income Support Program provided several years of community training in aquaculture in Sindh, but when the project was over there was no follow-up, and a potentially useful vulnerability reduction intervention was lost.

The case study projects noted the considerable investment of time and effort required to encourage information-sharing among administrative levels. Coordination carries transaction costs, yet it remains indispensable. A comparison of landslide hazard responses in Italy and India underlines the high pay-off to society in improving coordination [41]. From this perspective, it would appear that better channels of communication are needed to facilitate useful information flows both *from* and *to* vulnerable communities. While ‘bottom-up’ research approaches can capture and communicate vulnerabilities on the ground, ‘top-down’ action is also indispensable to build the institutional frameworks that can support sustainability and replication of CCA and DRR interventions that work. An improved flow of relevant information across hierarchical levels is a crucial step toward developing a society-wide sense of *complementary* and *shared responsibilities* for comprehensive security from natural hazards.

3.2. Building institutional engagement through learning processes

Merely setting a goal of increased communication is an inadequate pathway for achieving institutional change. Innovative learning and planning techniques are becoming available to support government agencies and NGOs in moving toward convergence. Such learning processes can support flexibility and proactive risk management over reactive policy stances [19,43]. Several projects were able to facilitate communication among researchers, communities, and government agencies by taking on the role of conveners of learning processes amongst the range of stakeholders and finding ways to contribute scientific inputs to disaster management planning processes.

The ICSD-AIDMI-IDS project used a Climate Smart Disaster Risk Management (CSDRM) approach to explore options for cyclone-resilient development. CSDRM is a process developed by IDS in collaboration with Plan International and ActionAid. Organizations can apply this approach to assess their strategic planning and policymaking against three pillars of action: disaster risk and uncertainties; adaptive capacity; and the structural causes of poverty and vulnerability. The CSDRM process explores institutional constraints and opportunities for CCA and DRR integration [32]. The ICSD-AIDMI-IDS research project introduced CSDRM to district-level officials and local NGOs, and the framework was then taken forward by a local group, Society for Women Action and Development, to include CCA and DRR actions in their development interventions. The project also used CSDRM to structure recommendations for village water planning and cyclone-resilient development in Odisha, based on experiences from cyclones Phailin and Aila.

The project in Gorakhpur, led by Gorakhpur Environmental Action Group (GEAG) with two partners, began by convening a series of Shared Learning Dialogues (SLDs). These iterative workshops and roundtables were designed to engage district-level agencies in discussion and useful re-interpretation of climate projections; to gauge their awareness of vulnerability and resilience issues; and to elicit action proposals toward a climate-sensitive District Disaster Management Plan (DDMP). Lessons from the SLD approach have also been adopted by Uttar Pradesh state, where the State Disaster Management Authority is planning to replicate the learning processes leading to DDMP development.

In Darjeeling, the Ashoka Trust for Research in Ecology and the Environment (ATREE) project used its regional workshops on CCA and DRR issues to lay the groundwork for new initiatives exploring climate-resilient agricultural technologies for mountain smallholder farmers. An increasing number of factors are influencing farmers’ decisions about whether to adopt innovations, specialize production for the market, reduce emphasis on agriculture, or give up farming entirely. This is compelling the group to expand its research focus to encompass an increasing diversity of livelihood opportunities (including new rural infrastructure development and an expanding tourism sector) as well as costs (especially growing losses from mammal herbivore crop-raiding).

These approaches point to the importance of the institutional learning process. Implementing such learning processes has substantial challenges, of course, including incomplete institutional buy-in, lack of financial resources, and the ubiquitous difficulties in scaling up from labour- and time-intensive pilot projects. However, these are the common obstacles to *all* institutional change, and they can be overcome, especially as some South Asian economies expand rapidly and the financial constraints become less definitive.

3.3. Strengthening community voices and the role of civil society

While it is not the responsibility of rural communities to mitigate global climate change, it is very much in their interest to increase their own awareness of expected changes, to implement response and adaptation options, and to exert pressure on governmental bodies to coordinate CCA and DRR planning at the regional level [16]. The six research projects documented a range of community-based adaptive initiatives to enhance community resilience in the face of climate challenges. Of course, bottom-up approaches also require substantial investments in scaling up and in coordination to match social, political and cultural viewpoints. Communities must be involved in continuous give-and-take through awareness programmes, trainings and reciprocal knowledge sharing.

Taking a sectoral approach in semi-arid Sindh, WWF-Pakistan observed that traditional fishing communities have recently begun practicing aquaculture to substitute for wild fish stocks that are being reduced by increasing temperatures of freshwater bodies. The WWF project carried out a productivity-loss study that strongly reinforced the case for increasing district and provincial support for offsetting climate-related losses in the livestock and fisheries sectors.

In North Sikkim, ATREE documented instances of community-organized voluntary meat rationing in response to reduced winter precipitation and poor pasturage. The traditional local authority, the *Dzumsa,* has also adjusted community transhumance schedules in response to changes in seasonal pest (black-fly) populations. Recently, the *Dzumsa* has begun encouraging the cultivation of a number of crops that have become viable at higher altitudes, including maize, cabbages and pumpkins at Lachen (2700masl), carrots at Thangu (4100masl) and potatoes at Gochung (4750masl) (T. Ingty, unpublished data). Like most traditional systems, the *Dzumsa* naturally tends to be reactive: systems are tweaked for instance in response to a series of warm winters, or to a reduction in the size of sheep herds.

However, community involvement in convergence must go beyond response actions. Flexible forward planning depends on information flows among resident communities, researchers, NGOs, and governments. Together with the State Meteorological Department, the project led by SEEDS-IIT-KU in Leh established a community weather station and disaster-response school to disseminate climate information amongst the community. Simultaneous work in Rajasthan helped girls' community groups deploy the power of microphone and digital recorder to produce radio programmes exploring climate change and climate disasters, local risk reduction solutions and government policies, mixed with expert interviews and cultural entertainment. These programmes are promoting public participation in the development discussion and connecting experts with local communities to share research and information.

Community-level initiatives, while essential to both climate adaptation and disaster management, do not by themselves represent convergence, since communities typically have little control over the larger-scale economic and environmental trends that generate local risks. Thus a core requirement of convergence is that community observations and needs must be communicated efficiently to higher administrative levels, where information should be synthesized and trends articulated. Unfortunately, there remains a persistent sense among NGOs in South Asia that many government agencies tend to be somewhat inflexible, making it difficult for outside groups to contribute useful inputs.

Here the research projects highlighted the role of NGOs and civil society as 'bridge organizations' [4] between communities and administrative bodies. By collaborating with an academic institution (namely, the Indian Institute of Public Administration-IIPA), the SEEDS-led project was able to disseminate their research findings to state and national policy makers. IIPA co-hosted the project's national policy workshop and articulated the research findings for the administrators. As a research and training institution of the government that supports the civil services, it emerged as a potentially effective bridge between research and policy-making.

The goal of better coordination within civil society may be advanced by improving networking, even in the absence of a formal umbrella agency [13]. For these reasons, the Eastern Himalaya Climate Awareness Forum currently being hosted by ATREE is designed both to draw together the efforts of disparate NGOs, and to develop a platform for stronger interaction with the regional political powers to push forward the concept of climate-conscious development.

4. Common constraints to convergence

Despite consensus on the importance of moving toward CCA and DRR convergence in South Asia, a number of issues hinder full integration. These include the absence of over-arching national policies (and corresponding financing mechanisms) to integrate CCA and DRR into various aspects of land-use planning; lack of capacity in many agencies to assess, interpret and apply data on climate change risks and vulnerabilities; and bottlenecks in integration of plans among and within agencies. The CDKN-START projects confronted a range of constraints affecting the implementation of institutional change for convergence. Constraints included chronic deficits in leadership and institutional capacity (discussed in Section 4.1); the need for local autonomy in planning and the sometimes countervailing need for central oversight (Section 4.2); and new risks directly or indirectly generated by economic growth (Section 4.3).

4.1. Leadership and human resource capacity

Getting CCA and DRR policy-making to converge will never be a goal with a single definable endpoint. Rather, it calls for a different way of doing things—a different *process*. Hence, convergence demands much flexibility from the available human resources. Policies need to be backed with legal instruments as well as human and financial resources; ensuring these requires sustained and evolving engagements within the policy domain. What if human resource capacity is lacking in important respects? Many district-level officials have relatively little formal education, which may make it difficult for them to integrate findings from science. Some researchers describe education itself as a key component of vulnerability reduction [33]. In many other cases, as we have seen, organizational structures present obstacles to leadership. The research projects encountered several obstacles related to human resource capacity.

The project led by SEEDS-IIT-KU in Leh, for instance, was able to work successfully with local government officials to document and transmit local experiences of climate-related stresses. However, the group found that vertical coordination among administrative agencies was often obstructed by institutional dynamics. Many officials occupy transferrable positions, which impedes the building of institutional memory. Others are based at headquarters or in offices remote from the events, where they cannot always rely on a consistent information flow.

These are by no means unusual challenges in South Asia. ATREE has encountered this problem repeatedly over its nearly 20 years' experience of working in sites in southern India. Rapid turn-over of key officials in rural postings tends to 'personalize' policy making, undercutting both administrative continuity and working relationships with locally-based organizations. In the Darjeeling hills, the agency in charge of disaster management hosts a rather casual yearly pre-monsoon stakeholders' meeting to discuss landslide risk planning and response; but there is little critical reflection on successes and failures of the previous year, or on future regional climate scenarios. Darjeeling district is currently in a transitional phase from the earlier administration to a new Gorkhaland Territorial Administration (GTA), which is currently taking on new powers and independence in land management. The ATREE project was able to open discussions with GTA officials on the subject of climate change and disaster risk. Hopefully this will lead to further sustained interactions between the district and civil society, including more scientific inputs into disaster planning.

The GEAG-ISET-NIDM project encountered some similar challenges in Gorakhpur district. They found the 'data maintenance culture' to be weak within the District Disaster Management Authority responsible for compiling annual District Disaster Management Plans (DDMP). Consequently, each year's DDMP tended to be largely a revision of the previous year's, without a systematic process for updating the inputs. This provided rather weak foundations for building institutional memory. In such cases, convergence depends on strengthening documentation systems so that DDMPs can become more responsive to the available climate information.

Several supported research projects expressed the wish for a 'champion' or 'intermediary' within the government bureaucracy—an effective leadership figure to take the idea of convergence forward. Occasionally, this wish is granted. In Gorakhpur, for example, the DDMP process presented such an opportunity. The project was able to hire an external consultant as Programme Officer at the district level. This officer had training in both CCA and DRR, and was able to coordinate the new data management activities, leading to improved relevance of the DDMP and supporting convergence. Thus, this challenge was temporarily solved through outside support; but clearly, the longer-term challenge can only be addressed by raising standards and improving data management within the responsible departments. This challenge is closely related to the larger question of decentralized authority.

4.2. Decentralization of authority vs unified central oversight

Recurrent themes of the research projects were the advantages and drawbacks of 'bottom-up' versus 'top-down' approaches to planning and policy development. This discussion reflects long-standing debates in South Asia (and globally) about devolution and decentralization of decision-making authority over natural resources [1,28,30,36,40,44,45]. Decentralization is commonly understood as the transfer of authority and management functions from central to local government levels,[33] but in the natural resource sector in South Asia, the picture is often more complicated. The need for decentralization in natural resource management is often couched in terms of the advantages of local knowledge and specificity over the generalized, 'one-size-fits-all' approaches more convenient to centralized state powers. The six case studies largely supported the view that convergence requires increasing the decision-making capacity of local authorities, since they are likely to be in the best position to understand and communicate local needs and constraints. Even where progressive administrative policies do exist, however, a number of persistent challenges in implementation seem to be common to the South Asian experience.

Case studies in India suggest that obstacles to convergence begin at national and state levels, where climate change is still seen primarily as a national and international political issue, while disaster management planning is largely the responsibility of district-level departments. Although the Disaster Management Act of 2005 made progressive statements, disaster management remains located in the Revenue Department, while the Ministry of Environment and Forests is responsible for tracking and documenting environmental effects of climate change. Planning and decision-making thus continue in sectoral 'silos'. The GEAG-ISET-NIDM project in Gorakhpur found that although in principle the state could mediate between these silos, in fact the Uttar Pradesh State Disaster Management Authority lacked the necessary guidelines and procedures to implement effective state-wide management plans. Consequently, disaster management remains an overly centralized, hence often blunt, instrument.

Similarly, in Sikkim ATREE found agreement among those who had experienced the damaging earthquake of 2011—which coincided with heavy late-monsoon rainfall—that the disaster response teams, apparently sent from as far away as Delhi, were not trained or equipped for the difficult terrain and conditions of central Sikkim during the monsoon. Due to poor coordination, there were delays in sending out local teams to affected rural areas. To quote a local NGO: "We noticed that the NDRF [National Disaster Relief Force] were untrained for this terrain. It would have been great if our boys who are part of the reserve battalions in Pangthang [near Gangtok] were used. It seems very unwise that they were not mobilized until the last minute." There are many similar examples of problems arising from the over-centralization of first response actions. In Pakistan, too, the WWF project found that despite decentralization rhetoric, powers are in fact rarely fully transferred to provinces, and decision-making capacity is limited by budget cuts and restrictions at the federal level.

On the other hand, there is the potential for loss of efficiency with decentralization. The NDRI project in the Koshi Basin of central Nepal—a region which attracts much research attention from national and international groups—suggests there could be a role for a central agency in formulating and overseeing strategic research and development plans. The researchers observed that in the absence of a single responsible agency, research projects have been duplicated and ambiguous data generated. In order to address issues of institutional memory and sustainable development, they recommended mandating an agency or commission with overall responsibility for development of the Koshi Basin resources. With a good master plan in hand, the NDRI group suggested, such an agency could streamline the efforts of different groups and organize next steps in the various sectors.

This point of view makes sense given the NDRI researchers' focus on quantifying historical and future risks to the watershed under IPCC climate change scenarios. Their simulations demonstrate the need for updating design flood values and 'dead storage' capacity for the proposed Koshi High Dam to accommodate future flood rates and sediment loads which are expected to be more than twice the values assumed under current climatic conditions. Such changes to planning can only be taken through coordinated central government agency interventions; they will affect at least 17 districts within Nepal alone (as well as large areas downstream in India). Hundreds of large and medium-capacity hydropower projects are under construction or in planning phases across the central and eastern section of the Himalayas—a region strongly affected by changing monsoon dynamics and therefore potentially flood-prone. To what extent are the Koshi findings likely to be reproduced at other potential hydro sites?

Clearly, convergence brings out some potential tensions between the need for efficient DRR through local or regional autonomy on the one hand, and the need for overall CCA coordination on the other. The Nepal group's perception that research toward convergence could be more effectively guided by a central agency reflects the fact that the tone of the relationship between NGOs and government agencies in Nepal is very different than just across the border in India. However, it is also true that the scale of the problem in Nepal is orders of magnitude smaller than the sub-continental scale of India. The perception of many citizens of Darjeeling district of West Bengal, for instance, is that the state bureaucracy—based far away in the lowlands of Kolkata, conducting business in an unrelated language—is too large and too 'foreign' to understand the problems people face in the Himalayan foothills. Integration of disaster risk management policies into climate-smart development would promote much more detailed awareness of the local challenges, and would go a long way toward building trust between the public and officialdom.

4.3. Development-related risks

It has been clear to observers for decades now that most 'natural' disasters are in fact not 'natural' (or not *only* natural), but are generated by risky human behaviors interacting with natural processes. Yet, UNISDR [48] pointed out that government agencies and specialists, as well as the public, continue to use a 'disaster' rhetoric focused on extreme or exceptional natural events, diverting attention from the role of economic and political decisions that generate or mediate risk.

The research projects agreed that neither rural communities nor their elected representatives are routinely given the opportunity or the means to participate in planning crucial aspects of development—especially key elements such as large infrastructure siting and design. Significant information is often lacking in the public domain. For example, the Geological Survey of India (GSI) has rarely made landslide risk assessments and maps available to the public or local officials—though there are now plans to gradually upload them onto the GSI website over the coming years [41]. In the absence of such information, many development projects are carried out somewhat blindly.

Investigations have shown that the planning and construction of new hydropower projects all along the southern face of the Himalayas in India, Nepal and Bhutan, is in many cases proceeding without adequate environment impact assessments, transparent financing procedures or rigorous adherence to scientific construction codes [12]. In a seismically active and geologically fragile environment, the ensuing risks are substantial and could affect communities both up-stream and down-stream, as well as biodiversity and even international relations. These risks are likely to continue increasing with climate change, as the annual weather cycle becomes more seasonally polarized and monsoon rain events become on the average more intense [42]. Yet data to explore the implications of these trends at a meaningful scale are generally lacking.

Overall, research supports the perception that in South Asia, economic *growth*—specifically, expansion of the scale of aggregate economic activity and material throughputs—is generating a number of serious risks, even while economic *development*—understood as an increase in economic efficiency—addresses others. These relationships are highly complex, with causal arrows pointing in both directions. Clarifying them makes heavy demands on data. It is crucial to keep in mind that the choice today is not between development versus stagnation, but between inclusive ('sustainable') development that is net regenerative of natural capital, versus the dangerous, uncoordinated growth associated with mounting local and regional negative impacts.

5. Research needs and knowledge gaps

The START/CDKN research projects highlighted a number of information lacunae and data gaps, both in understanding the current status of convergence and in delineating ways forward. Patterns of weather, land-use, and economic connectivity are all changing in interrelated ways. These changes are happening rapidly over wide areas, and in many cases they are being driven by institutions that are not well equipped to monitor and document ongoing change. Projects pointed out three kinds of information that are needed to strengthen the case for convergent planning.

5.1. Cost-benefit analysis for convergence

One of the biggest challenges in disaster-prone regions is to use the response phase *after* a disaster occurs as an opportunity to rebuild and reorganize in a more adaptive way—not so much "bouncing back" as "bouncing forward" [6]. In these moments, given the urgency of present needs, the likely impacts of future climate trends are rarely taken into account [27]. This underlines the need for putting institutional systems in place, in *advance* of crises, that will facilitate learning and increase risk awareness among all stakeholders for when the next crisis does strike. A potent tool for motivating convergent action is cost-benefit analysis that compares likely damage costs under a range of possible climate scenarios and discounting schedules to the up-front costs of preparing for such scenarios in advance. Appropriately conducted CBA can help government and the private sector understand the societal benefits of risk reduction, particularly for vulnerable communities. Improvements in post-event record-keeping are facilitating reasonable estimates of the costs of damages and compensation, even where the economy is largely informal.

Several CBA exercises undertaken by the researchers showed that building resilience up front is generally less costly than repeated damage control and remediation following disasters. WWF-Pakistan and ISET found that timely investments in flood- and storm-resilient shelter designs in India, Pakistan and Vietnam would, in the event of a serious flood, be repaid at a rate of over 5.5 times in avoided damages.

Following cyclone Phailin in Odisha, ICSD carried out an analysis of aid demand, including needs for restoration of damaged dwellings, compensation for livelihood losses and for crop loss, and federally-funded food supplies. Damage compensation appeared less expensive and was thus prioritized over investments in cyclone-proof housing. Viewed on a longer time scale, however, storm-safe housing is clearly the less expensive social investment—particularly given possible increases, over the next the 50 years, in severity and/or incidence of cyclones originating in the Bay of Bengal and in the Arabian Sea [2,14,51,52].

5.2. Regional-scale climate data

Another gap noted by several projects is the persistent dearth of regional climate change projections scaled down to a usable level. In Odisha, for instance, ICSD pointed out that recurrence frequency analysis needs to be carried out to estimate the likelihood of cyclones with wind speeds of 250 km and above striking the eastern Indian coast. Accordingly, specifications for reconstruction of housing, roads, above-ground irrigation infrastructure, power transmission and distribution are all needed, while departments need to be advised on implementation and monitoring. Housing situated close to current high tide lines and within regulated coastal management zones will need to be relocated.

Even when raw data are available, it is not always clear how useful they are. In Eastern Himalaya, ATREE researchers compiled publicly available regional weather station temperature and precipitation data from the APHRODITE project, covering 1951–2007 and 1961–2007 respectively. A different dataset from Tyndall Center, going back as far as 1901, gave divergent results. But how reliable are the underlying data? Even today there are rather few weather stations positioned across the extremely varied terrain of Eastern Himalaya. As long as projections have to rely on old data of unverifiable provenance and quality for parameterization, the level of uncertainty in this kind of exercise remains high.

In Gorakhpur district, GEAG-ISET-NIDM re-analyzed a dataset (downscaled under earlier projects) to provide easily interpretable climate projections to help departments understand the implications for their programmes. Extreme-event analysis was conducted on a set of six climate projection time-series using the GCM projections most relevant to Gorakhpur.

5.3. Merging science with local knowledge

The SEEDS-IIT-KU project found the development of usable community-level CCA and DRR indicators to be a challenge due to the lack of supporting research data. In particular, the effectiveness of community actions using traditional knowledge or local innovations to build climate resilience has been challenging to assess, as so much of the information in this domain remains anecdotal.

6. Conclusion and policy implications

Climate change emerges in the accounts of these six research-action projects as a new type of challenge to the agencies responsible for disaster risk reduction. On the one hand, climate change is a non-localized phenomenon presenting a scale mismatch to administrative structures and political units. On the other hand, meteorological impacts will vary at multiple geographical scales, and impacts will be felt locally. We do not yet have detailed information, at the needed geographical and administrative scales, about what to expect; indeed, most places will see dynamic changes over time. Unfortunately, administrative bodies tend to be most effective in stable environmental contexts, where lessons learned from past events can be applied to future risks. Among the minority of South Asian administrative agencies currently responding to these challenges, there is a temptation to look for models of expected future conditions based on a combination of historical data and future projections, and to tweak policy to fit these expected future conditions. Schindler and Hilborn [37] point out that since the variability in weather patterns is expected to increase, this may be a self-limiting approach. Instead, greater *flexibility* of policies and institutions is needed to confront unpredictable changing conditions. Such forward-looking flexibility can be described as *precautionary* thinking. In South Asia particularly, with its dense human populations, high levels of subsistence livelihoods, and already intensely seasonal meteorology, precautionary thinking dictates building a range of climate scenarios into future planning in many sectors.

A precautionary stance would carry strong implications for infrastructure and construction sectors in South Asia. Evidence from the present case studies, and many others, indicates that rural roads are often being sited, designed and constructed to low standards. Large hydropower projects are escaping serious EIA scrutiny, and are being designed to meet obsolete safety targets. Urban and rural building zoning regulations are being flouted with impunity in many areas. These problems will inevitably contribute to serious and sharpening public risks.

Yet the current reality is that at the sub-national level, climate change is often still perceived as a distant phenomenon. Many sectoral agencies remain unaware of the likely impacts of climate change on their areas of responsibility. Hence, civil society and governmental agencies must urgently seek shared learning opportunities that bring together climate modeling results—in user-friendly formats—with local-based knowledge in order to develop futures scenarios that are meaningful at local and regional levels. An increase in shared understandings of present vulnerabilities and potential future trends is urgently needed.

Additionally, the legal and institutional frameworks to support integration of CCA and DRR are sorely lacking. The six research projects identified a number of mechanisms to address this gap. Large-scale convergence will require strengthened institutional linkages across administrative levels, and persistent efforts to reduce departmental and agency isolation. Above all, continuous pressure will need to be applied by civil society to drive incremental changes in administrative habits and rigidity at all levels. Linkages between civil society and administrative agencies are unevenly developed in South Asia: they are far more developed in Nepal and Bhutan than in many parts of India, for example.

In sum, the case studies examined here show that in the most general sense, the needs are relatively easily defined: concerned NGOs and agencies must increasingly plan not for a future that reproduces current conditions, but for one that will likely present unprecedented challenges. The technical, human and financial resources to meet these challenges are, in principle, available—but only if we are able to refocus priorities to improve coordination among responsible groups and foster the capacity to anticipate and plan for uncertainties. In short, climate change presents serious challenges to social cohesion. For development to continue and to be 'sustainable', these challenges urgently need to be confronted and overcome. Above all, the ability to reach consensus on priorities for social investments in climate-aware development will need to be strengthened. Convergence—defined as doing disaster planning *in light of* current and expected climate change—is a necessary step in that direction.

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