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Review Paper

Evolution of a transboundary landscape approach in the Hindu Kush Himalaya: Key learnings from the Kangchenjunga Landscape

Janita Gurung [a], Nakul Chettri [a, *], Eklabya Sharma [a], Wu Ning [a], Ram P. Chaudhary [b], Hemant K. Badola [d, 1], Sonam Wangchuk [c], Yadav Uprety [b], Kailash S. Gaira [d], Namgay Bidha [c], Karma Phuntsho [a, 2], Kabir Uddin [a], Ghulam M. Shah [a]

[a] International Center for Integrated Mountain Development, Kathmandu, Nepal
[b] Research Center for Applied Science and Technology, Tribhuvan University, Kirtipur, Nepal
[c] Nature Conservation Division, Department of Forests and Parks Services, Ministry of Agriculture and Forests, Royal Government of Bhutan, Thimphu, Bhutan
[d] GB Pant National Institute of Himalayan Environment and Sustainable Development, Gangtok, Sikkim, India

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ABSTRACT

The transboundary landscape approach builds on principles of integrated social-ecological systems with conservation and development perspectives at a transboundary level. The evolution of one such transboundary landscape in the Hindu Kush Himalaya (HKH) from the 1990's to the present is discussed through a phase-wise process. Both global and regional discourses have been influential in designing the transboundary Kangchenjunga Landscape which is shared by Bhutan, India and Nepal. The 25,085 sq.km landscape ranges in elevation from 40 to 8,586 m asl and is home to more than seven million people, while hosting more than 4,500 species of plants and at least 169 mammal and 618 bird species. With the aim of conserving and managing the landscape for sustained ecosystem services that ultimately contribute to the livelihoods of the women and men residing therein, the Kangchenjunga Landscape Conservation and Development Initiative was implemented since 2016. Lessons from the Kangchenjunga Landscape indicate that participatory and iterative boundary delineation, transboundary cooperation, identification of a lead institution, ensuring the global-local-global feedback cycle, and regional data sharing are key components for implementing transboundary landscape programmes in the region.

1. Introduction

Climate change, poverty, biodiversity loss, and food insecurity are global contemporary concerns (Barrett and Carter, 2013; Laurance et al., 2014; Kremen and Merenlender, 2018). This is more prevalent in the mountains due to strong social-ecological

* Corresponding author.International Centre for Integrated Mountain Development, GPO Box 3226, Kathmandu, Nepal.
E-mail address: Nakul.Chettri@icimod.org (N. Chettri).
[1] Present address: Chief Minister's Office, Government of Sikkim, Gangtok, Sikkim, India.
[2] Present address: Independent consultant, Thimphu, Bhutan.

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interdependency and specificities (Jodha, 2000; Palomo, 2017). The traditional sectoral approaches to address these often inter-connected issues are considered inadequate (Reed et al., 2015). In the course of evolution of biodiversity conservation practices, the 'Integrated Landscape Approach' or 'Landscape Approach' has emerged as a complementary means to address these issues (Franklin, 1993; Chazdon et al., 2009; Reed et al., 2016; Sayer et al., 2016). The Landscape Approach is expounded as a framework to combine science, policy and practice for equitable and sustainable use of land, and to fortify measures to mitigate and adapt to various drivers of changes including climate change (Milder et al., 2010; Scherr et al., 2012; Sayer et al., 2013; Reed et al., 2016). This approach takes into account the characteristic physical features of the landscape, along with internal and external socio-economic and socio-political drivers that affect land and natural resource use, particularly in relation to conservation, forestry and agriculture (Sayer et al., 2013). By applying adaptive and integrated management systems to balance competing demands on land and ecosystem services, the landscape approach attempts to tackle ubiquitous and multiplex environmental, social and political challenges that extend beyond traditional management boundaries (Bennett et al., 2015; Reed et al., 2016).

Generally, the landscape approach is embedded in conservation and the science of landscape ecology (Lindenmayer et al., 2008; Sayer, 2009). Early conservation theory promoted landscape-level thinking through the principles of island biogeography (Kingsland, 2002) to particularly address biodiversity conservation (Rosenberg et al., 1997). Subsequently, a variety of frameworks were developed to include different sectors − such as agriculture, farms, forests, rangelands conservation, and development − within broader landscape management strategies (Estrada-Carmona et al., 2014; Reed et al., 2016; Kremen and Merenlender, 2018). Foremost among these was the 'Ecosystem Approach' which promoted integrated management of land and natural resources for conservation and sustainable use (Secretariat of the CBD, 2004). Other sectors adopting the landscape approach include agricultural development, natural resource management, rural development, and water resources and watershed management, among others (Scherr et al., 2012; Reed et al., 2016).

Landscape planning, more so in the transboundary context, is a complex process (Leibenath et al., 2010). The ecosystems in a landscape often extend beyond political and administrative boundaries (López-Hoffman et al., 2010; Erg et al., 2012). Key characteristics of this approach include 'participation' of stakeholders from the planning to the management and monitoring levels, 'transdisciplinarity' by engaging multiple stakeholders from various sectors through participatory processes, 'multifunctionality' to address the multiple objectives of a landscape, 'complexity' of social-ecological systems that include various land use types within a landscape, and 'sustainability' for provisioning of ecosystem services in the long term (Freeman et al., 2015). The UNEP World Conservation Monitoring Centre has documented 227 transboundary protected areas (Lysenko et al., 2007). To ensure effective management of such areas, cooperation across international boundaries is required (Vasilijević and Pezold, 2011; Lambertucci et al., 2014). The IUCN's World Commission on Protected Areas (WCPA) has proposed three types of transboundary conservation areas: transboundary protected areas, transboundary conservation landscapes and/or seascapes, and transboundary conservation migration areas (Vasilijević et al., 2015).

The landscape approach in conservation has seen several applications both globally (e.g., Ichikawa, 2012; Landscapes for People, Food and Nature Initiative, 2012; Scherr et al., 2012; Estrada-Carmona et al., 2014; Milder et al., 2014; Hart et al., 2015; Zanzanaini et al., 2017), as well as regionally in the Hindu Kush Himalaya (HKH) (e.g., NCD, 2004; MFSC, 2006; Zomer and Oli, 2011; MFSC, 2015). Within the HKH, Nepal uses a mixture of protected areas and conservation landscapes to protect biodiversity along north-south gradients; and Bhutan uses protected areas combined with biological corridors to provide connectivity between protected areas and across ecoregions (Dinerstein et al., 2017). These processes involve effort and both financial and human resources from their conceptualization to the operational stage. However, the 'process' that provides lessons for overcoming challenges is generally undermined and not adequately documented. This paper documents the evolution of a transboundary landscape approach in the HKH (Fig. 1). The discourse highlights the rationale for developing the transboundary Kangchenjunga Landscape, the phase wise process from its conceptualization to implementation, and some key lessons that can be applied to other transboundary landscape programs.

2. Rationale for transboundary landscapes in the HKH

The HKH, stretching over four million sq.km across the Himalaya and adjoining ranges, is endowed with rich and globally significant biodiversity at genetic, species and ecosystem levels (Pei, 1995; Wikramanayake et al., 2004; Brooks et al., 2006; Mittermeier et al., 2011). The region also sustains the lives and livelihoods of over 240 million people and supports almost two billion people living downstream in the ten river basins which emanate from these mountainous regions (Molden et al., 2017). It has a significant natural history beginning from the 19th century with notable explorations by botanists, zoologists and nature explorers from across the world (e.g. Hooker, 1854; Blandford, 1872). In recent decades, the region witnessed significant advances in regional approaches to biodiversity conservation which evolved from 'people exclusionary' and 'species focused' to 'people-centred community-based' and 'ecosystem/landscape' approach as reflected by conservation policies and practices within the region (Sharma et al., 2010).

To sustainably support humanity, a working landscape, i.e. 'a landscape that works for biodiversity and people,' must be productive while maintaining ecosystem services, including pollination, pest control, and nutrient cycling (Kremen and Merenlender, 2018). The classical approach to biodiversity conservation emphasized the preservation of flagship species (e.g., Yonzon, 1989; Wikramanayake et al., 1998) but evolved to the understanding that 'conservation and management of biodiversity are impossible without people's participation' (Phuntsho et al., 2012). This resulted in protection of more than 39% of the HKH's geographical area as protected area networks (Chettri et al., 2008). About 20% of these protected areas were

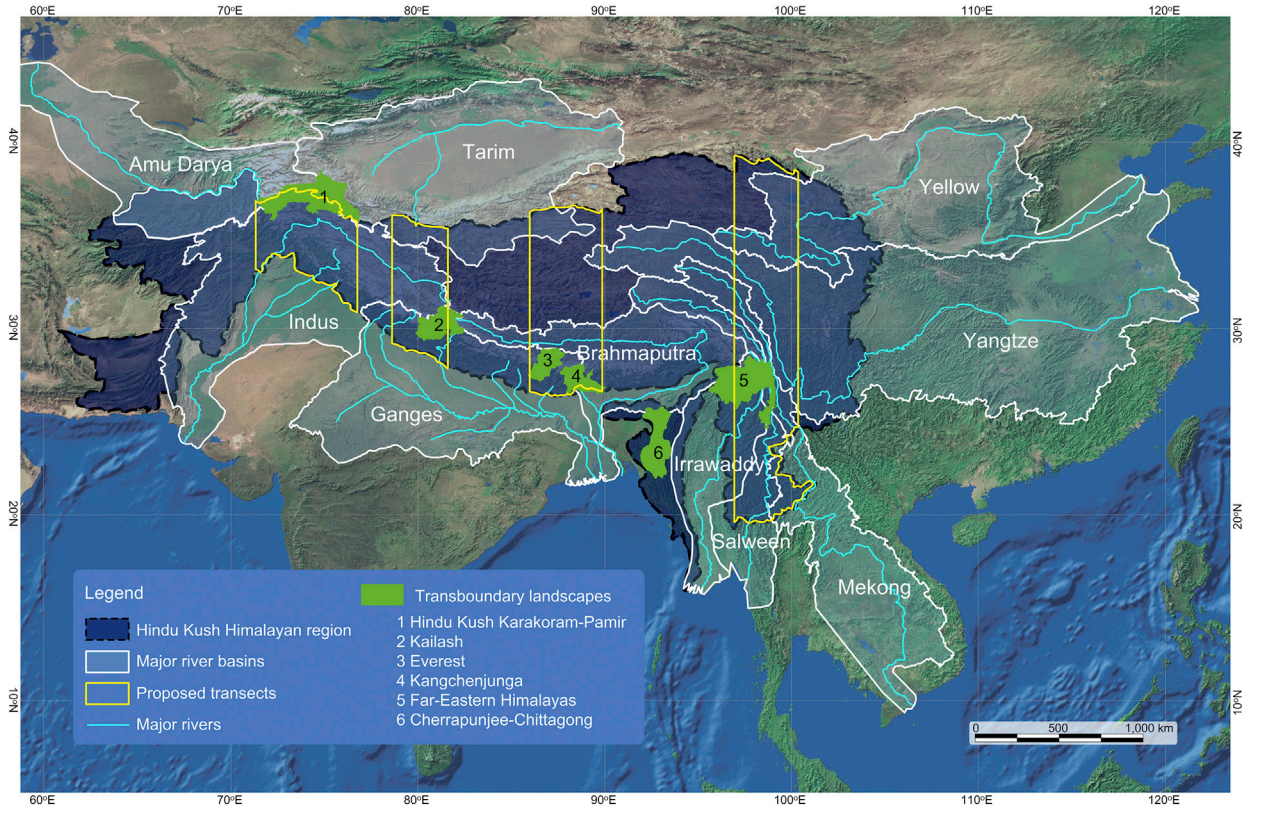

Fig. 1. The six transboundary landscapes in the HKH region.

transboundary in nature with habitats contiguous across political boundaries and having greater conservation significance due to their higher biodiversity values (Chettri et al., 2008). The conservation plans of these protected areas, however, usually encompassed only the country of their location because of logistical, institutional and political challenges (Chettri et al., 2010; Sharma et al., 2010; GoS et al., 2012; Molden et al., 2017). Thus, there was an urgent need to strengthen transboundary conservation planning and landscape approach to ensure connectivity for the survival of species, particularly mega wildlife species (Wikramanayake et al., 2011; Forrest et al., 2012; Palomo, 2017; Sinha et al., 2018).

3. Kangchenjunga Landscape: an evolutionary discourse

3.1. Pre-1997: setting the stage

The cross border protected areas around Mount Everest, the world's highest mountain - Sagarmatha National Park (1,148 sq.km) in Nepal established in 1976 (SNP, 2016) and Qomolangma Nature Preserve (10,325 sq.km) in China established in 1989 and subsequently approved as a National Nature Reserve in 1994 (Zong, 1997) - initiated collaboration in 1986 (Sherpa et al., 2003). In the 1990s, separate regional programs on biodiversity conservation in the Mount Everest ecosystem were implemented by The Mountain Institute (TMI), an international non-profit organization (Sherpa et al., 2003), and International Centre for Integrated Mountain Development (ICIMOD) (ICIMOD, 2004). TMI initiated the Transboundary Biodiversity Conservation in the Eastern Himalayas Program in 1994, while ICIMOD started the Program on Regional Collaboration for Biodiversity Management in the Eastern Himalayas in 1995. At this time, the HKH region witnessed comprehensive stock-taking of its biodiversity for a regional conference facilitated by ICIMOD, an inter-governmental regional knowledge and enabling center, in 1995 (Pei, 1995). This platform provided an opportunity to conduct dialogue for cooperation at the regional scale. Throughout this process, the Kangchenjunga area featured as an ancillary site until 1997 when the first regional consultation to conserve the 'Kangchenjunga mountain ecosystem' was conducted (Rastogi et al., 1997).

3.2. 1997–2001: Kangchenjunga in the limelight

In 1997, ICIMOD and WWF Nepal Program brought together participants from China, India and Nepal with the aim of achieving regional collaboration in the Kangchenjunga region (Rastogi et al., 1997). Recommendations from this consultation

included the establishment of a Kangchenjunga Mountain Ecosystem Coordination Forum which would be responsible for holding a subsequent regional planning workshop in 1998, and designation of the areas around Mount Kangchenjunga as protected areas by the year 2000 (Rastogi et al., 1997). Additionally, frameworks to assess and monitor biodiversity, share conservation benefits with local people, and achieve regional collaboration for management of the Kangchenjunga mountain ecosystem were prepared (Rastogi et al., 1997).

The areas immediately east and west of Mount Kangchenjunga, the world's third highest mountain, currently exist as protected areas. In Nepal, an area of 2,035 sq. km in Taplejung District was declared as Kangchenjunga Conservation Area in 1997 (Bhuju et al., 2007). In India, the Khangchendzonga National Park (KNP) was declared in 1977 initially covering an area of 850 sq. km and later extended to 1784 sq. km in 1997 (GoS, 2014). In 2000, the park was further expanded and designated as a Biosphere Reserve with KNP as the core zone and a buffer zone of 836 sq. km with total area coverage of 2620 sq. km (GoS, 2014).

In 1998, an international meeting on Ecoregional Cooperation for Biodiversity Conservation in the Himalayas was co-organized by UNDP, WWF and ICIMOD followed by a workshop on 'A Biodiversity Vision for the Eastern Himalaya' in 1999 (WWF and ICIMOD, 2001). Applying the 'ecoregion' approach to conservation (Olson and Dinerstein, 1998), the 'Kanchenjunga Landscape' was identified as one among 17 priority conservation landscapes in the Eastern Himalaya (WWF and ICIMOD, 2001). This landscape, spanning an area of 11,500 sq. km (Fig. 2), was delineated largely around India's Teesta river watershed in Sikkim and West Bengal and included six protected areas in India and one, i.e. Kangchenjunga Conservation Area, in Nepal. Three critical priority areas for conservation were identified within the landscape – Singalila-Ilam corridor, Senchal Wildlife Sanctuary, and the Jhapa-Morang-Ilam-Koshi Tappu Corridor (WWF and ICIMOD, 2001).

3.3. 2002–2011: participatory conservation planning

In 2002, ICIMOD initiated the Kangchenjunga Landscape program by building on conservation priorities identified in previous years (Chettri et al., 2007). During the five year period between 2002 and 2006, six potential corridors were

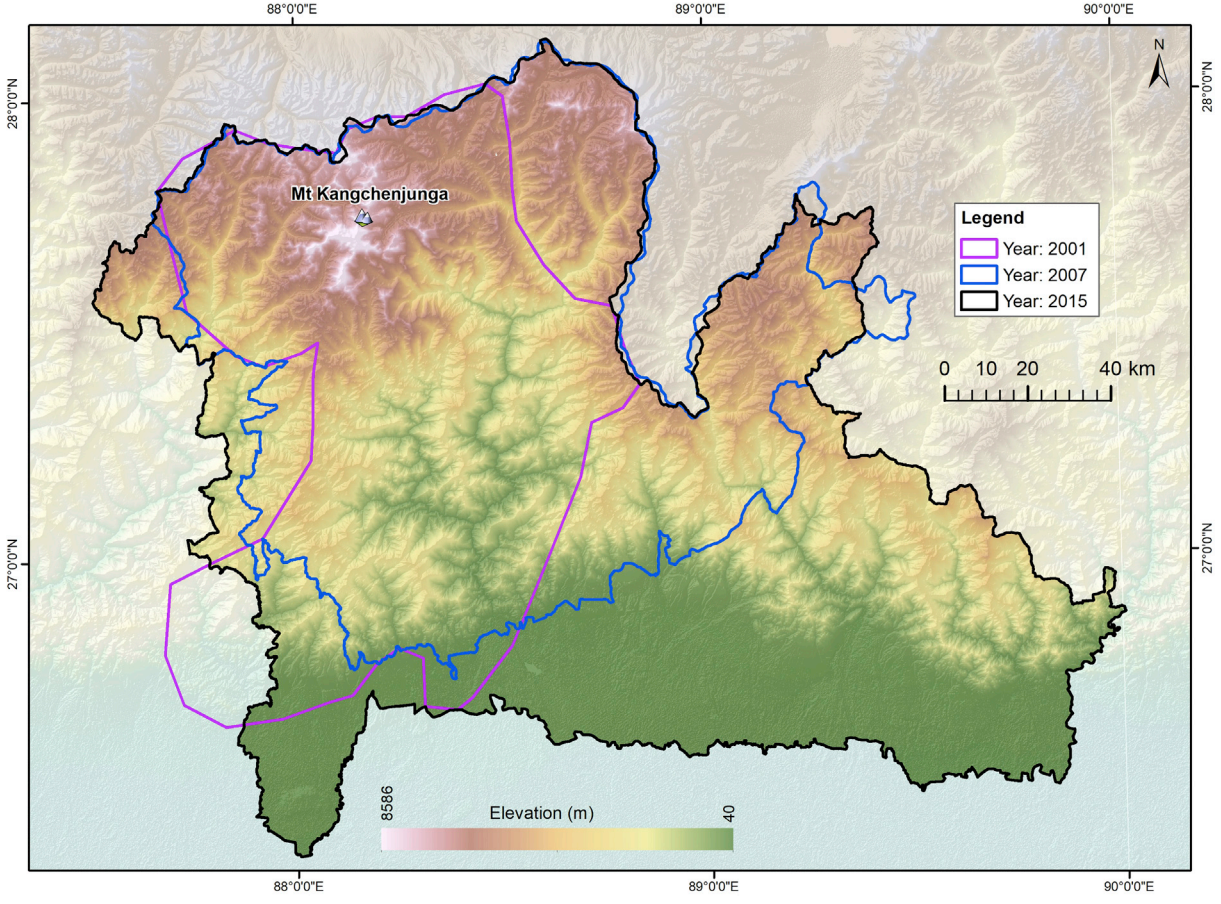

Fig. 2. Evolution of the Kangchenjunga Landscape from 2001 to 2015. Boundary in 2001 included 11,500 sq. km area in India and Nepal (WWF and ICIMOD, 2001); boundary in 2007 included 14,432 sq. km area in Bhutan, India and Nepal (Chettri et al., 2007); while boundary in 2015 included 25,086 sq. km area in Bhutan, India and Nepal (ICIMOD, 2016). [Please note that in some cases the boundaries do not overlay each other because they were delineated based on topographical features.].

identified to connect nine protected areas within the landscape resulting in a revised landscape boundary that encompassed an area of 14,432 sq. km (Fig. 2) (Chettri et al., 2007, 2008). The corridors were subsequently verified on the ground, and detailed assessments were conducted to establish baseline information and prepare management plans. A participatory planning approach was adopted involving both local community members, as well as conservation practitioners working in the corridors (Chettri et al., 2007). In 2006, baseline information on the landscape was collated and presented at a regional workshop which guided the development of a regional cooperation framework for implementation of the Convention on Biological Diversity (CBD) in the Kangchenjunga Landscape (Sharma et al., 2007).

Global and regional events during the first decade of the millennium significantly influenced the direction of the Kangchenjunga Landscape. While the 'ecosystem approach' was adopted by the Conference of the Parties (COP) to the CBD in 1995, its description and five points operational guidance was endorsed in 2000 (Secretariat of the CBD, 2004). In 2004, Mountain Biodiversity was adopted as Decision VII/27 during the CBD's seventh COP meeting (Sharma and Acharya, 2004). The program of work on mountain biodiversity called for achieving targets through various actions, one among which was regional or transboundary collaboration (Sharma and Acharya, 2004). During this time, the Sacred Himalayan Landscape – spanning eastwards from the central mid-hills of Nepal, through the Kangchenjunga region in Sikkim and Darjeeling of India to Jigme Khesar Strict Nature Reserve in Bhutan – covering an area of 29,021 sq. km was also being designed (Gurung et al., 2006; MFSC, 2006; Chettri et al., 2010).

With the release of the IPCC's Fourth Assessment Report (AR4), the HKH was identified as a 'data deficient' region (Rosenzweig et al., 2007). As a result, ICIMOD conceived the 'trans-Himalayan transect' and 'Transboundary Landscape' approach in the HKH in 2008 (Chettri et al., 2009). In this approach, four north-south transects and six transboundary complexes, i.e. Hindukush Karakoram-Pamir, Kailash, Everest, Kangchenjunga, Far-Eastern Himalaya, and Cherapunjee-Chittagong were proposed to achieve transboundary collaboration for research, monitoring and implementation of action research projects (Fig. 1) (Chettri et al., 2009, 2012). Simultaneously, ICIMOD produced a series of comprehensive reports on climate change vulnerability highlighting trends and potential impacts on biodiversity in the Eastern Himalaya (Sharma et al., 2009; Chettri et al., 2010; Tse-ring et al., 2010). Subsequently, ICIMOD initiated the preparatory phase of Kailash Sacred Landscape Conservation Initiative (KSLCI) from 2009 with the governments of China, India and Nepal within a 31,175 sq. km transboundary landscape area around Mount Kailash (Zomer and Oli, 2011). The Kailash Landscape differed from the Kangchenjunga Landscape in that it engaged relevant government institutions at the highest level at its inception and design phase. Based on the lessons learned from the process of both designing and implementing the Kailash program (Pasakhala et al., 2017), the next phase of the Kangchenjunga Landscape was initiated in 2012.

3.4. 2012–present: regional cooperation for Kangchenjunga Landscape

In 2012, ICIMOD brought together stakeholders – comprising of national and state government officials, academics and researchers, and members of local, regional and international organizations – from three countries sharing the Kangchenjunga Landscape, i.e. Bhutan, India and Nepal, to design the transboundary Kangchenjunga program (ICIMOD, 2014a). Over a period of three years, letters of agreement were signed with three national partners of the Kangchenjunga Landscape Conservation and Development Initiative who then assessed the program's feasibility, delineated boundaries for the landscape, prepared conservation and development strategies and implementation plans, and agreed upon a regional cooperation framework for implementing the initiative (ICIMOD, 2014a,b,c; ICIMOD, 2015a; ICIMOD, 2016; ICIMOD et al., 2017a; b).

The recently delineated Kangchenjunga Landscape spreads over an area of 25,086 sq. km across the southern slopes of Mount Kangchenjunga, the world's third highest mountain at 8,586 m asl, covering parts of four districts of eastern Nepal, the entire state of Sikkim and parts of north Bengal in India, and five districts in western Bhutan (Fig. 2) (ICIMOD et al., 2017b). Elevations in the landscape range from 40 to 8,586 m asl. The boundary coordinates of the landscape are at 26° 21′ 40.49″ and 28° 07′ 51.25″ latitude and 87° 30′ 30.67″ and 90° 24′ 31.18″ longitude (Fig. 3). The landscape is globally significant with one Ramsar Site, 22 Important Bird and Biodiversity Areas (IBAs) (Birdlife International, 2014), and 11 Important Plant Areas (IPAs) for medicinal plants (Hamilton and Radford, 2007; GWB, 2010). The floral diversity is one of the highest in the region with more than 4,500 species of plants enumerated from the landscape (Chaudhary et al., 2015; ICIMOD et al., 2017b), many of which have socio-economic, ethnobotanical and commercial values (Pradhan and Badola, 2008, 2013; Uprety et al., 2016; O'Neill et al., 2017). At least 169 mammal species and 618 bird species have been recorded in the landscape (ICIMOD et al., 2017b; Kandel et al., 2018), but information on other taxa, particularly invertebrates, is either limited or lacking (Kandel et al., 2016).

With 19 protected areas under various management regimes in the landscape (Fig. 3), two are globally significant. The Kangchenjunga Conservation Area (KCA) in Nepal was designated a community conserved area in 2006 (Kothari, 2006), while the Khangchendzonga National Park (KNP) in Sikkim-India was designated a UNESCO World Heritage Site in 2016 under mixed category of nature and culture (O'Neill, 2017). Nine among the 19 protected areas are transboundary in nature sharing borders between Nepal and India (Kangchenjunga Conservation Area, Khangchendzonga Biosphere Reserve, Barsey Rhododendron Sanctuary, Singalila National Park), India and Bhutan (Jigme Khesar Strict Nature Reserve, Jaldapara National Park, Buxa Tiger Reserve, Neora Valley National Park), and India, Bhutan and Tibet Autonomous Region of China (Pangolakha Wildlife Sanctuary). A majority of the protected areas are less than 500 sq. km in size, and many are isolated, thereby making them susceptible to inbreeding and genetic loss, with smaller protected areas facing higher risks of species loss through altered ecological processes (Hansen and DeFries, 2007; Haddad et al., 2015). Many of these protected areas are also

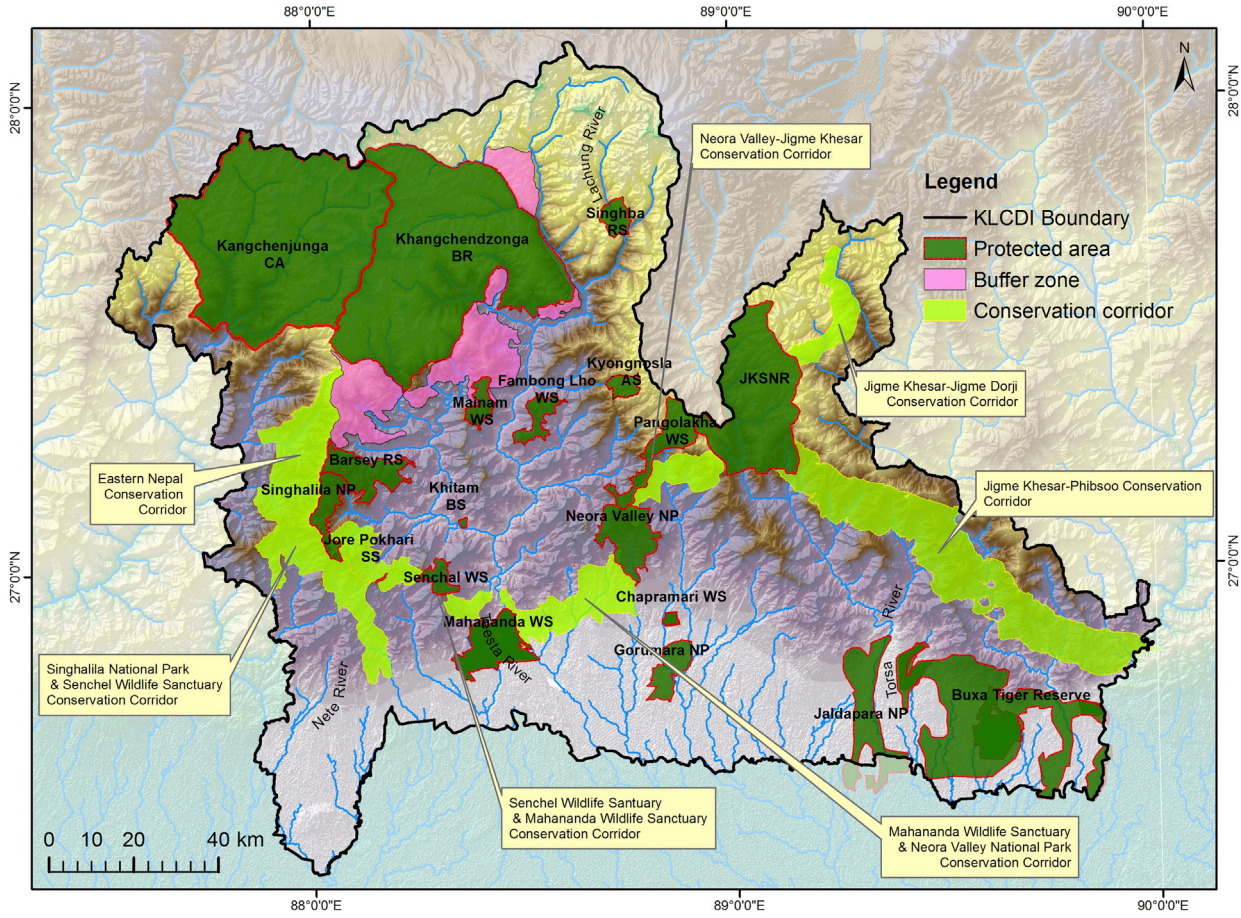

Fig. 3. Protected areas and conservation corridors in the Kangchenjunga Landscape. Note: While the Jigme Khesar-Jigme Dorji Corridor is operational, the other corridors are proposed by KLCDI.

vulnerable to climate change with limited options for movement due to lack of vertical and horizontal connectivity (Chettri et al., 2010; Tse-ring et al., 2010; Chhetri et al., 2018). Furthermore, given future climatic scenarios, these protected areas may lose their effectiveness as refuge to many threatened taxa (Chhetri et al., 2018).

Home to more than seven million people, the landscape is rich in culture with strong interdependencies among the communities between Nepal-and-India and India-and-Bhutan (Badola, 2017; ICIMOD et al., 2017b). There are testimonies of cultural affinities between the highland communities of Haa, Bhutan and North Sikkim, India, as well as between India's North Bengal and Sikkim with Nepal (ICIMOD et al., 2017b). The ecosystems that local people depend upon are contiguous with common characteristics. The local communities practice common approaches in agriculture and livestock rearing, capitalizing on shared tourism destinations between the countries, and facing common challenges such as human-wildlife conflict, wildlife poaching and trade, and climate change (ICIMOD et al., 2017b). These shared social-ecological characteristics and challenges formed the basis for adopting the transboundary landscape approach in the Kangchenjunga region.

One of the defining aspects of this phase of transboundary conservation initiative in the Kangchenjunga Landscape was the involvement of the highest level of relevant government institutions at the initial stages – Ministry of Agriculture and Forests (MoAF) in Bhutan; Ministry of Environment, Forest and Climate Change (MoEFCC) in India; and Ministry of Forests and Environment (MoFE) – then termed Ministry of Forests and Soil Conservation (MFSC) – in Nepal. This ensured that the initiative was in congruence with national priorities such as biodiversity strategies and action plans (MoEF, 2008; GoS et al., 2012; MFSC, 2014; MoEFCC, 2014; NBC, 2014), landscape and corridor programs (NCD, 2004; MFSC, 2016), and ongoing conservation programs being implemented in the region (CEPF, 2005; MFSC, 2006). Furthermore, it facilitated the endorsement of a regional cooperation framework by relevant ministries of Bhutan, India and Nepal for implementing the transboundary initiative (ICIMOD et al., 2017a). A summary of the chronology of events that shaped the transboundary landscape approach in the Kangchenjunga Landscape is presented in Fig. 4.

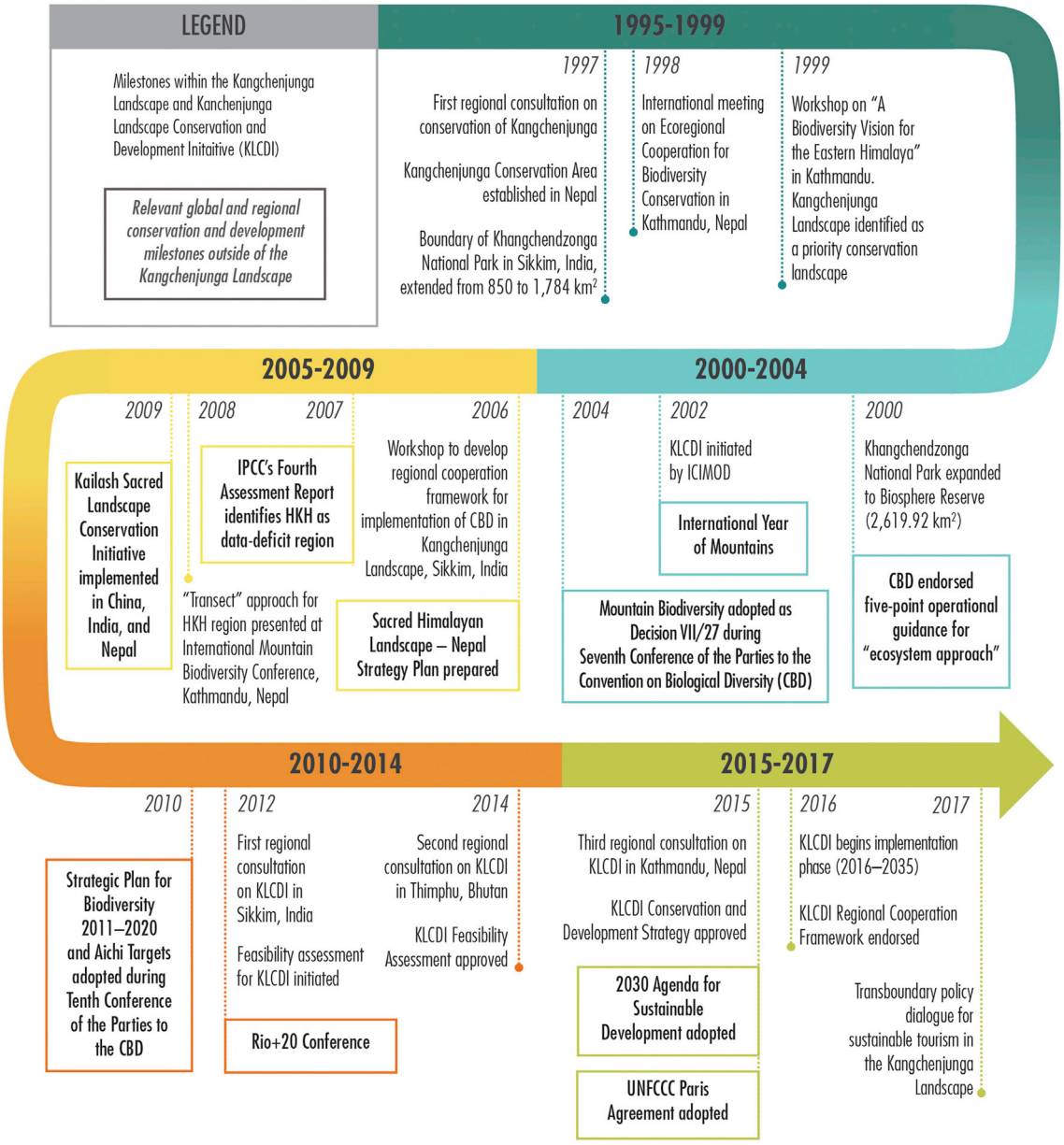

Fig. 4. Chronology of significant events in the Kangchenjunga Landscape along with relevant global and regional events.

4. A theory of change for transboundary landscape conservation and development

Successful implementation of programs in transboundary settings requires a shared understanding of common issues which is commonly achieved through a series of purposeful interactions between stakeholders at different scales (Renkow and Byerlee, 2010). Moreover, intelligent planning and management tools are required to address the complex issues found in transboundary landscapes (Gladwell, 2006; Patton, 2010). One such tool used for KLCDI was the participatory development of theory of change and impact pathways which brought together multiple stakeholders from the landscape, stimulated them to discuss common issues and challenges, and agree on mutually acceptable solutions for the landscape (Kusters et al., 2016).

A theory of change was developed for KLCDI identifying the pathways of change, pre-conditions and expected outcomes (ICIMOD, 2016). Six pathways of change were identified (Fig. 5) to achieve conservation and management of the Kangchenjunga Landscape: i) ecosystem-based approaches for integrated transboundary conservation and development, ii) management of protected areas, Ramsar sites, biological corridors, and ecosystems outside protected areas, iii) promotion of

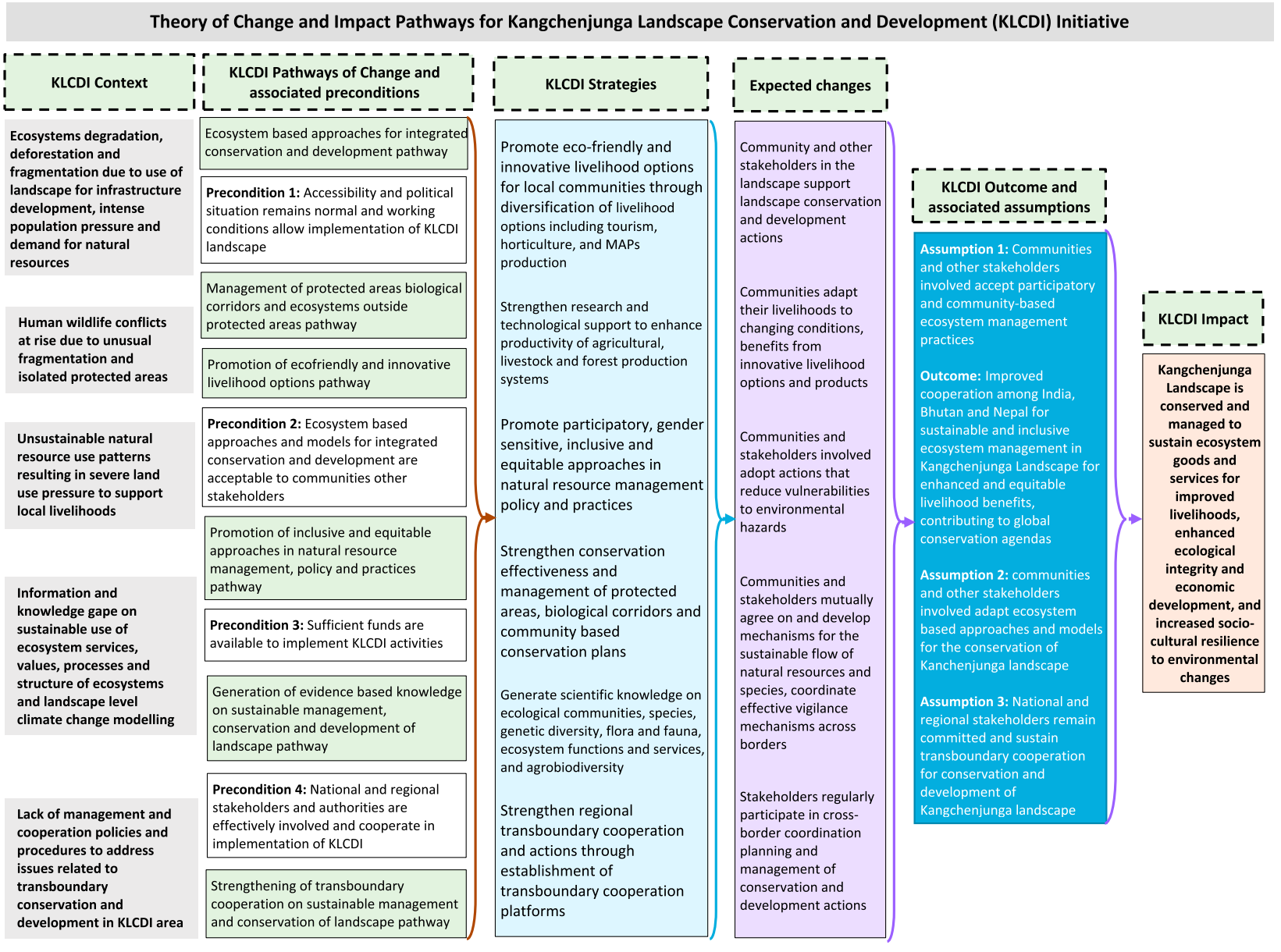

Fig. 5. Impact pathways and theory of change flow diagram for Kangchenjunga Landscape.

ecofriendly, inclusive, and innovative livelihood options, iv) strengthening governance for social-ecological system thinking in policy and practices, v) generating and sharing evidence based knowledge on sustainable management, conservation and development, and vi) strengthening transboundary cooperation on sustainable management and conservation of the landscape.

Participatory development of the theory of change and impact pathways not only helped stakeholders develop a common understanding of conservation and development issues, but it also helped them to agree on coordination and delivery mechanism for the program. The discussions, negotiations and joint planning exercises conducted during the process contributed to a greater ownership of the KLCDI by the stakeholders. At the same time, it also helped to identify pathways, pre-conditions and assumptions, expected success scenarios and broader strategies that are required to achieve the desired outcome of the program.

5. Key learnings from the transboundary Kangchenjunga landscape initiative

With a journey spanning two decades, valuable learnings have resulted from the Kangchenjunga Landscape with implications for designing, planning and implementing transboundary landscape programs. Building on the adaptive management process for ecosystem management in the HKH (Yi et al., 2017), the key components for ensuring transboundary landscape management are highlighted in Fig. 6.

5.1. Landscape boundary delineating process must be participatory and iterative

Landscape boundaries are not static; they alter when the processes that define their boundaries change over a given period of time. The boundary of the Kangchenjunga Landscape changed with evolving conservation priorities from 2001 to the present (Fig. 3). In the phase starting from 2012, when the KLCDI program was conceived and implemented, boundary delineation was one of the priority tasks of the implementing partner institutions. Key stakeholders from the government, research institutions, non-government organizations, and local communities participated in the process of boundary delineation.

Three major themes – ecology and conservation, livelihoods and development, and management and planning – were applied to delineate the landscape boundary (Table 1) (Chaudhary et al., 2015; ICIMOD et al., 2017b). For instance, the inclusion of protected areas, biological corridors, Ramsar Site, IBAs and IPAs within the landscape boundary has ecological and conservation significance. Moreover, the criteria of including areas prone to human-wildlife conflicts resulted in the inclusion of lowland grasslands and moist deciduous forests in the southern portion of the landscape. Here, conflicts between humans and elephants are consistently increasing as a result of increased human population within the last three decades, along with increased rates of forest fragmentation and infrastructure development which have resulted in the loss of elephant habitat and disruption of their migratory paths (Kansakar, 1985; ICIMOD et al., 2017b).

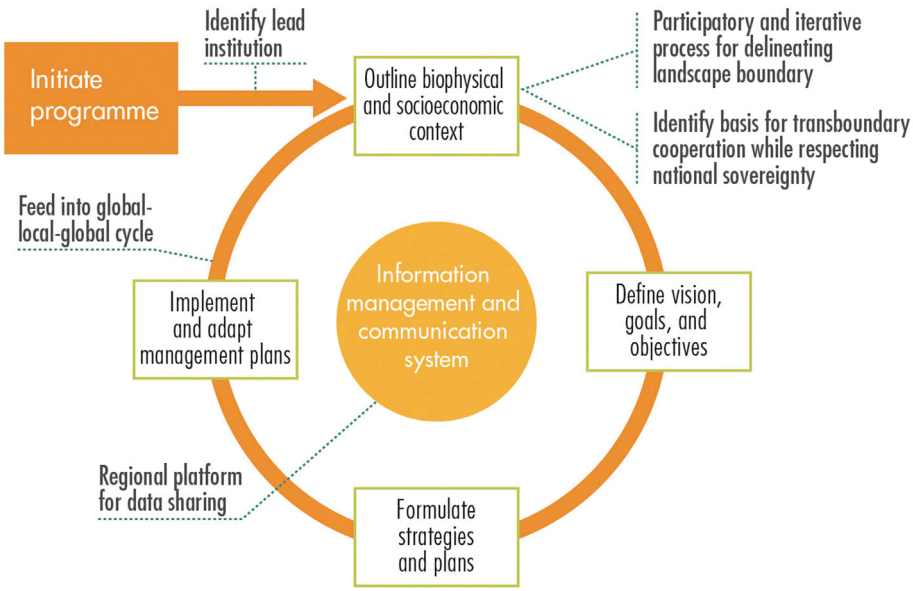

Fig. 6. Key components for transboundary landscape management transposed within the ecosystems management framework (Yi et al., 2017) for HKH.

Table 1
Thematic areas and criteria for landscape boundary delineation.

Thematic area	Criteria
Ecology and conservation	• Transboundary ecosystem contiguity and ecosystem services • Eco-climatic zones and environmental gradients • Key biodiversity areas including migratory habitats, biodiversity corridors, Important Bird Areas, Important Plant Areas • Protected areas, wetlands (including Ramsar Sites), other priority conservation areas • Watershed and river basin coverage for headwater areas of major rivers originating in the landscape • Habitat ranges of endemic, indicator, and/or threatened species
Livelihoods and development	• Livelihood linkages with conservation and development • Culturally significant sites including pilgrimage routes • Existing and potential tourism areas • Vulnerability to globalization, migration, and other drivers of change • Urbanization and infrastructure development • Human-wildlife conflict affected areas • Indigenous knowledge, access and benefit sharing
Planning and management	• Areas vulnerable to shocks and stresses • Areas that are currently or potentially under threat from conservation perspective

Source: Chaudhary et al. (2015); ICIMOD et al., 2017b.

5.2. Transboundary cooperation requires respect for national sovereignty

Many social processes in the Kangchenjunga Landscape are historically transboundary in nature. There is a shared culture within the landscape, and a number of indigenous ethnic communities, such as the Lepcha, Limbu and Mech (or Meche) people, have made their homes in the landscape – notwithstanding geo-political boundaries – for hundreds of years (Dalton, 1872). The mid-1800s to early-1900s witnessed a surge of Nepali migration into Darjeeling District in India mostly to work in the newly established tea estates which would later become one of the key economic industries in the district (Das, 2008). Nepalis are now the major social group that form the district's population (Census of India, 2011). In the highlands of the landscape, transboundary movement of livestock, herders and farmers, particularly between Bhutan-India and India-Nepal, was responsible for genetic exchange of yak breeds, forage seeds and farming practices (Wu et al., 2016).

Ecological processes in the Kangchenjunga Landscape also transcend geo-political boundaries. Many ecosystems and ecoregions are contiguous in the landscape. Mount Kangchenjunga is itself shared by India and Nepal (Freshfield, 1903) with parts of the range occurring in Sikkim, India, and parts in Taplejung, Nepal. In most areas of the landscape where there are no major physical barriers for wildlife movement, species with large home ranges are known to migrate across geo-political barriers: a snow leopard was tracked moving in and around Kangchenjunga Conservation Area in Nepal and Khangchendzonga Biosphere Reserve in Sikkim, India (MFSC, 2017); and Asian elephants from West Bengal migrate to Eastern Nepal and Bhutan and even further east to Assam (Tiwari et al., 2017).

The existing cross-border social and ecological dynamics are the bases for transboundary cooperation in the Kangchenjunga Landscape (ICIMOD et al., 2017a). Critical issues that necessitate transboundary cooperation include the illegal trade of wildlife products, human-wildlife conflicts, cross-border pastoral practices, transboundary tourism, and environmental problems arising from mining, illegal timber harvesting, waste disposal, and use of pesticides. Both field-level, as well as policy-targeted actions have been undertaken to address some of the pressing transboundary issues in the landscape (e.g., ICIMOD and NCD, 2018; ICIMOD, 2019). Existing policies at the individual country level to address these issues have been accounted for while addressing the transboundary nature of these pressing problems in the landscape.

5.3. One must lead the many stakeholders

The landscape approach requires a multi-sectoral approach that engages a variety of stakeholders to address the existing, often complex, social-ecological challenges (Freeman et al., 2015). However, assuming the leadership role by one key relevant institution at the country level is important to ensure both national sovereignty, as well as effective stakeholder engagement. Within the Kangchenjunga Landscape, lead roles are undertaken by MoAF in Bhutan, MoEFCC in India, and MoFE in Nepal, who ensure alignment of the landscape program with national priorities and programs. Implementation of the program in pilot sites of the landscape was entrusted to Nature Conservation Division in Bhutan, GB Pant National Institute of Himalayan Environment and Sustainable Development in India, and Research Centre for Applied Science and Technology in Nepal. The implementing organizations coordinate with several stakeholders, particularly with provincial and local governments, along with academia, research institutions, non-governmental organizations, private sector, and community organizations.

5.4. Transboundary landscape approach must facilitate the global-local-global feedback cycle

Several global and regional events have catalyzed the evolution of the Kangchenjunga Landscape (Fig. 4). While the CBD's 'Ecosystem Approach' contributed to the adoption of a landscape scale program in the Kangchenjunga region, the IPCC's Fourth Assessment Report triggered the design of transboundary north-south transects across the HKH region for research

and monitoring through action research projects. Regional programs such as the Sacred Himalayan Landscape in Nepal and Kailash Sacred Landscape Conservation and Development Initiative in China, India and Nepal, were also instrumental in shaping the Kangchenjunga Landscape program, particularly in developing the regional cooperation framework for implementing the program.

Applying global concepts at the local level requires the formulation of strategies and actions that match with the local context (Erg et al., 2012). In the Kangchenjunga Landscape, this involved a rigorous process of developing implementation plans for the project at both national and regional levels. Strategies were identified to address major biodiversity conservation and sustainable development challenges in the landscape (ICIMOD, 2014c; ICIMOD, 2015b). These strategies were then applied to develop a Theory of Change and implementation plans at the national and regional level. Based on these implementation plans, pilot projects are currently on-going to address key issues of ecosystem degradation, human-wildlife conflicts, unsustainable natural resource use patterns, data gaps, and transboundary cooperation in the landscape. Results from the pilot projects will be collated for the landscape, and the scientific data produced thereafter can be used to feed into data analysis processes at the national or regional levels, which in turn can contribute to global assessments and frameworks (Fig. 7).

5.5. Sharing data through a regional platform has multiple benefits

Knowledge sharing is one of the key aspects of transboundary collaboration (Molden et al., 2017). Among a variety of knowledge products, scientific data is a valuable resource that can be shared at the transboundary level in the Kangchenjunga Landscape. Sharing data has many benefits: data can be 'reused' by other researchers to create new knowledge (Zimmerman, 2008); data can be used by non-researchers for decision-making purposes (Arzberger et al., 2004; Michener, 2015); and multiple 'smaller' datasets can contribute to a 'big-data landscape' which can then be used to solve large-scale ecological problems (Hampton et al., 2013).

One of the regional platforms for sharing data in the HKH region is the Regional Database System (RDS), an online platform, which is housed at ICIMOD (Uprety et al., 2014). The RDS is a central data repository for storing data on several thematic areas pertaining to the HKH region. It can be accessed through 'rds.icimod.org'. Currently, the RDS houses 35 records on the Kangchenjunga Landscape and includes data and/or metadata on topographic features, land-use and land-cover change, protected areas and corridors, and biodiversity. Another regional platform that provides access to publications on KLCDI is through the Himaldoc (http://www.icimod.org/?q=11420). Regional knowledge sharing through various platforms provided a sound basis for addressing transboundary issues in the landscape.

6. Conclusion

Within a period of almost two decades, the Kangchenjunga Landscape evolved from a concept into a transboundary conservation initiative implemented by the governments of Bhutan, India and Nepal. Although shaped by global and regional events, this transboundary landscape aligns itself to national priorities on sustainable development and biodiversity conservation. The landscape approach is a long-term and iterative process which is evidenced by the changes that the Kangchenjunga Landscape has experienced from 1997 to the present. Adapting to the changing priorities in the landscape is an important feature in the KLCDI program's theory of change. Moreover, key learnings from the Kangchenjunga Landscape program has added to our working knowledge of the landscape approach and transboundary conservation. Together, they can be applied in other transboundary landscapes to achieve sustainable livelihoods while contributing to global targets on biodiversity and sustainable development.

The transboundary landscape approach continues to be a dynamic process. The next phase of the Kangchenjunga Landscape is focusing on presently critical issues that include landscape governance at the transboundary level and funding

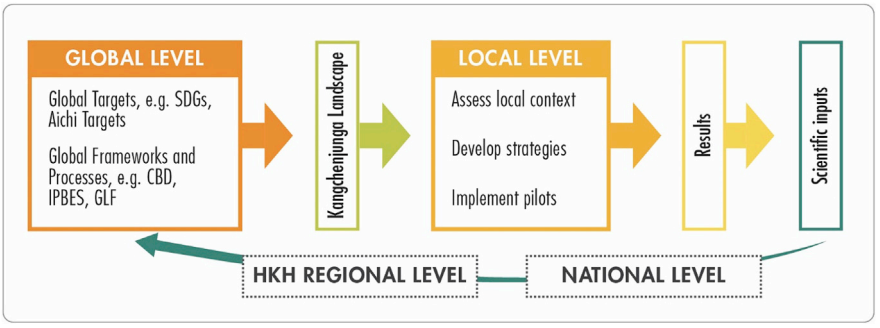

Fig. 7. The global-local-global feedback cycle in the Kangchenjunga Landscape.

mechanisms for long-term sustainability. The lessons learned from other regional and global landscape programs in these aspects can be useful for ensuring the governance and long-term financing of the Kanchenjunga Landscape.

Disclaimer

The views and interpretation in this publication are those of the authors and should not be ascribed to their respective institutions.

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Appendix A. Supplementary data

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