WWF

NEPAL

CONNECTING CORRIDORS

TERAI ARC LANDSCAPE

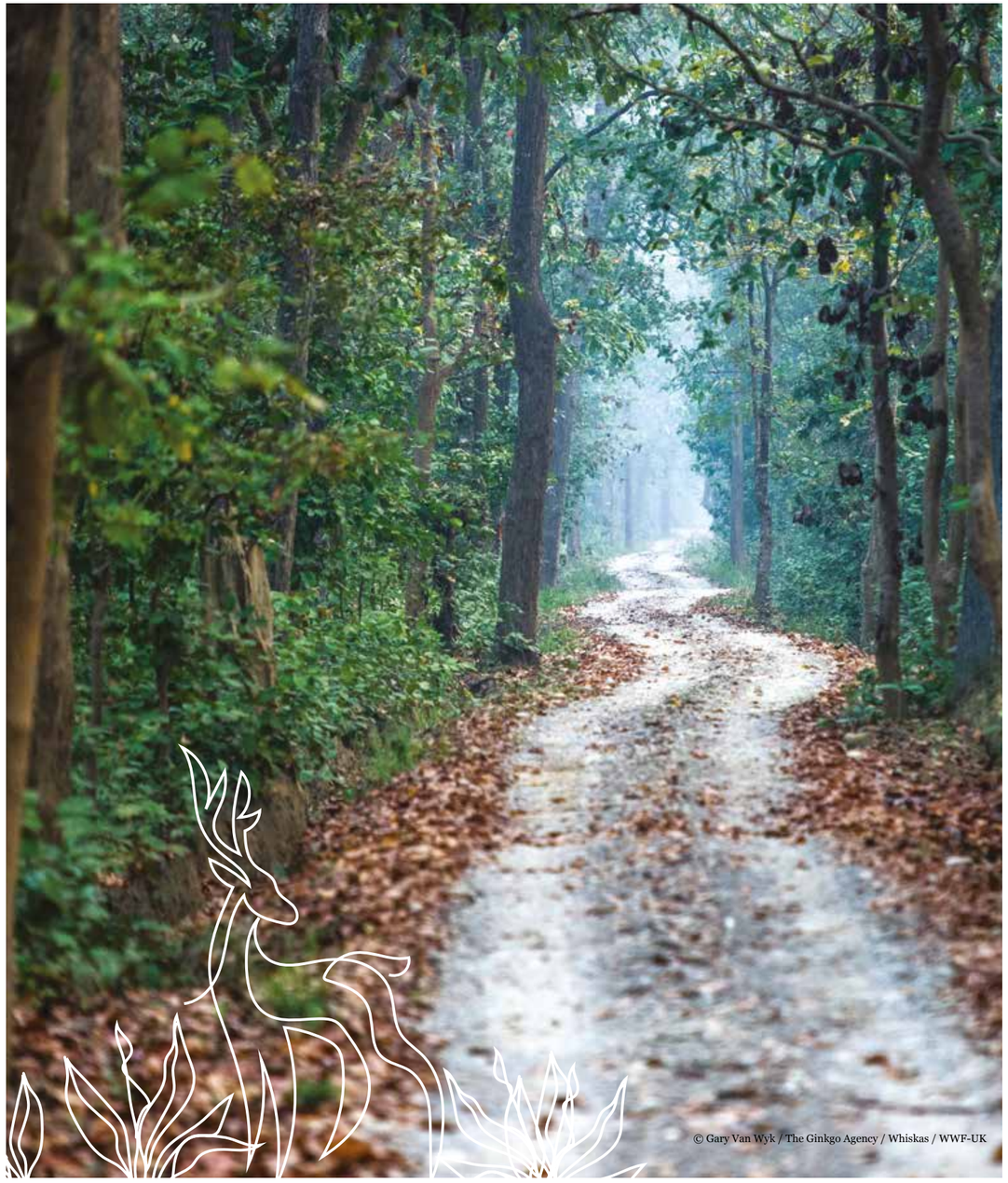
Citation:
Thapa, K., Tuladhar, S. (Eds.) 2021. Connecting Corridors. WWF Nepal, Kathmandu, Nepal.

Cover Image:
© Audra Melton / The Coca-Cola Company / WWF

Designed by:
Kazi Studios

Published by:
WWF Nepal
PO Box: 7660
Baluwatar, Kathmandu, Nepal
T: +977 14434820, F: +977 1 4438458
info@wwfnepal.org, www.wwfnepal.org

CONTENTS



MESSAGE

WWF Nepal first embarked on its journey of conservation in the Terai Arc Landscape in early 2001, when the landscapes in Nepal and India were home to an estimated 3,765 tigers; the highest number of tigers in the world. The Terai Arc Landscape was consequently accorded the status of being one of the most critical tiger landscapes among 13 tiger range countries. Unfortunately, these numbers saw a sharp decline in ensuing years, as poaching, habitat loss, degradation, and human tiger conflict increased.

The Terai Arc Landscape was conceptualised primarily based on the tiger dispersal model, which aimed to increase the persistence of tigers over a larger landscape, beyond initial source populations within protected areas. This laid the foundations for conservation efforts in Nepal's corridors, ranging from forest restoration, reducing threats to species, safeguarding livelihoods, to effective transboundary cooperation between Nepal and India. Corridor functionality as measured by tiger dispersal is evident in many corridors in the landscape today. This functionality has triggered the importance of corridor connectivity, contributing towards the persistence of tigers in the landscape. Today, the transboundary Terai Arc Landscape boasts over 880 tigers; with both Nepal and India having close to doubled their tiger numbers, a testament to the unwavering resolve and belief in the landscape approach of conservation partners, positioning Nepal as a leader in tiger conservation.

Since its first program was implemented in the Khata Corridor, WWF Nepal has continued to galvanize its efforts towards improving ecological connectivity between protected areas and enhancing benefits to communities living alongside the corridors of Nepal. This would not have been possible without the sustained efforts of multiple stakeholders, primarily local communities working tirelessly in diverse roles such as citizen scientists, community based anti-poaching units, forest guards and social mobilizers.

The two-decade long partnership with the government has yielded remarkable results with most of the corridors now fully functional. WWF Nepal remains committed in supporting the Government of Nepal and its communities in corridor restoration efforts and also reaffirms its commitment to international initiatives such as the UN Decade of Ecosystem Restoration (2021-2030) to ensure healthy ecosystems for the benefit of people and nature.

This publication foregrounds the many interventions, achievements, challenges, and setbacks faced while restoring the critical corridors of the Terai Arc Landscape, accentuating the critical relationship with local communities, and conservation partners at the park, state, and government levels. I extend my sincere gratitude to the Government of Nepal, our donors, the WWF Network, and our partners for joining forces in realizing our conservation goals in the Terai Arc Landscape.

Ghana S Gurung, PhD

Country Representative
WWF Nepal

TESTIMONIALS

"Terai Arc, Nepal is a priority landscape identified by the Government of Nepal. Over the last twenty years the government has prioritized forest restoration initiatives and facilitated ecological connectivity along these critical corridors identified in the Terai Arc Landscape. Nepal's work in ecological corridor connectivity is a tried and tested model, replicable globally. This publication demonstrates the collaborative and cohesive efforts of the government—national, provincial and local—communities, conservation partners and other stakeholders."

KRISHNA PRASAD ACHARYA, PhD

SECRETARY, MINISTRY OF AGRICULTURE AND LIVESTOCK DEVELOPMENT
GOVERNMENT OF NEPAL

"Guided by the Terai Arc Landscape Strategy and Action Plan, the project is the longest running program by the Government of Nepal. The Department of Forest and Soil Conservation in partnership with WWF Nepal continues to support on the ground forest restoration initiatives, community stewardship programs, and wildlife management in protected areas and corridors across the landscape. The results over the last 20 years have been tremendous with improved forest cover, wildlife dispersal and community stewardship. This publication not only documents the history of conservation in these corridors, but also outlines the emerging challenges and opportunities that lay ahead."

MAN BAHADUR KHADKA

DIRECTOR GENERAL, DEPARTMENT OF FORESTS AND SOIL CONSERVATION
MINISTRY OF FORESTS AND ENVIRONMENT

"Securing ecological connectivity and human wellbeing in the complex and ever more crowded landscapes of our planet is the conservation challenge of our time. This report showcases brilliantly how local communities in Nepal have tackled this challenge head on, with enormous success. Their leadership in restoring and managing their forests in ways that strengthen their development as well as providing permeability for wildlife is inspirational and gives us all a fantastic base of lessons to scale up throughout Asia and beyond. The future still holds many challenges, and much support will be needed to holistically address these challenges to ensure a long-term resilient future for people and wildlife in the Terai."

WENDY ELLIOTT

DEPUTY LEADER, WILDLIFE PRACTICE
WWF INTERNATIONAL

"In Nepal's context, connectivity is key to the doubling of tigers in the wild - which Nepal is on course to do. During the last 20 years, interventions have been tried, tested and proven. The results speak for themselves. From the siting of corridors and habitat restoration to building community ownership and trust, these techniques have all contributed to the extraordinary success that is the Terai Arc Landscape."

STUART CHAPMAN

LEAD, TIGERS ALIVE INITIATIVE

NEPAL'S CORRIDOR HISTORY

LOCAL EFFORTS, GLOBAL IMPACT

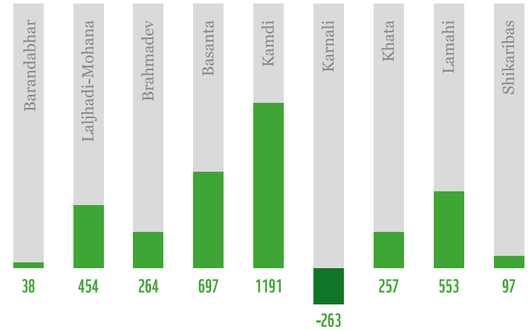
KANCHAN THAPA, SHAYASTA TULADHAR

Wildlife movement from one forested area to another is a natural process that does not adhere to geographical boundaries: in fact, this movement is crucial for gene flow and genetic diversity. Unfortunately, growing urbanization and development across landscapes has led to the fragmentation of forested wildlife habitats and, today, these patches of forests are primarily contained within protected areas. Corridors, which include defined forested areas intermixed with grasslands and wetlands, provide connectivity between protected areas and are integral for easy dispersal of wildlife populations in conservation landscapes. With wildlife populations declining globally, it is imperative to prioritize or scale up restoration efforts in corridors, particularly in large natural areas and interconnected forests.

Located in the shadows of the Himalayas, the trans-boundary Terai Arc Landscape stretches from Nepal's Bagmati River in the east to India's Yamuna River in the west, connecting 16 protected areas across both countries. Envisioned by the Government of Nepal in 2001, the Terai Arc Landscape was based on the tiger dispersal model and the realization that conservation interventions within protected areas alone would not be enough to increase the persistence of tigers in the long run. A key characteristic of the Terai Arc Landscape, Nepal is the presence of six protected areas, eight corridors and two bottlenecks: a landscape conservation approach that facilitates wildlife dispersal between transboundary protected areas while also engaging local communities in forest restoration and management.

Nepal currently has five protected areas dedicated to tiger conservation; however, these areas alone are inadequate in terms of sustaining tiger populations in the long term. Large investments have, therefore, been made to secure and restore connectivity in biological corridors to achieve gene flow between populations and avoid inbreeding depression. In the last 20 years, the Government of Nepal devised two landscape strategies and action plans (2004-2014 and 2015-2025) for the Terai Arc Landscape supported by conducive policies under which the community forest program and buffer zone approach were developed and implemented.

This publication outlines the importance of Nepal's various biological corridors, conservation interventions, and status in terms of functionality. It highlights the various challenges that have risen to the forefront, such as habitat loss or degradation, negative human wildlife interactions, poaching, and climate vulnerabilities



NET FOREST COVER CHANGE IN THE LAST 5 YEARS, 2015-2020 (IN HA)

such as forest fires, droughts, and flooding, etc. While these threats and vulnerabilities have been tackled through a combination of strategic field level interventions such as protection, management, and restoration, all guided by the Terai Arc Landscape Strategy and Action Plan, these threats and vulnerabilities will continue to persist if conservation efforts abate. Meanwhile, a primary emerging challenge is the development of linear infrastructure, with roads, highways, and irrigation canals increasingly bisecting corridors and national parks, and disrupting connectivity. Mitigation measures such as sustainable green infrastructure, and adequate policy framework and guidelines, will therefore be critical in maintaining or recreating connectivity as we move ahead.

The two-decade long partnership with the government has yielded remarkable results, with most of the corridors now functional. Today, corridor functionality as measured by wildlife dispersal, including tigers, is evident in a majority of identified corridors in the landscape—Shikaribas, Barandabhar, Kamdi, Khata, Karnali, Basanta, Laljhadi-Mohana, and Brahmadev. Meanwhile, moderate tiger genetic diversity estimated at 61% highlights the success of restoration efforts in corridor connectivity. A key contributing factor has been inclusive conservation models that prioritize the role of communities and community-based conservation in the restoration of wildlife habitats.

However, the functionality of these habitats can easily change with variations in habitat dynamics, and the loss of these biological corridors could result in the loss of all three structural, functional, and compositional functions of the landscape. Ecosystem restoration is critical for both communities and wildlife, a fact exemplified by initiatives such as the UN's Decade on Ecosystem Restoration (2021-2030) which aims to halt and reverse the degradation of ecosystem across the world through massive restoration efforts. Nepal's efforts in corridor restoration are expected to complement global initiatives such as these. The functionality of these corridors today, are also owed to major flagship projects such as USAID's Hariyo Ban Program, GEF/UNDP/SNV/LIBIRD/WWF's Western Terai Landscape Complex Project, GEF/NTNC's Tiger Rhino Project, IUCN-KFW's Integrated Tiger Conservation Habitat Project, and numerous others over the last 20 years in Nepal.

Protected Area, Nepal
Terai Arc Landscape, Nepal
Buffer Zone
Corridor
Protected Area [TAL India]

NP - National Park
CA - Conservation Area
WLS - Wildlife Sanctuary
TR - Tiger Reserve

CHINA

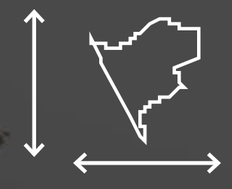
NEPAL

INDIA

Brahmadev
Shuklaphanta NP
Basanta
Karnali
Bardia NP
Pilibhit TR
Dudhwa NP
Laljhadi - Mohana
Katarniaghat WLS
Khata
Banke NP
Lamahi
Kamdi
Suhelwa WLS
Barandabhar
Chitwan NP
Parsa NP
Valmiki TR
Sohagi Barwa WLS
Shikaribas

0 25 50 100 150 200
Kilometers

SHIKARIBAS CORRIDOR



CORRIDOR AREA
3.26 sq. km

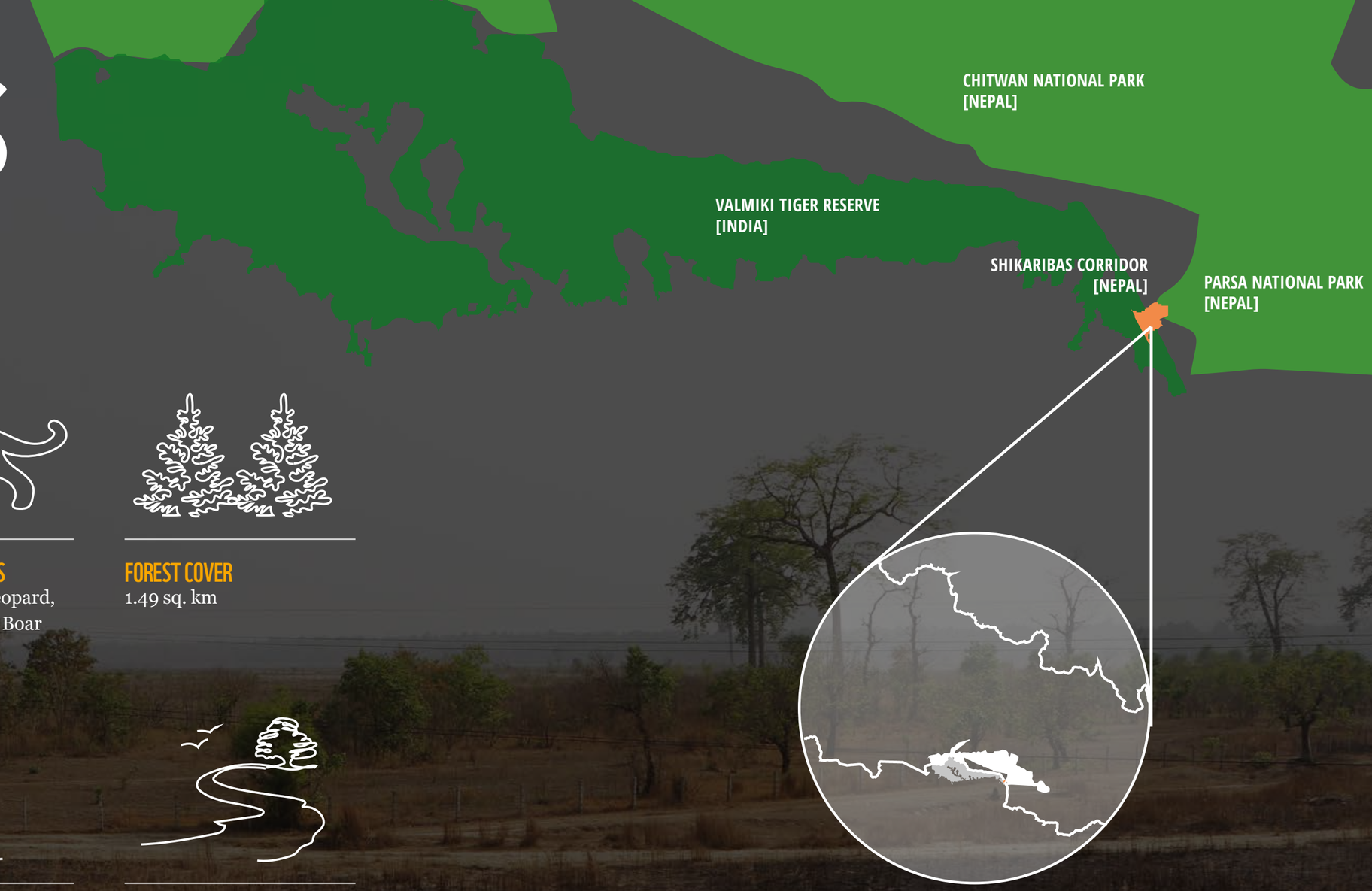
KEY WILDLIFE SPECIES
Tiger, Elephant, Leopard, Deer Species, Wild Boar

FOREST COVER
1.49 sq. km

PRIMARY HABITAT TYPES
Mixed Hardwood Forests and Grasslands

PRIMARY CHALLENGES
Encroachment, Fuelwood Collection, Postal Highway

MAJOR RIVERS
Shikaribas Khola



SHIKARIBAS

NEPAL'S SMALLEST CORRIDOR

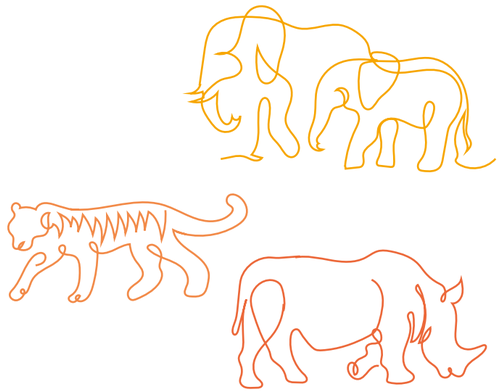
KANCHAN THAPA, KAMAL RAJ RAI, SHAYASTA TULADHAR

In the winter of 2015, a local herder basking in the sun on the Shikaribas bridge saw a herd of elephants at a far-off distance, swiftly marching towards the Valmiki Tiger Reserve. The elephants were moving through the narrow strip of forests, which we know today as the Shikaribas Corridor. Shikaribas, which literally translates to "hunter's place" in Nepali is a relatively new area in the Terai Arc Landscape, with the potential to become a functional corridor. Named after the river Shikaribas, this is the smallest amongst the corridors in the Terai Arc Landscape, and the only one that connects two national parks—Chitwan National Park and Parsa National Park—in Nepal, with the Valmiki Tiger Reserve in India. The Shikaribas river also forms the administrative boundary between Chitwan and Parsa National Parks in the southeastern part of the complex.

The slender deciduous forest corridor measuring just over 3.26 sq. km lies halfway between the buffer zones of Chitwan and Parsa National Parks. This corridor is strategically placed within 3,669 sq. km of forested area that comprises of the Chitwan-Parsa-Valmiki Complex, and allows for the dispersal of large mammals such as tiger, elephant, rhinoceros etc. within the three transboundary protected areas.

From a bird's eye view, the Shikaribas Corridor has a mosaic pattern with mixed hardwood forests, dry seasonal riverbeds, and restored habitats with agricultural fields along the side. The Chitwan-Parsa-Valmiki Complex holds approximately 141 tigers, 697+ rhinoceros, and 50+ migrating elephants in its three protected areas. As such, restoration initiatives in the Shikaribas corridor are critical for the survival and wellbeing of these long ranging mammals, within the complex and beyond. Possibly due to its relatively small size, the restoration of Shikaribas Corridor did not receive initial attention. Periodic assessments of forest cover change however showed drastic loss in forest cover between 2001 and 2015.

Without conservation interventions, the ongoing trend of forest cover loss would have resulted in diminished connectivity among the protected areas in the Chitwan-Parsa-Valimiki Complex. However, with concerted efforts from the government, conservation groups and local communities, this forest loss was halted under a pioneer forest restoration initiative in Shikaribas Corridor that commenced in 2016. This is the second corridor after Barandabhar where corridor restoration in the buffer zone of Protected Areas is relatively new.



THE SOUTHERN SIDE OF THE CHITWAN-PARSA-VALMIKI COMPLEX LIES WITHIN THE CHURE AND BHABAR PHYSIOGRAPHIC ZONES, WHERE WATER IS BOTH A LIMITING AND REGULATING FACTOR FOR SPECIES AND THEIR DISPERSAL - MOST AVAILABLE STREAM BEDS ARE SEASONAL IN NATURE AND THE SUB-SURFACE REMAINS DRY MOST OF THE TIME.

Forest Guard guarding the plantation site in Shikaribas Corridor

ENCROACHMENT, DRY SPELLS, AND INFRASTRUCTURE

The Tharu people are the original inhabitants of the Shikaribas Corridor, however large-scale migration from the mid-hills and high mountains to the Terai in the late 1950-1960's has now resulted in a more heterogeneous population inhabiting the landscape. This migration led to land use conversion, with large swathes of forested land replaced by agricultural land and settlements. Furthermore, limited forest areas within the buffer zones of Parsa National Park has resulted in higher pressures on the forests of Shikaribas Corridor due to heavy demand for fuelwood and fodder from surrounding communities. As with other corridors, forest encroachment has been a significant issue, with large swathes of forest areas being cleared for agricultural practices in the buffer zone side of Parsa National Park, risking the loss of this strategic transboundary connectivity. From an overall area point of view, this issue is particularly critical for Shikaribas given its small size in comparison with other corridors in the landscape.

Moreover, the southern side of the Chitwan-Parsa-Valmiki Complex lies within the Chure and Bhabar physiographic zones, where water is both a limiting and regulating factor for species and their dispersal—most available stream beds are seasonal in nature and the sub-surface remains dry most of the time. Sustaining corridor restoration initiatives in such conditions with continuous dry spells and climate related risks such as droughts can therefore be challenging. Poaching is another issue in the corridor and within the complex. With a shared international boundary of approximately 100 km, the southern part of the Chitwan-Parsa-Valmiki Complex is particularly vulnerable to illegal hunting of wildlife, especially for bushmeat as evidenced by bushmeat seizures by park authorities of a variety of species such as sambar, barking deer, spotted deer, and wild boar.

The existing Postal Highway also passes through Shikaribas Corridor, with major expansion ongoing along various sections. While a part of the existing bridge over the Shikaribas river currently acts as an underpass for wildlife, further expansion of the Postal Highway in this region could impact forests and restrict movement of wildlife as traffic volumes increase.

Villagers in Subarnapur feeding their livestock in an improved cow shed in an effort to reduce grazing pressure.

© WWF Nepal/Lilu KC

TRANSBOUNDARY INITIATIVES

Unlike other well-established corridors in the landscape, community-based conservation was a relatively unmatured concept in the buffer zones adjoining Shikaribas. The Government of Nepal's transformational buffer zone policy provisioned for 30-50% of park revenue to be reinvested into buffer zone communities. Unfortunately, unlike Chitwan National Park community development activities in the buffer zones of Parsa National Park were relatively limited and, therefore, communities received fewer conservation benefits. As such, motivation for corridor conservation and restoration was relatively limited among communities in Shikaribas.

The opportunity for comprehensive conservation actions in the corridor arose through an IUCN/KFW project whereby two offices—WWF Nepal and WWF India—jointly executed a transboundary project in the complex. This strategic alliance has been the first of its kind in the landscape, supporting corridor restoration and survival of wildlife species in the transboundary complex.

Conservation interventions in the Shikaribas Corridor are relatively recent as advocacy for restoration started very late in comparison to other corridors in the landscape. This issue became particularly prominent during 2015-2016, when large areas of land were illegally encroached, and agricultural practices were in full swing. The first step was therefore the restoration of illegally encroached land. This was immediately followed by planting trees to support regeneration of new forest patches, as well as fencing and changing land-use practices, such as grazing, to avoid any further loss of vegetation. Meanwhile, local forest guards were hired from the buffer zone communities to provide protection to newly fenced regeneration areas. As mentioned earlier, the Shikaribas Corridor lies on a dry riverbed and replanting initiatives have been particularly challenging.

Officials from Chitwan National Park and Valmiki Tiger Reserve discuss local transboundary issues at the office in Valmiki Tiger Reserve.

© WWF Nepal/Prasiit Sthapit

As such, natural regeneration—even two years after replantation is limited, with moderate success in the survival rate of trees planted.

Despite being confronted by a range of conservation issues, limited knowledge on the significance of the region and inadequate knowledge on management of negative human wildlife interactions among local communities, resulted in a difficult start for community-based conservation in the corridor. Through the IUCN/KFW project, WWF Nepal, therefore initiated Behavioral Change Communication (BCC) classes—a voluntary peer group learning platform on various issues including conservation—which proved to be an effective tool in raising awareness among communities, as well as educating them on the values of conservation. This, alongside other initiatives such as livestock management and stall-feeding programs, helped control overgrazing and gain support for efforts, whereas promotion of livelihood initiatives, such as homestay promotion and skill-based trainings, helped uplift the local economy thereby fostering community stewardship.

Tiger

Sloth Bear

Elephant

Leopard

Camera trap image of wildlife from Shikaribas Corridor

IMPROVED FOREST COVER AND WILDLIFE DISPERSAL

Conservation efforts over the last five years have had a positive effect on the forests of Shikaribas Corridor. While there have been conservation gains, forest restoration in the corridor is yet to compensate for the losses incurred from the impact of large-scale encroachment into the corridor. Periodic assessments of forest cover in the corridors show that changes in the net forest cover is still negative. However, while there has been no positive increase in forest cover as of yet, the degree of net forest cover loss in the corridor has decreased over the last five years, a sign of improvement in the biophysical conditions of the corridor.

In terms of functionality, the Shikaribas Corridor has historically been a migratory route for pachyderms such as rhinoceros and elephants, as reported by local communities and protected area authorities. Since conservation initiatives started in 2016, local communities have once again started reporting sightings of elephant herds passing through the corridor on a regular basis. Meanwhile, surveys have also captured tigers in self-triggering camera traps, confirming the use of the corridor by tigers. While the required forest cover for wildlife dispersal is still low, continued progress and positive changes in forest cover over the years will facilitate wildlife dispersal of large carnivores through the corridor in the Chitwan-Parsa-Valmiki complex.

Facilitation of transboundary knowledge sharing has also resulted in communities from both sides of the transboundary complex regularly exchanging and sharing ideas, experiences, and knowledge that could be replicated in their respective areas. These strategic initiatives are expected to improve community-based conservation in Shikaribas in the long term.

LOOKING AHEAD

In the last five years, forest restoration initiatives have resulted in a few positive signs, such as the improvement in biophysical conditions in Shikaribas corridor. However, there is a high chance of the corridor reverting to its degraded state if conservation interventions are interrupted. As an immediate next step, forest restoration effort needs to be prioritized with a focus on protecting forest plantation areas. Once the corridor matures with improvement in the forest tree stands, forests within the corridor can then be handed over to communities for management as buffer zone community forests.

Integrated conservation and development initiatives such as homestay programs, livelihood enhancement activities, and stall-feeding activities etc. along with institutional capacity development will be necessary for moving ahead and preventing regression of the corridor to its previous state. Similarly, support for youth focused institutional development, such as Community Based Anti Poaching Units (CBAPU) and eco clubs, will be critical in facilitating and maintaining mass awareness among local communities. For long term sustainability of conservation interventions, it is vital that we realize the linkages between motivation of communities, corridor restoration, and functionality.

With emerging challenges such as the expansion of the existing Postal Highway that cuts through the corridor, it is critical that a minimal damage approach be taken—particularly in terms of any infrastructure development within the corridor—which must adopt appropriate mitigation measures to allow for unimpeded dispersal of wildlife.

CASE STUDY

WILDLIFE DISPERSAL IN SHIKARIBAS

Large mammals such as elephants, tigers and rhinoceros can disperse across long distances in a landscape. Corridors are therefore critical for wildlife dispersal as they provide cover for safe dispersal. For instance, the Parsa-Chitwan elephant population is known to be migratory in nature. In the summer of 2016 and 2018, large herds of elephants (as many as 15) were observed crossing over from the Chitwan National Park side of the corridor into Valmiki Tiger Reserve in India through the Shikaribas Corridor. As the corridor passes through settlements and agricultural fields, movement of large herds of pachyderms often places communities on either side of the corridor at risk, leaving them vulnerable to negative human elephant interactions.

In 2019, an opportunistic camera trap survey was carried out in the forests of Shikaribas to gather photographic evidence of wildlife presence in the corridor. This consequently led to the first photographic evidence of tigers, leopards, bears, as well as elephants and deer species within the corridor, a testimony to conservation initiatives and functionality of the corridor with respect to wildlife dispersal.

A comparison of camera trapped tigers in Shikaribas with other tigers camera trapped in the Valmiki Tiger Reserve consequently resulted in a match. It was later confirmed that the same tiger from the Manguraha range of Valmiki Tiger Reserve—located merely 8-10 km away from Shikaribas—had crossed over either to Parsa or Chitwan National Park through the Shikaribas Corridor. Similarly, a rhinoceros was also recorded in the same range, possibly using the Shikaribas corridor to move within the three transboundary protected areas. Such evidence clearly indicates the functionality of Shikaribas from a wildlife dispersal point of view.

Under the leadership of respective governments, WWF Nepal and WWF India are working in close collaboration with the common goal of increasing corridor functionality and ensuring the protection and survival of tigers and other species within this transboundary complex. Because of its significance, the Shikaribas Corridor; is also referred to as “corridors for the future of tigers” by IUCN/KFW.

Tobacco plantation along Subarnapur village adjoining Shikaribas Corridor

BARANDABHAR CORRIDOR

CORRIDOR AREA
109.13 sq. km

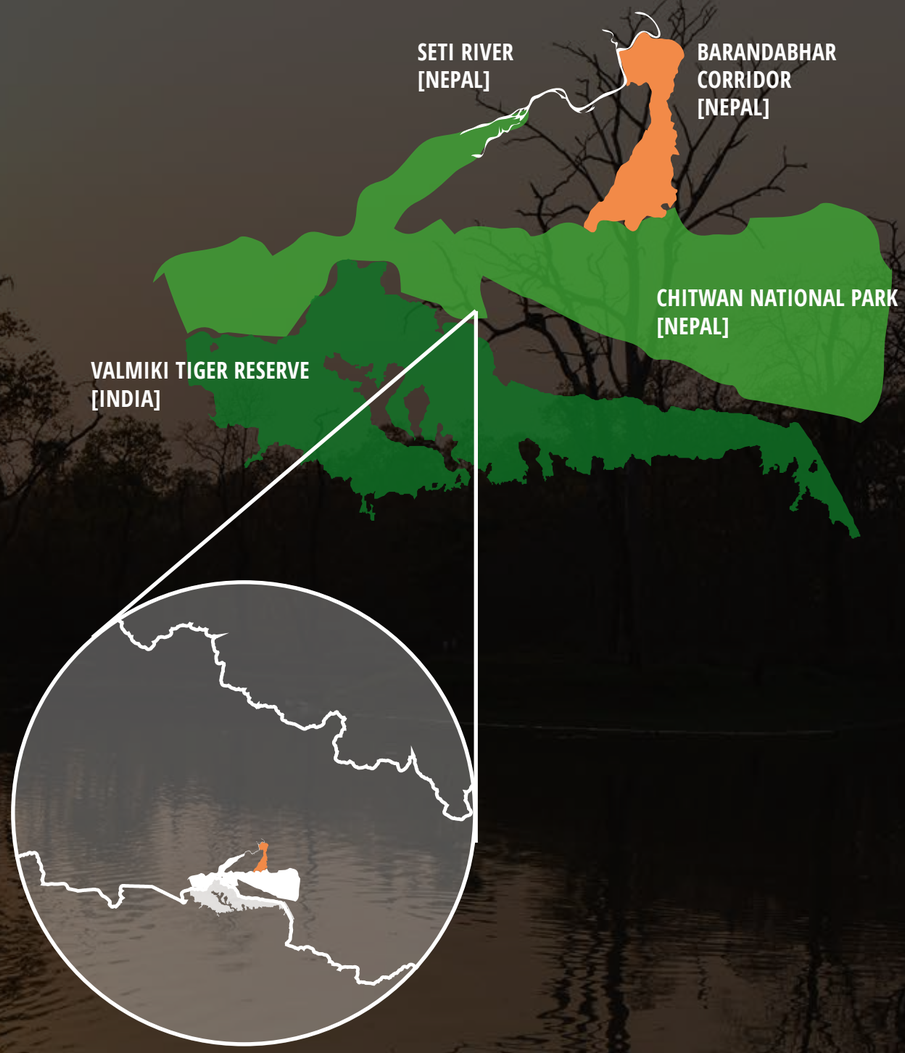
KEY WILDLIFE SPECIES
Tiger, Leopard, Elephant, White Rumped Vulture, Gharial

FOREST COVER
99.18 sq. km

PRIMARY HABITAT TYPES
Sal Forests, Wetlands, Grassland

PRIMARY CHALLENGES
Drought, Water Pollution, Eutrophication, River Poisioning, Encroachment, Invasive Species, East-West Highway, Railway

MAJOR RIVERS AND RAMSAR SITES
Khageri, Beeshazar and Associated Lakes



BARANDABHAR

ON MIDDLE GROUND

JAGADISH CHANDRA KUIKEL, RAJESH SADA, KANCHAN THAPA, SHAYASTA TULADHAR

The Barandabhar Forest Corridor is a critical forest strip that connects Nepal's two conservation landscapes—the Terai Arc Landscape in Nepal's low-lying plains with the Chitwan Annapurna Landscape (CHAL) in the mid-hills and high mountains. Located between Chitwan National Park in the south and the Seti River Corridor and Mahabharat range in the north, the corridor covers an area of 109.13 sq. km. Barandabhar is one of the first corridors in Nepal where restoration initiatives began in the 1990s implemented by the National Trust for Nature Conservation (NTNC).

Barandabhar corridor is one the few corridors in the Terai to host wetlands of international importance—Ramsar sites such as the Beeshazar and Associated Lakes. Besides being rich in biodiversity, the corridor also provides significant ecological services. For instance, water from these lakes and the Khageri Irrigation System supports irrigation of 39 sq. km of agriculture lands, regulates flooding, and recharges groundwater for the western Chitwan area. As the Barandabhar Corridor hosts several wetlands and is the only remaining forest patch that connects Chitwan National Park with the Chure and Mahabharat range, the corridor acts as a highland refuge site for wild animals particularly during the periodic monsoon floods when the Rapti river and its tributaries overflow into the low-lying floodplain areas, as well as during other erratic weather conditions.

The Barandabhar forest corridor is reported to be home to over 32 species of mammals, 329 species of birds, 37 species of fishes, and 45 species of herpetofauna. Its rich biodiversity in terms of wildlife, forest coverage, and wetlands have consequently led to its delineation as one of the country's 32 Important Bird and Biodiversity Areas. Meanwhile, core areas of the corridor; north of the East-West highway, was designated as a Forest Conservation Area (formerly Protected Forest) in 2011. Under this system, the corridor falls under the jurisdiction of the Chitwan Divisional Forest Office, whereas the area south of the highway is designated as a buffer zone forest and is under the jurisdiction of Chitwan National Park.

THE BARANDABHAR FOREST CORRIDOR IS REPORTED TO BE HOME TO OVER 32 SPECIES OF MAMMALS, 329 SPECIES OF BIRDS, 37 SPECIES OF FISHES, AND 45 SPECIES OF HERPETOFAUNA.

Riverbank cutting protection measures upstream of Khageri River

CHALLENGES AND VULNERABILITIES

Despite the critical value of the corridor, the forests and wetlands of Barandabhar are under serious pressure from illegal timber collection, inappropriate land use, and forest encroachment due to increasing urbanization in its surrounding cities—Kalika and Ratnanagar Municipalities in the east and Bharatpur Metropolitan City in the west. An assessment of biodiversity threats and climate change vulnerability in 2012, indicated a "Very High" threat rating for Barandabhar Corridor, with challenges arising from climatic and non-climatic risks, unpredictable rainfall patterns, drought, water pollution, eutrophication, proliferation of invasive species, and infrastructure development.

Uncertain rainfall patterns often result in either too little or too much rainfall, leading to drought, drying up of water sources, forest fires, landslides in the hill slopes of Chure, flash floods, riverbank cutting, or sediment deposits in the downstream areas. Degradation in the upstream watershed area, increase of sediment load in water bodies, and sediment deposits due to landslides and soil erosion reduces water flow into the Khageri Irrigation Canal, which consequently negatively impacts water levels in the Beeshazar Lake. Equally, the lake also faces serious problems from eutrophication and proliferation of invasive species which significantly affects the wetlands health.

Likewise, poorly planned infrastructure development—inside as well as outside the corridor—pose new challenges, altering natural ecologies along the upstream and downstream areas. Habitat destruction upstream in the form of forest encroachment—although at a low scale—can have direct environmental impacts downstream. For instance, the relatively dry upstream areas of Chure and Bhabar may become more vulnerable to forest fires or droughts during the dry seasons. Meanwhile, downstream, communities may face greater likelihoods of floods, riverbank cutting, and sedimentation during the monsoons. Similarly, intensification of agriculture in the upstream areas also results in increased flow of chemical effluents, triggering proliferation of invasive species in wetlands downstream. Meanwhile the East-West Highway, Narayanghat-Mugling Highway, Khageri Irrigation Canal, and a new roadway to the Padampur settlement relocated outside Chitwan National Park also fragments the Barandabhar corridor in different areas, severely hindering north-south dispersal of wildlife.

INTEGRATED SUB-WATERSHED MANAGEMENT

As a critical climate refuge site, one of the focused conservation interventions is protection and management of this critical sub-watershed. The Integrated Sub-Watershed Management Plan of Khageri Khola sub-watershed prepared with support from USAID's Hariyo Ban Program in 2017 focused on increasing the productivity and utility of land and water resources for biodiversity conservation and livelihood promotion through an integrated watershed management approach while maintaining upstream and downstream linkages. Initiatives in the upstream areas are primarily focused on reducing forest encroachment, degraded land rehabilitation, riverbank protection, and water source protection including ground water recharge. The 18 wetlands located within the Barandabhar Corridor have been the focus of conservation through restoration efforts such as removal of invasive species, construction or maintenance of dykes and outlets, extraction of deposited sediments etc. Six new lakes have been created within this narrow strip of forest corridor to increase water storage capacity during monsoons, regulate flooding, replenish groundwater in the region and improve the habitat for terrestrial and aquatic biodiversity. Meanwhile, initiatives downstream focus on grassland and invasive species management, and water source management for wildlife. The Integrated Sub-Watershed Management Plan also engages multiple stakeholders and addresses a myriad of climatic and non-climate threats, which complement conservation efforts to maintain the functionality of the Barandabhar Corridor.

LEVERAGING COMMUNITIES

Over the past three decades, WWF Nepal along with conservation stakeholders, and under the leadership of the Government of Nepal has undertaken a wide range of corridor and wetland restoration initiatives in the Barandabhar Corridor. Community engagement was a critical factor here and a diverse assortment of interventions were undertaken with the aim of generating community buy-in. For instance, building community awareness through media, street drama, and early education programs; and community empowerment and livelihood diversification through capacity building, skill-based trainings as well as on-farm and off-farm based activities such as honey production, wool weaving, dairy, off-farm vegetable production, and goat/pig rearing. These initiatives helped raise awareness among communities helping to diversify their annual income streams alongside reducing stress on natural resources.

Livelihood support, leveraged through provision of revolving funds spurred community members to participate in conservation activities such as tree plantations, fencing, control of livestock grazing and forest fires, prevention of illegal extraction of forest resources, and anti-poaching initiatives. Meanwhile, Community Based Anti-Poaching Units (CBAPU) were mobilized to deter poaching of wildlife and illegal harvest of forest products.

Communities piloting Nepal's first water mower machine - Gokaarno, in Beeshazar Lake


Leopard


Rhino


Tiger


Sloth bear

Camera trapped pictures of wildlife from Barandabhar Corridor

THRIVING FORESTS AND COMMUNITIES

"The Barandabhar Forest Corridor used to be so degraded in the past that one could see the settlements on either side of the corridor", recalls Dr. Shant Raj Jnawali, renowned rhino biologist. The degradation and deforestation in the corridor were acute in the 1990s, so much so that renowned tiger biologist Dr J. L. Dvavid Smith, expressed his concerns on the fate of the corridor's forests. The forests were so degraded that one could view the East-West Highway from one end of corridor.

Continuous support and engagement in the corridor these past 20 years, have visibly reduced the overwhelming threats to Barandabhar's ecosystem and biodiversity. The improved health of forests, grasslands and wetlands, have helped the corridor become functional once again, supporting wildlife dispersal, including during extreme weather events. Community sightings and surveys indicate that a variety of species—mammals including tiger and rhinoceros, and birds—are increasing in the region. While negative human wildlife interactions in the form of crop depredation and livestock killings is still an underlying issue in nearby communities, proactive interventions such as fencing have succeeded in reducing their frequency. Likewise, wetland restoration efforts and construction of new wetlands inside the forest have shown clear results in reducing negative human wildlife interactions and increasing groundwater levels in nearby settlements.

Gaurs are one of the largest species of wildlife found in Chitwan National Park; primarily moving within the higher elevation Chure forests in the south. However, a few of these bovines were recently found recolonizing forest habitats along the northern Chitwan Valley including the Barandabhar Corridor. Experts have hinted that this recolonization is possibly due to high level degradation and disturbances within the Chure habitat. This recent finding; though unverified, acts as a preliminary example on the potential value of Barandabhar as a long-term micro refuge site. Meanwhile, the corridor also provides habitat for large mammals such as tigers, rhinoceroses, and elephants. For instance, recent surveys show a minimum of four tigers using the Barandabhar corridor. Likewise, regular wildlife monitoring in Barandabhar Corridor by the NTNC shows high use of habitat by a suite of wildlife such as leopards, civets, deer species in the forest, and gharial and mugger crocodiles in the river and wetlands, indicating high corridor functionality with respect to wildlife dispersal.

LOOKING AHEAD

In the last 20 years, net forest cover within the corridor has increased by 1.28 sq. km, while over 72,000 households living on either side of the corridor have benefited through various conservation and development initiatives. Transformative conservation polices and approaches such as the community forestry program and buffer zone concept have been a turning point, not only for the corridor but the Terai Arc Landscape as a whole. Meanwhile, embracing the concept of integrated conservation and development, through flagship projects such as the NTNC led Global Environment Facility (GEF) project, and USAID's Hariyo Ban Program, has helped transform the Barandabhar Corridor, linking Chitwan National Park to the broader Mahabharat Range, thereby benefiting forests, wildlife, and communities.

Looking ahead, conservation practices must continue to prioritize upland watershed protection to minimize degradation of critical wetland ecologies and climate refuge sites. Approaches such as Integrated Watershed Management that takes into consideration upstream and downstream linkages and maintains biodiversity conservation and community wellbeing at its center, will be critical.

A spate of new challenges have also arisen for the corridor, with booming urbanization, industrialization, and development of linear infrastructure. Construction of roadways in upstream regions, and expansion of highways and proposed railway construction in the lower part of the corridor are of particular concern. Placement of strategic and timely mitigation measures such as the construction of overpasses and underpasses, regulation of vehicular traffic, etc., will need immediate attention in the days ahead. While any form of construction causes damage to the natural environment; tackling them strategically and adopting a minimal damage approach to natural resources, can safeguard both the environment and human wellbeing.

CASE STUDY

WILDLIFE UNDERPASSES AT BARANDABHAR CORRIDOR

Increasing wildlife mortality due to vehicular collisions are a growing concern in Nepal, particularly along highways that traverse national parks and corridors. Such incidents of Vehicular Wildlife Collisions present immense challenges, as the Barandabhar Corridor is the only remaining forest in Chitwan that provides north-south habitat connectivity for wildlife dispersal between Chitwan National Park and the mid-hills and mountains in the north.

To alleviate these challenges, the Department of Roads constructed four underpasses in 2016 to facilitate wildlife mobility across the Narayanghat-Mugling Highway, that bisects the Barandabhar corridor. Six km of the 35 km highway currently passes through the dense forests of the corridor, increasing wildlife susceptibility to Vehicular Wildlife Collisions.

In 2017, WWF Nepal monitored the movement of wildlife over a year using camera traps to determine the effectiveness of these underpasses. The results were encouraging, with over 15 mammal species–such as the common leopard, wild boar, jungle cat, common palm civet, deer, monkey, etc. found to be using the underpasses regularly. According to the Divisional Forest Office in the region, incidents of vehicular wildlife collisions involving wildlife plummeted significantly since the underpasses and guiding fences were introduced along highway sections.

Such examples of underpasses coupled with guiding fences prove that wildlife friendly infrastructure is a distinct possibility for Nepal as we move towards rapid development. These mitigation measures are effective in minimizing vehicular wildlife collisions and should be prioritized while upgrading and developing new highway sections crossing through national parks, corridors, critical watersheds and habitats in Nepal.

Barandabhar corridor hosts one of the highest density of spotted deers in Nepal's corridors

LAMAHI CORRIDOR

CORRIDOR AREA
243.74 sq. km

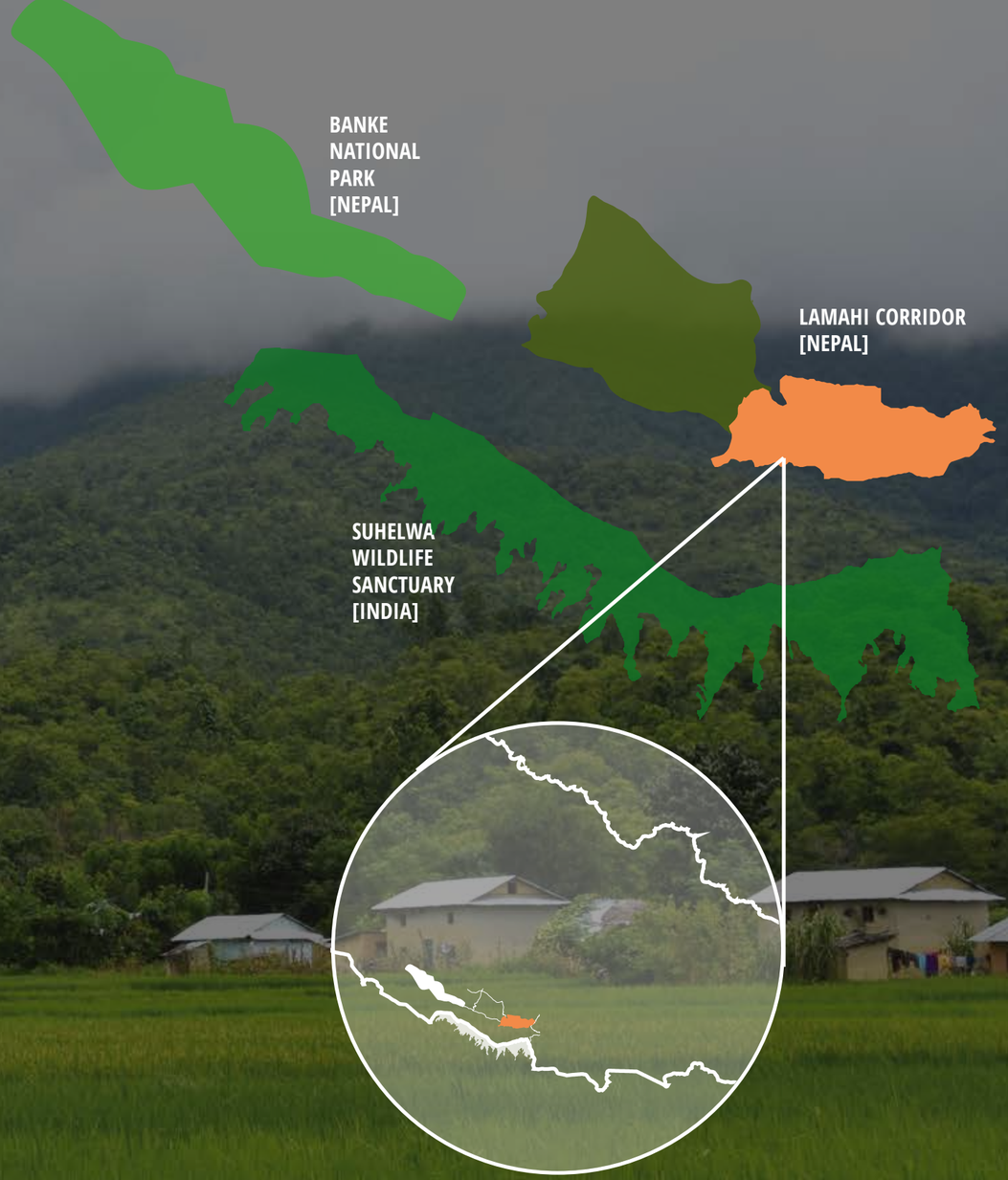
WILDLIFE SPECIES
Hyena, Elephant, Leopard, Deer Species

FOREST COVER
146.25 sq. km

PRIMARY HABITAT TYPES
Mixed Hardwood Forests and Sal Forests

PRIMARY CHALLENGES
Deforestation, Overgrazing

MAJOR RIVERS
Rapti



LAMAHI

GOOD GOVERNANCE AND FOREST RESTORATION

KANCHAN THAPA, DHAN RAI, SHAYASTA TULADHAR

Lamahi Bottleneck Forest is one of three bottlenecks in the Terai Arc Landscape—Lamahi, Mahadevpuri, Dovan—considered critical for restoring forest connectivity. Nestled within the Chure range, the Lamahi Bottleneck Forest covers an area of 243.74 sq. km, joining large forest blocks on either side facilitating forest connectivity in the landscape. The western part of the forest block connects with Banke National Park, the eastern part with Chitwan National Park, and the southern part with the extended forests of Kamdi Corridor.

The forests of Lamahi form a part of the Deukhuri Valley, which is also an important bird area (IBA) due to its forest conditions, water availability, and proximity to national parks. Lamahi's forests along the Chure foothills in the Terai Arc Landscape make up a historic migration route for wild elephants in the country. In the past, wild elephants from Banke National Park were known to use these forests to travel up till the northern side of Kapilvastu. The region is an important reservoir for groundwater and has been identified as a critical and strategic site for forest restoration to facilitate wildlife dispersal within the Terai Arc Landscape

CONSERVATION EFFORTS

Once rich in forest resources, the area subsequently became heavily deforested due to illegal logging and open grazing of cattle, particularly during the 1950's following large-scale migration of communities from the hilly regions into Terai's lowland areas. During this time, the forests within Dang Valley, including Lamahi, faced large-scale deforestation as communities took over forested land to engage in agricultural practices, which led to grazing pressures that limit natural regeneration and forest growth. Additionally, the construction of the East-West Highway, popularly known as Mahendra Highway, during the 60's led to further fragmentation of large-scale forest patches. Growing urbanization around the region subsequently led to an increased demand for fuelwood from market centers such as the Lamahi Bazaar, which was then met though timber from the nearby forests.

Conservation interventions in Lamahi started in 2001 through the Corridor and Bottleneck Restoration Project, implemented by the Government of Nepal and WWF Nepal under its Terai Arc Landscape Program. Communities were initially averse to the concept of the Terai Arc Landscape, since they believed its aim was to create protected areas that would curtail their access rights to natural resources. With the Lamahi Bottleneck Forest heavily degraded with only sporadic patches of forest in between, forest restoration was the first and primary conservation focus through strengthening of community institutions. Prior to 2001, 19 Community Forests (CFs), measuring ~1100 ha, had already been formed and handed over to communities to support restoration initiatives as well as empower community-based organizations by enhancing livelihood opportunities and promoting good governance practices.

Under the leadership of the Community Forest Coordination Committee (CFCC)—a loose network of Community Forest User Groups (CFUG) that work primarily in natural resource governance—communities thereby initiated programs to deal with common issues such as encroachment, illegal logging, grazing pressures, etc. At the same time, the CFCC's also worked towards strengthening their institutional operations, transparency, and accountability towards stakeholders. Sustainable livelihood initiatives and alternate energy programs through biogas and improved cooking stoves financed using micro-credit were also introduced to reduce household dependence on natural resources and diversify income opportunities. Improved community stewardship through various such programs consequently helped address challenges such as increase in forest fires, poaching and negative human wildlife interactions.

Similarly, partnerships with specialized I/NGOs and other government line agencies have been a key factor for conservation initiatives in Lamahi. Through these partnerships, a range of developmental issues such as access to clean drinking water, primary healthcare, education, governance etc. has been addressed. For instance, agencies such as United Nations Development Program-Micro-Enterprise Development Programme (UNDP-MEDEP) have been involved in developing livelihood skills, CARE Nepal in good governance, Department for International Development (DFID) in Non-Timber Forest Product (NTFP) cultivation, biogas companies in biogas construction etc. As such, partnerships and resource leveraging through community engagement with developmental agencies have helped bring in added financial, technical, and managerial resources towards ongoing forest restoration initiatives. Collectively, over 385,000 people have benefited from various forest restoration, institutional development, and livelihood-related interventions in the Lamahi Bottleneck Forest since 2001.

Degraded forest habitats

Pressure on forests for fuelwood

Illegal settlements inside Lamahi, Degraded forest habitats

Dry stream bed in Lamahi Corridor.

PARTNERSHIPS AND RESOURCE LEVERAGING THROUGH COMMUNITY ENGAGEMENT WITH DEVELOPMENT AGENCIES HAVE HELPED BRING IN ADDED FINANCIAL, TECHNICAL, AND MANAGERIAL RESOURCES CONTRIBUTING TOWARDS ONGOING FOREST RESTORATION INITIATIVES.

Honey Badger

Leopard

Striped Hyena

Camera trapped pictures of wildlife from Lamahi Bottleneck Forest

© Chiranjeevi Khanal

IMPROVED BIOPHYSICAL CONDITIONS AND SPECIES RECOVERY

Over the last 20 years, net forest cover in the Lamahi Bottleneck Forest has increased by almost 9.18 sq. km with completely deforested regions now flourishing, demonstrating the impact of forest restoration initiatives in the Chure hills. During this time, the Terai Arc Landscape Program facilitated the plantation of roughly 0.85 million units of native tree and shrub species in the Lamahi Bottleneck Forest. New community forests were also formed bringing a majority of forest areas in Lamahi under community-based management.

A visible impact of reforestation efforts and improved forest conditions has been on the recharge of underground water and spring sources, in a region otherwise faced with periodic dry spells, benefiting both communities and wildlife. With forests aiding the process of natural regeneration of groundwater, local communities have benefited from irrigation facilities that contribute to their agricultural livelihoods. For instance, in 2014 the Kalapani forest within Lamahi, was declared as a zero-grazing site by the local CFUG. Today, communities enjoy various benefits from their conservation initiatives such as access to drinking water from springs sources and wells, meeting forest product needs sustainably through their community forests, planting and harvesting various NTFPs, etc.

Improved forest conditions also facilitated the recovery of wildlife in the region with camera trap evidence of 23 species of wildlife, including leopards and hyenas in the area. Likewise, communities have also observed the recovery of different species of vultures in the area.

In 2004, a herd of elephants were seen migrating along their historical routes which also passes through the Lamahi Bottleneck Forest, pausing briefly at a large conservation pond situated at the foothills of Lamahi. Many such incidences have also been recorded by communities in the past. While large carnivores such as tigers and leopards were historically known to move through these forests, camera trap evidence of a male tiger in the northern part of Kapilvastu district, 40 km east of Lamahi was officially recorded, according to a 2021 Chure survey report published by National Trust for Nature Conservation. The probable site from which this tiger dispersed is considered to be Banke National Park due to its proximity, with the tiger traveling through two possible routes—the Chure foothills in the Lamahi Bottleneck Forest or the Chure foothills of Kamdi Corridor.

The Lamahi Bottleneck area, before and after restoration

© WWF Nepal

LOOKING AHEAD

It is safe to say that the Lamahi Bottleneck Forest is no longer a bottleneck, as successful implementation of forest restoration initiatives over the last two decades have brought about remarkable changes, evident through its regenerated forest cover; and thriving wildlife populations. This process has consisted of long-term investments, local political will (homogeneous communities), and support from communities (cohesiveness). Cultural beliefs of communities such as the *Rakhauna* system in the early days—which states that one should preserve natural resources for future and use it sustainably—have obliged local communities to use and protect natural resources in a wise and sustainable manner. Meanwhile, natural calamities such as unexpected cloud bursts and periodic flooding in the region have further driven communities to adopt forest restoration and climate adaptation initiatives. These coupled with time-specific conducive government policies such as community forest programs have been conducive to Lamahi's forest recovery.

Over the last 20 years, forest restoration efforts have helped re-develop a mosaic of wetlands, grasslands, and forested areas, suitable for wildlife dispersal, as well as provided access to forest resource among communities. The corridor forest restoration model in Lamahi showcases the importance of government leadership, community stewardship, good governance and leveraging partnerships and finances, thereby carrying the potential for replication in other critical sites. However, external factors such as growing Lamahi market centers, village road construction, expansion of existing highways, and sand and gravel extraction in Chure may exert additional pressure on forest resources, as well as increase the likelihood of negative human wildlife interactions. Continuous engagement, collaboration and dialogue among the concerned stakeholders will, therefore, be key moving ahead.

CASE STUDY

FOREST, WATER, WILDLIFE, AND COMMUNITIES

The Kalapani community forest is a 19.5 sq. km forest block located within the Lamahi Bottleneck Forest. This community forest has had good forest coverage, perennial sources of water through its river channels and high usage of its forests by wildlife. The community forest is also a historical migratory route for elephant dispersal across lowland areas, with communities having observed occasional visits from large pachyderms in the past. Prior to 2001, the Kalapani community forest was highly degraded, with wide scale pressure from livestock overgrazing, illegal timber felling, etc. exposing the red soil underneath.

Forest restoration initiatives by both communities and the divisional forest office have, however borne fruit over the last 20 years, with stark improvements in forest cover and forest condition, offering multiple benefits for wildlife and communities. For instance, one of the small spring sources within Kalapani has increased to almost 500 m^2, from just 5-10 m^2 previously, holding approximately 1,000 m^3 of water. The water source is now used for irrigation and drinking by downstream communities.

“We have been able to protect and conserve this small spring source which has now grown into a big conservation pond. The water has been critical in vegetable farming” states Baliram Chaudhary, President of the Kalapani CFUG. Our results show that these households earn approximately USD 1,230 annually from the sale of fresh seasonal vegetables in nearby market centers. “CFUGs are now finally seeing the benefits of conserving these forests as our active efforts have been showing results” stresses Chaudhary. Over 300 households; primarily from the indigenous Tharu communities, are now direct beneficiaries from the Kalapani Community Forest.

Chiranjeevi Khanal, an enthusiastic wildlife biologist from Dang district, states “Hyena, barking deer, and civets are now resident wildlife in these forests”. Forest cover in the Kalapani community forest has increased by 12 sq. km in the last 20 years, with documented evidence of wildlife recovery, thereby showcasing the nexus between forest cover, groundwater recharge, and wildlife recovery, as well as the well-being of communities.

Community member weeding wildlife deterrant mint crops in Lamahi

KAMDI CORRIDOR

CORRIDOR AREA
667.36 sq. km

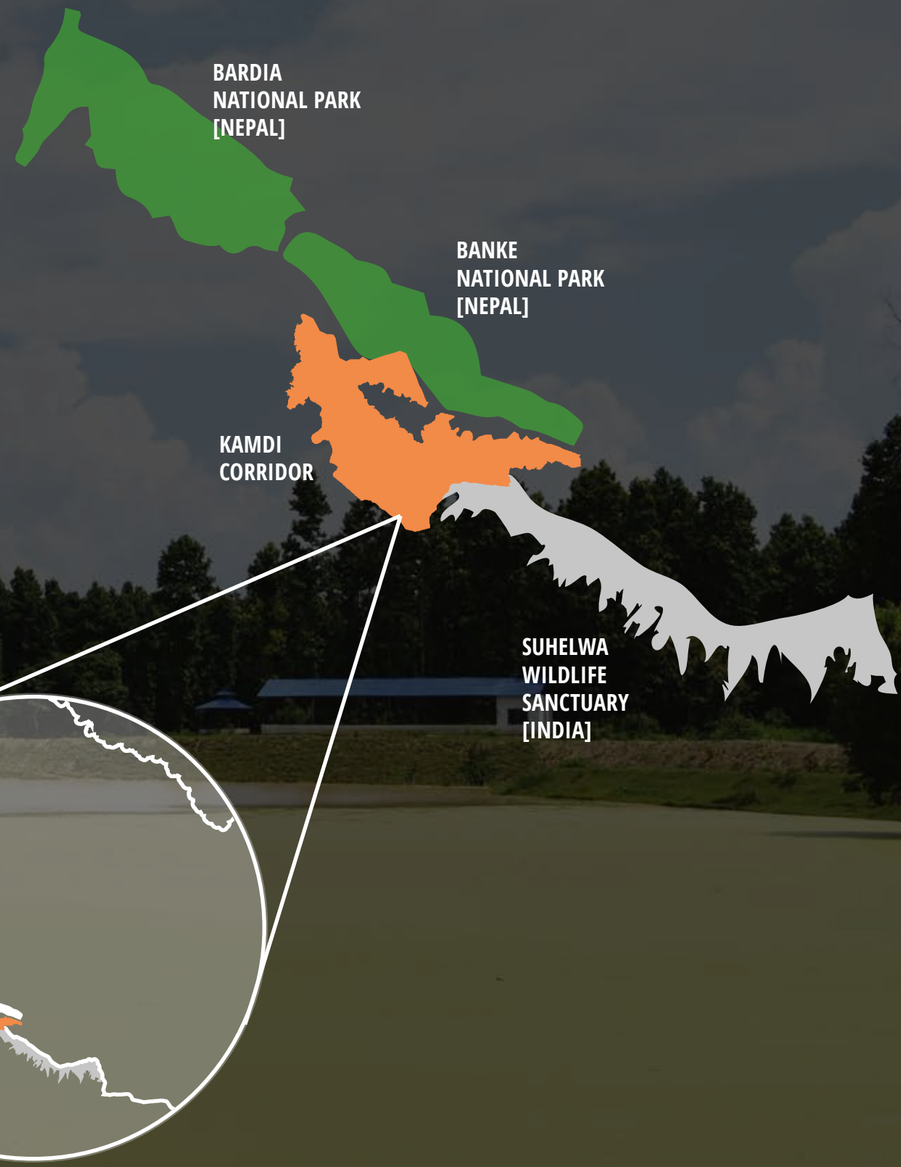
KEY WILDLIFE SPECIES
Elephant, Tiger, Leopard, Hyena, Sloth Bear, Sambar Deer, Leopard Cat, Gharial

FOREST COVER
524.41 sq. km

PRIMARY HABITAT TYPES
Sal Forests, Mixed Hardwood Forests, Floodplain Grasslands

PRIMARY CHALLENGES
Overgrazing, Fuel Wood Collection, Poaching, Droughts, Sand and Gravel Mining, Postal Highway, Irrigation Canals

MAJOR RIVERS
Rapti



KAMDI

CONSERVATION AMIDST CHALLENGES

KAPIL KHANAL, KANCHAN THAPA, SHAYASTA TULADHAR

Kamdi, the largest corridor in the Terai Arc Landscape, stretches across an area of 667.36 sq. km from Dang district to Banke National Park in the mid-western region of Nepal. Linking Banke National Park in Nepal and Suhelwa Wildlife Sanctuary in India, Kamdi is of utmost importance for the conservation of megafauna such as tigers and elephants. The region is a priority complex for tiger recovery and spillover tiger populations from the high-density tiger site of Bardia National Park.

Initially known as the Mahadevpuri Bottleneck Area, the area was renamed Kamdi after the establishment of Banke National Park. The Kamdi Corridor represents a mosaic of three major physiographic zones of Nepal—Chure, Bhabar and Terai flood plains—facilitating north-south linkage for wildlife dispersal. While the corridor faces diverse social, ecological, and infrastructural challenges, it holds considerable conservation significance as a dispersal pathway and as a provider of ecological services through regulation of water availability in the landscape. Additionally, the floodplains of the Rapti river, which passes through the corridor, are also prime habitats for the critically endangered gharial.

Some regions within the corridor such as Chure and Bhabar are however considered highly climate sensitive zones characterized by dry lands facing extreme weather events such as prolonged droughts and floods and have poor water retention capacity. An assessment of biodiversity threats and climate change vulnerability in 2012, indicated a "Very High" threat rating for Kamdi Corridor with forest fires, poaching, deforestation, grazing, poorly planned infrastructure development, and droughts as the primary challenges.

WWF Nepal started working in Kamdi Corridor with support from the Save the Tiger Fund, which focused on linking forest restoration with tiger recovery and community benefits. The basic premise was the presence of wildlife in the region as a catalyst for conservation efforts; and rewarding communities in cash for the presence of wildlife in their area. However, this cash remuneration model was later changed into a grant model due to compliance issues.

Bridge over a Sikta Irrigation Canal in Kamdi Corridor. © Muna Thapa/WWF Nepal

CHALLENGES WITHIN THE COMPLEX

The dense forests of Kamdi Corridor formerly provided a rich habitat for wildlife as well as fuelwood and fodder for local communities. However, a major flooding of the Rapti river in 2006 left the region inundated, and in its aftermath large swathes along the fringes of Chure were converted into temporary settlements for flood victims. Encroachment into the corridor only increased following the flooding of the Rapti in 2014, 2015 and 2017, further aggravating forest degradation and loss in this corridor. Community forests in the corridor were hit hard with increased pressure on forest resources, overgrazing, and gradual escalation of illegal activities, such as illicit harvesting, timber felling, and poaching. Consequently, large patches of grasslands and forests gradually transformed into settlements.

With Kohalpur in the north and Nepalgunj in the south of the corridor—both cities facing rapidly increasing population and mass urbanization—the subsequent increase in consumptive demands resulted in increased pressures on the forests in the region. With the updated protection status of Banke National Park—established in 2010, the booming demand for forest resources from the growing neighboring cities fell disproportionately on the Kamdi Corridor located south of the national park. Forest loss and fragmentation were further exacerbated by large infrastructure development such as construction of irrigation canals and postal highways running through the corridor as well as expansion of the East-West Mahendra Highway.

COMMUNITY BASED CONSERVATION & HABITAT MANAGEMENT

Conservation of the deciduous forests, and grasslands of Kamdi began in 2006 with the Gokul Community Forest, a critical forest stretch which was heavily degraded from overgrazing. This was one of the first projects undertaken by WWF Nepal focused on reducing demand for forest resources among nearby communities and fostering regeneration in the degraded southern bottleneck area of Banke National Park. Consequently, WWF Nepal also strategically engaged in addressing key challenges in other parts of the complex.

The Government of Nepal's community forestry program with a focus on reducing demand for forest resources and restoring forests meant establishing a people centered approach to conservation. Community Forest Conservation Committees (CFCC) were formed in the Kamdi Corridor in 2008, to restore forest areas lost to encroachment, restore degraded land, and protect and maintain the remaining forest corridors. Consequently, a total of 141 Community Forest User Groups (CFUGs) were networked into the three CFCCs of the corridor—Gadhawa, Mahadevpuri and Kamdi—to address conservation challenges.

Led by the Terai Arc Landscape Program, various rounds of consultations were initially held with local communities, with the intention of engaging them in the conservation agenda. After multiple rounds of dialogues, local communities had begun to understand that conserving forests were imperative for the well-being of both communities and species. Enthused by this idea, communities initiated fencing out of areas to bar cattle entry, and began massive plantation drives in degraded areas of the corridor. Meanwhile, with the region known to be dry, significant efforts were also expended on building new waterholes and rehabilitating pre-existing ones.

Restoration efforts in the region were further bolstered in 2010, with the declaration of Banke National Park and the formation of Kamdi Corridor. Following the establishment of Banke National Park, the Terai Arc Landscape program and the national park introduced alternative energy programs like biogas, and sustainable livelihood initiatives such as a revolving fund to support fish and vegetable farming, and skill-based trainings, to shift communities from forest-based to farm-based livelihoods. Till date, roughly NRs. 12 million has been mobilized through this revolving fund. Likewise, when 30-50% of Banke National Park's revenues were directed to buffer zone communities, their attitude towards conservation changed positively, eventually diverting them away from forests for their livelihoods.

Mesh wire fence to deter negative human wildlife interactions © Shayasta Tuladhar/WWF Nepal

Grazing pressure from domestic cattle © Tilak Dhakal/WWF Nepal

Grazing pressure from small livestock © Muna Thapa/WWF Nepal

Forest guards in Kamdi Corridor © Muna Thapa/WWF Nepal


Leopard crossing bridge over irrigation canal


Striped Hyena in forest


Leopard near irrigation canal


Hyena along the irrigation canal


Jackal


Sloth bear

Camera trapped pictures of wildlife from Kamdi Corridor

ILLEGAL WILDLIFE TRADE

However, challenges in the region persisted with the emerging threats of poaching and illegal wildlife trade in the area. Poachers were often sighted fully equipped with protective gear and poaching equipment, in the relatively less monitored area of Narainapur near the Nepal-India border. As of 2020/21, two cases of tiger poaching and one case of retaliatory tiger killing resulting from negative human-wildlife interactions has been recorded in the Kamdi Corridor.

The first entry point for conservation initiatives in this area was therefore the formation of 140 Community Based Anti-Poaching Units (CBAPUs) in Kamdi, mobilized between 2010 and 2020 to monitor wildlife through voluntary patrols in their surrounding forests. WWF Nepal supported capacity building of CBAPU members through trainings, and in building networks with sub-divisional forests offices, CFUGs, and CFCCs, which significantly contribute towards reducing incidences of poaching and illegal forest harvesting in the corridor. The Nepal Police, including the Central Investigation Bureau (CIB), has played a substantial role in disrupting the illegal wildlife trade nexus in Kamdi Corridor in close coordination with local law enforcement agencies, such as the Divisional Forest Office (DFO) and national park office.

INFRASTRUCTURE DEVELOPMENT

In order to address the threats to wildlife from linear infrastructure such as roadkill resulting from vehicular wildlife collisions, wildlife drownings in irrigation canals, etc. WWF Nepal through USAID's Hariyo Ban Program supported pilot projects such as canopy bridges to reduce road accidents of arboreal species and installation of guiding fences to reduce wildlife drownings in irrigation canals, in certain sections of the Banke-Kamdi complex. The Government of Nepal has also drafted a “Wildlife Friendly Linear Infrastructure Guideline” which focuses on the need for appropriate mitigation structures such as overpasses and underpasses along critical stretches of biologically important areas where linear infrastructure cuts through.


Grazing Pressure in Gokul Community Forest

A RAY OF HOPE

Restoration, protection, and management activities along the floodplains have brought tremendous changes to the region over the last two decades with approximately 4.48 sq. km of forest plains restored in Kamdi between 2015-2020. The restored floodplains have now become breeding centers for wild boars and birds, whereas wildlife populations have been augmented—a direct result of enhanced community stewardship, protection measures and multi-stakeholder coordination with The President's Chure Terai Madhesh Conservation Development Board, Nepal Police–CIB, Department of Roads, etc.

Tiger populations also flourished between 2013 and 2018, as evidenced by the National Tiger Survey of 2018 which documented 21 tigers in Banke National Park compared to just four in 2013 making a strong case for corridor functionality and wildlife dispersal between Bardia, Banke, Kamdi and Suhelwa in the long run. While scientific evidence of tiger dispersal in the core areas of Kamdi is lacking, instances of negative human tiger conflict and retaliatory tiger killings confirms its use by large carnivores such as tigers.

Although wildlife populations are on the rise, on the flip side this has led to increased instances of negative human wildlife interactions in the form of crop raids by wild boars, monkeys, and elephants, property damage, and human and livestock injury/loss by large carnivores such as common leopards and tigers. Various preemptive measures have been undertaken such as construction of predator proof pens, fencing, and plantation of unpalatable crops to directly reduce conflict, as well as establishment of relief funds to minimize financial losses incurred by victims.

TOWARDS CONNECTIVITY

The fragile Chure area within the corridor holds considerable significance in terms of the landscape’s water ecology, as the rain in this region percolates into the lowlands of Terai, recharging underground water tables. Forest cover and habitat management is therefore critical for the dry Kamdi region, where conservation efforts are a boon to both communities and wildlife. A follow up on the biodiversity threats and climate change vulnerability assessment conducted in 2017, consequently downgraded the threats to Kamdi Corridor from “Very High” to “High”; denoting the success of conservation measures and decline in threats.

With the success of conservation interventions, the ecological resilience of the corridor has improved, addressing threats and vulnerabilities over the last two decades, benefitting local communities, and facilitating wildlife dispersal; including large mammals. As such, this corridor holds considerable potential for maintaining corridor functionality over the long term.

MR. UMAKANTA PANT

Chairperson, Gadhawa Community Forest Conservation Committee, Kamdi Corridor

The rate at which the forests of Kamdi were being exploited and degraded in the early 2000's was alarming. Illegal logging and harvesting, overgrazing, and poaching was rife. The 10-year long political insurgency had taken a toll on the forests that once flourished with towering trees and provided shelter to wildlife.

It was a tough task to address these roaring conservation challenges back then, in fact a seemingly impossible task. Eventually in 2008, Community Forest Coordination Committees were formed in Gadhawa, Mahadevpur and Kamdi, bringing together 141 CFUGs.

WWF Nepal under its Terai Arc Landscape Program also started engaging in forest protection and restoration activities starting with Gokul Community Forest. Under this program, we were collectively able to form and mobilize mother and youth groups to run mass awareness campaigns with a particular focus on flood plain restoration and forest regeneration along the Rapti river. We also formed CBAPUs which significantly reduced poaching and other forest related illegal activities in the area.

The revolving fund supported by the Terai Arc Landscape Program also had a telling effect in strengthening community stewardship. Community members were able to secure loans through the fund and establish green business ventures, while also reducing their dependancy on forests. This initiative helped community members become mindful about the reciprocal relationship between nature and humans—if we protect nature, nature will continue to provide for us.

Today, I see the thriving forests in the corridor and cannot describe the feeling it gives me. Kamdi has revived and is now thriving with flood plains restored, community stewardship bolstered, and frequent wildlife sightings. However, we must not get complacent as there is still much work to be done to improve forest management in Kamdi.

KHATA CORRIDOR

CORRIDOR AREA
202.39 sq. km

KEY WILDLIFE SPECIES
Elephant, Tiger, Leopard, Rhinoceros, Sambar Deer, Leopard Cat

FOREST COVER
96.57 sq. km

PRIMARY HABITAT TYPES
Riverine Forests, Mixed Hardwood Forests, Sal Forests and Grasslands

PRIMARY CHALLENGES
Negative Human Wildlife Interactions, Poaching, Overgrazing, Linear Infrastructure Development - Postal Highway and Irrigation Canals

MAJOR RIVERS
Karnali, Geruwa, Orahi, Babai

KHATA

THE GENESIS OF KHATA

SABITA MALLA, KANCHAN THAPA, SHAYASTA TULADHAR

Nepal's landmark landscape level approach to conservation was initiated in 2001 with the endorsement of the Terai Arc Landscape program, which aimed to provide a contiguous habitat for tigers to roam freely, while connecting conservation with communities. One of the primary areas of focus was identifying and restoring critical corridors and bottlenecks across the landscape—one of which was the Khata Corridor.

The Khata corridor held immense potential to serve as a functional corridor due to its strategic position linking Nepal's Bardia National Park with India's Katerniaghat Wildlife Sanctuary, providing a contiguous forested habitat for tiger dispersal. Unfortunately, the corridor was in a poor state with the only patch of trees across 1.15 sq. km of land; prior to the commencement of conservation programs in 2001. The land was degraded from uncontrolled grazing of cattle, and land clearings for settlements and agriculture.

The Khata corridor covers 202 sq. km of area, and is approximately 13 km long with a varying width of 1-6 km, interspersed with agricultural fields and settlements between the two transboundary protected areas. The Karnali river flows through the corridor and is a lifeline for both communities and wildlife residing in the corridor.

CHALLENGES IN THE CORRIDOR

The eradication of malaria in the Terai in the late 1950s, and the ensuing resettlement of communities from the hilly regions to Terai's fertile riparian plains of Geruwa-Karnali, led to large scale deforestation and clearance of forested lands for cultivation, confining wildlife movement to core areas within protected areas. The remaining forest patches were further eroded during the political insurgency (1990s to early 2000s) with wide scale encroachment into the corridor, alongside escalation in poaching and livestock grazing. As a result, the once pristine forests and grasslands spanning Bardia National Park and the adjoining Khata corridor, consequently faced the empty forests syndrome, with forests devoid of wildlife.

The task of restoring the severely degraded forests of Khata was seemingly impossible in 2001, with every household relying on the forest corridor for cattle grazing, and the conversion of remaining forests into open scrublands. Habitat deterioration by fast spreading invasive species like the *Lantana camara* and *Cassia tora* was another issue. Fearful of being denied access to the forests, local communities of Khata were initially resentful of conservation initiatives, protesting interventions by the Terai Arc Landscape Program. Meanwhile there was also a brewing resentment among communities towards park authorities, government, and international organizations in the buffer zones of Bardia National Park. The reasons were simple, while settlements just a few kilometers north of their villages availed of several economic benefits from the national park, communities in the buffer zones of Khata were completely devoid of such benefit or support. Feeling largely neglected, these communities perceived conservation efforts as a threat to their natural resource dependent livelihoods.

Cane furniture enterprises through community livelihood programs

EARLY RESTORATION EFFORTS

The objective of the Terai Arc Landscape Program was to strategically bring on board local communities into corridor conservation by making them an integral part of restoration efforts. In 2001, WWF Nepal undertook a socio-economic survey and threat assessment of western Khata through its Western Chure Conservation Program which would set the baseline for the program. Conservation interventions, in effect, started with awareness building programs such as door-to-door visits and community consultations, alongside establishment of community-based institutions such as community forestry programs to take forward restoration initiatives. Until this time, only two community forests (CF)—Srijanshil and Shiva—had been handed over to local communities. Restoration activities under the Forest Operational Plan (FOP) ranged from establishment of nurseries, and plantation of seedlings of native tree species in community forests with large barren patches, while also promoting natural regeneration, all the while keeping communities and their engagement at the forefront.

Forest restoration programs were complemented by integrated conservation initiatives to help further spur community stewardship. Alternate energy programs through biogas; a clean cooking fuel from animal dung and improved cooking stoves helped replace household requirements for firewood to reduce pressure on forests. Similarly, sustainable livelihood schemes supported by micro-credit facilities helped fund households through homestays and agri-based community enterprises such as marmelos juice, turmeric, cane furniture, and mentha, providing alternate income opportunities for people otherwise dependent on forest resources.

This gradually led to a shift in perception as communities began to realize that their current practice of resource use was unsustainable. Powered by the stewardship of communities, the idea of *kanzi* was introduced; where cattle left freely to graze were housed in a certain area, and owners fined. The cash generated was then used to pay for forest watchers who were deployed by each community forest to protect newly planted seedlings inside the forests. Cattle grazing and extraction of natural resources were thereby regulated providing adequate breathing space for forests to regenerate and recover.

This initial effort in building community stewardship consequently resulted in the formation of more Community Forest User Groups (CFUGs) along with its consortium Community Forest Coordination

Committees (CFCC), which in turn, helped sustain conservation actions in Khata. Restoration efforts were primarily concentrated in western Khata during the first 10 years (2001-2011), whereas the next 10 years (2011-2020) focused on restoring eastern Khata.

FUNCTIONAL CORRIDOR, EMPOWERED COMMUNITIES

Presently, Khata corridor comprises of a network of 74 community forests, each created and managed by local communities under the supervision of the Divisional Forest Office, Bardia. Restoration efforts are now visible on ground with thick forested habitats connecting Katerniaghat Wildlife Sanctuary with Bardia National Park, further validated by geo-spatial analysis confirming a net forest gain of 19.11 sq. km in the last 20 years, establishing restoration efforts in Khata corridor as one of the most successful community initiatives in the Terai Arc Landscape. This model has been replicated in seven other critical corridors identified in the landscape.

Today, Khata is a vibrant ecosystem and a functional corridor allowing for previously fragmented populations of tigers and other wildlife to connect across the transborder regions. The functionality of the Khata Corridor is supported by ample empirical evidence of its use by over 30 wildlife species such as tiger, elephant, rhino and other small and large mammals. Correspondingly, tiger populations in Bardia National Park increased almost five- fold from 18 in 2013, to 87 in 2018. Careful analysis suggests that tiger recovery is not only due to tiger births within Bardia National Park, but also through tiger dispersal between the adjoining transborder habitats.

Meanwhile, joint Nepal-India camera trapping studies carried out in 2014 confirmed four tigers common to both countries. Long term camera trapping study in the Khata corridor has also helped understand corridor use by tigers—establishing profiles of 46 individual tigers over a period of four years. Likewise, information from satellite collared rhinos, shows evidence of transboundary movement between protected areas in Nepal and India, through the Khata corridor. This evidence thereby proves the functional use of Khata by large mammals, as a safe conduit between Nepal and India.


Rhino with calf


Tiger with cubs


Spotted deer


Tiger


Striped Hyena


Male and female Leopard


Grey Langur


Peacock


Spotted deer

Camera trapped pictures of wildlife from Khata Corridor

©DoFSC /WWF Nepal

NEGATIVE HUMAN WILDLIFE INTERACTIONS

While the results of 20 years of conservation initiatives have been astounding in terms of reforestation and wildlife dispersal, negative human wildlife interactions in the form of crop depredation, destruction of homes and loss of life, remains a major challenge for communities living around the corridor. Addressing these challenges proved to be a tough task for the Terai Arc Landscape Program; particularly in terms of engaging communities to protect wildlife. Crops such as Mentha and Chamomile—unpalatable to wildlife due to the high essential oil content—were introduced to minimize crop depredation, alongside installation of solar fencing, mesh wire fencing, and bio fencing, or a combination of these fences around crop fields. Likewise, improved cattle sheds and predator proof pens were also introduced to minimize livestock predation.

Such strategies gradually increased the understanding and acceptance of wildlife among communities, resulting in the formation of youth-led Community Based Anti-Poaching Units (CBAPUs). Their engagement has been critical in deterring illegal activities in the corridor, which falls outside the national park and is subsequently afforded less protection. In addition, Rapid Response Teams (RRTs) also led by youth help in managing conflict by bridging information gaps between communities, and park and district forest authorities. While negative human wildlife interactions are inevitable there is a need for proactive measures to tackle the increasing frequency of both human and wildlife casualties. The first step towards addressing this issue is understanding the scenario, identifying measures to keep both people and wildlife safe, and finding and implementing solutions to adequately manage negative human wildlife interactions.

THE FORMATION OF YOUTH-LED COMMUNITY BASED ANTI-POACHING UNITS (CBAPUS) HAS BEEN CRITICAL IN DETERRING ILLEGAL ACTIVITIES IN THE CORRIDOR; WHICH FALLS OUTSIDE THE NATIONAL PARK AND IS SUBSEQUENTLY AFFORDED LESS PROTECTION. LIKEWISE, RAPID RESPONSE TEAMS (RRT) ALSO LED BY YOUTH HELP IN MANAGING CONFLICT BY BRIDGING INFORMATION GAPS BETWEEN COMMUNITIES, PARK AND DISTRICT FOREST AUTHORITIES.

Predator Proof Pens © Emmanuel Rondeau/WWF-US

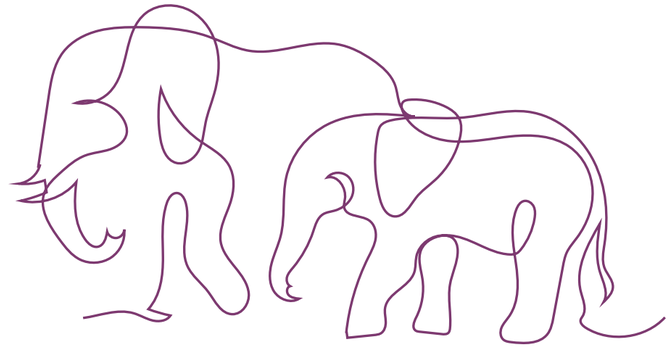
Locals collecting fuelwood © James Morgan / WWF-US

Blue bull trapped in Babai Irrigation Canal © Karun Dewan/WWF Nepal

CBAPU members handing over woolen snares to the division forest sector office © Gary Van Wyk / The Ginkgo Agency / Whiskas / WWF-UK

IN TERMS OF FUTURE IMPACT, LINEAR INFRASTRUCTURE DEVELOPMENT SUCH AS ROADS, IRRIGATION CANALS, ETC. IS RAPIDLY EMERGING AS THE BIGGEST THREAT TO CORRIDORS DISRUPTING THE HARD-EARNED CONNECTIVITY, AND HAMPERING THE LOCAL ECOSYSTEMS SUPPORTING IT.

Large herd of elephants spotted migrating into Bardia National Park through Khata corridor.



LOOKING AHEAD

Twenty years hence, Khata has received a complete facelift–from 1.15 sq. km of forests to 96.57 sq. km, and encompassing more than 6,000 community members as stewards of the land. Improvement in forest quality over time has helped to create a buffer against floods, restored wetlands, and recovered lost species assemblage in the corridor. The corridor presently facilitates the effective movement and dispersal of tigers with 46 individual tigers identified over the last four-year period, free to roam between the forests of Nepal and India.

While wildlife numbers are on the rise, so are cases of negative human-wildlife interactions. Extensive use of the corridor by wildlife means that pre-emptive measures will be necessary in dealing with such negative human-wildlife incidences going ahead, while engaging all concerned stakeholders. However, the search for solutions continues through technological advancement and close collaboration with communities and stakeholders at all levels.

In terms of future impact, linear infrastructure development such as roads, irrigation canals, etc. is rapidly emerging as the biggest threat to corridors disrupting the hard-earned connectivity, and hampering the local ecosystems supporting it. Proactive measures have been undertaken by the Government of Nepal in Khata, particularly in terms of green infrastructure such as wildlife overpasses and underpasses across the Postal Highway that bisects the corridor. Meanwhile plans are also underway to integrate nature-based solutions through construction of an underpass across 556 meters of a critical forest stretch in the corridor, to allow for safe passage of wildlife.

Over the last 20 years, strengthening of community capacity has led to progress in sustainable forest management, thus ensuring equitable benefit sharing among communities, while maintaining transparency of programs. Moving ahead, it will be necessary to track governance mechanisms of these institutions to ensure community well-being and continued dispersal of wildlife.

CASE STUDY

NEPAL'S PEOPLE-CENTERED APPROACH

Nepal's Khata Corridor, a significant functional corridor, connects Nepal's Bardia National Park to India's Katerniaghat Wildlife Sanctuary. During the country's last tiger survey in 2018, it was estimated that at least 34 tigers use the Khata Corridor. With increasing tiger movements, negative human wildlife interactions in the area has also increased. In 2020, between August – September, four people were killed by a tiger around the corridor. Although these tragic incidents created terror and panic among the local government and the communities living in the area,, there are surprisingly no records of retaliatory killings of tigers. Apart from increased tolerance, the approach with which the community took proactive steps to address the issue also exemplifies community ownership to conservation and how communities and other stakeholders in the area are embracing tiger conservation.

After a recent human tiger conflict incidence, the Khata CFCC, a community based organisation formed two decades ago, brought all stakeholders (community representatives, forest officials, national park, district administrative authorities, local government, Bardia Conservation Program, and the Terai Arc Landscape Program together to address the issues and proposed immediate compensation to the families through the CFCC's endowment fund. The community based RRT were also present at the site to support concerned authorities in managing the conflict. To minimise such conflicts, the CFCC in partnership with the CBAPU, RRT and the *Bhalmansas* (leaders in the indigenous Tharu communities), organised various awareness programs in and around the corridor. Khata is an example of how people-centred approaches operate in practice.

Rapid Response Team in a discussion with community members on relief fund disbursement mechanisms.

KARNALI CORRIDOR

CORRIDOR AREA
148.95 sq. km

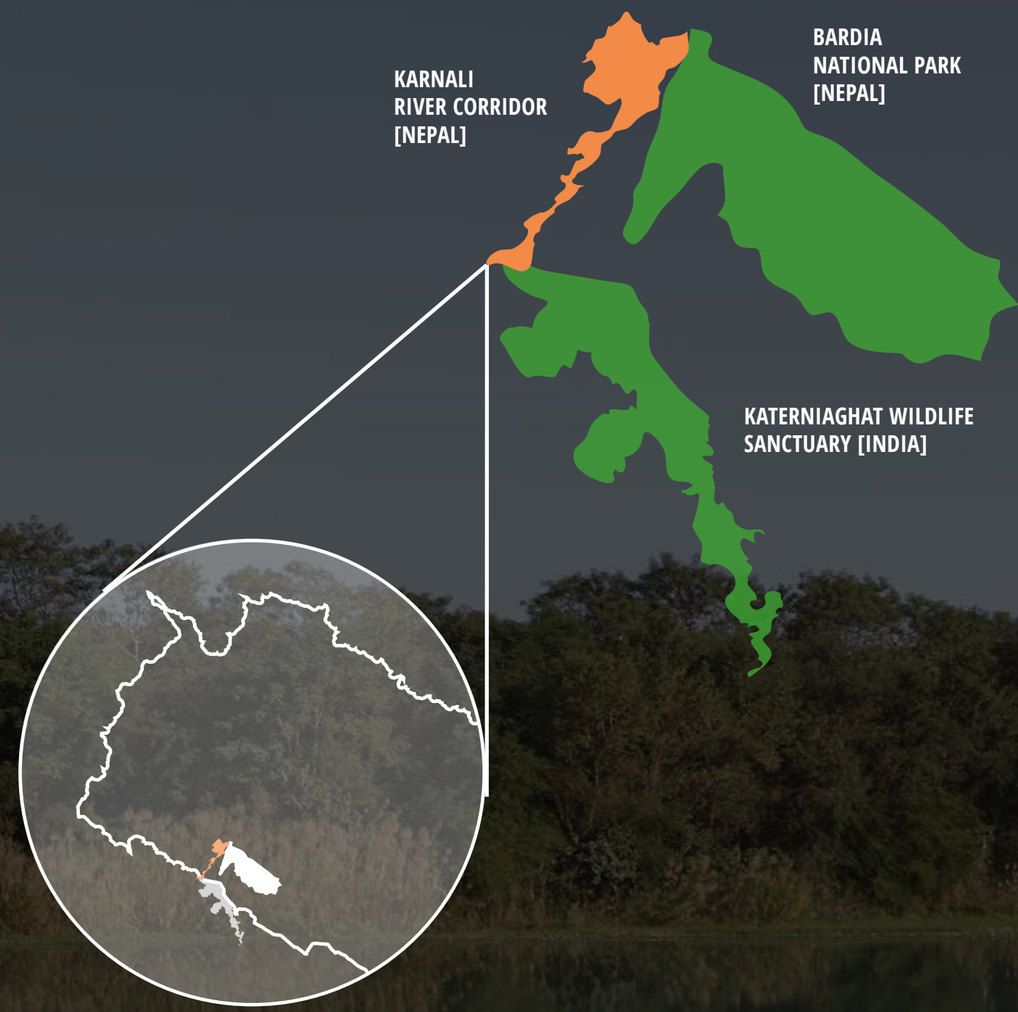
KEY WILDLIFE SPECIES
Tiger, Leopard, Gharial, River Dolphin, Elephant, Rhinoceros, Honey Badger, Golden Jackal

FOREST COVER
111.37 sq. km

PRIMARY HABITAT TYPES
Riverine Forests and Floodplain Grasslands

PRIMARY CHALLENGES
Overgrazing, Forest Fires, Floods, Sand and Gravel Mining, Drought, Postal Highway, Railway, Irrigation Canal

MAJOR RIVERS
Karnali



KARNALI

NEPAL'S ONLY RIVERSCAPE

RAJESH SADA, KANCHAN THAPA, SHAYASTA TULADHAR

Sourced from the Himalayan region in transboundary China, the Karnali is Nepal's longest river at roughly 504 km. Flowing through Nepal, it merges with Ghaghara River in India, a major tributary of the river Ganga. This critical 35 km stretch along the lowlands of Terai is popularly known as the Karnali River Corridor. Nepal's first and only river and forest corridor, Karnali is a priority ecological corridor that connects Nepal's Chure Forest and Bardia National Park in the north with India's Katerniaghat Wildlife Sanctuary in the south. Spanning an area of roughly 148.95 sq. km, the corridor provides north-south connectivity, facilitating the movement of both terrestrial and aquatic animals, notably threatened freshwater megafauna such as the Gangetic dolphin, gharial and golden mahseer. Running parallel to the Khata corridor in its east, both these corridors strengthen transboundary connectivity and are critical for north-south dispersal of megafauna such as rhinos, elephants, and tigers.

Karnali's riverscape provides a rich mosaic of habitats that includes riverine forests, as well as floodplain grasslands supported by a network of rivers, oxbow lakes, and agriculture lands. It boasts one of the largest floodplain corridors among the identified corridors in the landscape and supports the dispersal of a wide range of wildlife species. Over 74 fish species use this major section of the river as their habitat, while associated tributaries are major nursing and spawning sites for fish.

This riverscape is not only a critical habitat for its rich biodiversity, but also for people living nearby. Over 80 community forest user groups and 25,000 resource dependent households have benefited from managing the forests in the corridor. In fact, the corridor includes one of the biggest community forests based on boundary delineation, the Chhatiwan Community Forest.

THREATS AND CHALLENGES

As a river and forest corridor, the threats and challenges faced by Karnali are doubly diverse, varying between forest encroachment, overgrazing, intensive fishing, sand and gravel mining and poaching, to the spread of invasive species, and climate induced disasters such as floods, landslides, forest fires, and riverbank cutting. Meanwhile, negative human wildlife interactions remain a persistent problem, with the Asian elephant, blue bull and monkeys considered the most conflict-prone animals in the corridor.

While encroachment into forest land and riverbeds in the southern end of the corridor is a major issue, climate change and infrastructure development; near the Nepal-India border constitute the biggest challenge, nearly disrupting the connectivity. Unlike other corridors in the Terai, the Karnali river corridor is vulnerable due to a variety of large infrastructure projects fragmenting the corridor. For instance, the East-West Highway bisects a major forest patch in the Chure, as does the Postal Road, the Rani Jamara Kulariya Irrigation System and the Bheri Babai Multipurpose Diversion Project along the various sections of corridor. These irrigation, water, and road projects, severely impact water flow, river ecology and hinder north-south wildlife dispersal in the corridor. Likewise, another threat is illegal and destructive fishing, and resultant by-catch using gill nets which often leads to death of aquatic species including endangered Gangetic dolphins.

Sand and gravel mining has also seen a sharp increase in the corridor. The rampant mining not only increases turbidity in the river water but also changes the geomorphology of the river which has adverse effects on aquatic animals, severely damaging fish spawning sites and nursery grounds as well as gharial sun basking sites and nesting

Gabion retaining wall being constructed along the Karnali river bank to avoid river cutting and impact of fast moving water caused by floods.

© Karun Dewan/WWF Nepal

grounds. Furthermore, environment management plans for sand mining and gravel extraction projects are inadequately implemented and monitored due to lack of technical capacity.

Besides this, climate change is another looming threat with its effects severely impacting conservation efforts and the lives of people in and around the corridor. Floods, droughts, and riverbank cutting are just some of the visible implications. Recent studies on the impact of climate change on water availability in the Karnali basin shows that annual precipitation and average annual river discharge of the Karnali river is projected to increase, though the increase is not uniform for all seasons, indicating the possibility of future impacts such as flooding, riverbank cutting, inundation and landslide. Given the scale of challenges in the corridor, an assessment of biodiversity threats and climate change vulnerability, ranked the threat level of the corridor at "High"in 2012.

RAMPANT MINING NOT ONLY INCREASES TURBIDITY IN THE RIVER WATER BUT ALSO CHANGES THE GEOMORPHOLOGY OF THE RIVER WHICH HAS ADVERSE EFFECTS ON AQUATIC ANIMALS, SEVERELY DAMAGING FISH SPAWNING SITES AND NURSERY GROUNDS AS WELL AS GHARIAL SUN BASKING SITES AND NESTING GROUNDS.

RESTORATION AND CLIMATE CHANGE ADAPTATION

As in other cases, community engagement and support have been invaluable in conservation efforts in the region particularly due to access restriction for river dependent communities. Comprehensive endeavours to diversify and improve livelihoods and reduce dependency on river and forest resources through skill building programs, income generating activities, adoption of alternative energy scheme such as biogas and improved cooking stoves over the last two decades have therefore been critical, culminating in saving of the fuelwood equivalent of almost 10 sq. km of forests. Meanwhile, over 99.26 sq. km of community forests were handed over to 80 forest user groups over the last two decades to foster community stewardship and boost regeneration.

The breadth of the Karnali river corridor is relatively narrow in comparison to other corridors in the Terai Arc Landscape. Restoration of its forests, floodplains and wetlands are therefore critical for both terrestrial and freshwater megafauna such as the Gangetic dolphins that use these routes for migration. Various activities have therefore been undertaken to manage the grasslands and habitats in this region, such as floodplain restoration, river conservation, construction of fire lines to control forest fires, fencing to support natural generation, etc.

However, habitat management alone is inadequate as a conservation measure and challenges such as negative human wildlife interactions and illegal wildlife trade must also be addressed. Relying on experience, various interventions such as support for electric fencing, predator proof pens to protect livestock, and mobilization of Community Based Anti-Poaching Units (CBAPU) to control poaching, and illegal harvesting of natural resources—primarily fuelwood collection, and sand and gravel mining—were undertaken. With climate change a growing concern for this valuable but vulnerable region, Local Adaptation Plan of Actions (LAPA) and Community Adaptation Plan of Actions (CAPA) were also implemented integrating conservation and climate change issues that ultimately enhanced the adaptive capacity of local communities and co-benefiting wildlife conservation through habitat protection and management.

Woman working to clear weeds in Mahila Jagaran Community Forest in Karnali corridor.

© James Morgan / WWF-US

Blue bull

Spotted deer

Golden Jackal

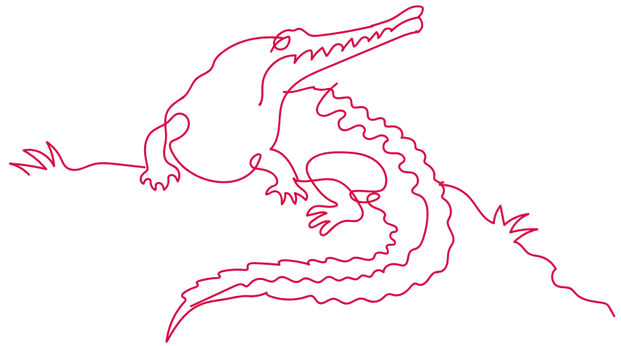
Tiger

© DoFSC/WWF Nepal

Striped Hyena

Camera trapped wildlife pictures from Karnali Corridor

WHILE SIGNIFICANT PROGRESS HAS BEEN MADE, ILLEGAL AND DESTRUCTIVE FISHING PRACTICES STILL PREVAIL, AS DOES EXTENSIVE SAND AND GRAVEL MINING THAT DRASTICALLY IMPACTS FRESHWATER SPECIES AND REDUCES FISH NUMBERS IN THE RIVER.



LOOKING AHEAD

As a corridor providing north-south connectivity, continued support in the restoration of Karnali's forests, floodplains and wetlands is vital for both wildlife and local communities. As a critical habitat for the endangered Gangetic river dolphin, the critically endangered gharial and several threatened fish and bird species, and a corridor between Nepal's Bardia National Park and India's Katerniaghat Wildlife Sanctuary, the site holds immense potential to be a transboundary Ramsar site.

Considering the current context of encroachment and corridor fragmentation that hinders wildlife movement, forest and floodplain restoration through reforestation, afforestation, and fencing is essential in this corridor. Promotion of private forestry and agro-forestry in private agricultural land could be instrumental in making this corridor more functional. However, restoration efforts must reconcile sustainable benefits to local communities as well as biodiversity conservation targets.

While significant progress has been made, illegal and destructive fishing practices still prevail, as does extensive sand and gravel mining that drastically impacts freshwater species and reduces fish numbers in the river. Practices such as these must be strongly discouraged through the introduction of regulatory instruments, awareness building programs and diversifying income opportunities for river dependent communities to promote sustainable harvesting and freshwater conservation in the long run.

Collaboration with local governments, community forest user groups and irrigation water user committees will be key in covering wider ground. For instance, community-based river stretch co-management—which resembles community forestry in forest management—has just been initiated in this riverscape, and if promoted and up-scaled, will be an excellent measure to conserve rivers, fish and other aquatic species. Meanwhile, critical fish nursing and spawning sites can also be identified in the river and handed over for management to either local fishery groups such as the *Sonaha* and *Majhi* indigenous communities or to local aquatic animal and biodiversity conservation group in the area. Such initiatives help build the capacity of the indigenous fishing communities while also sustaining traditional practices and maintaining fish stocks in the river.

Karnali's riverscapes provide a natural buffer for communities and their assets during floods. While, forest cover has increased in the last 20 years; challenges remain in terms of sustaining past efforts against new emerging threats. With almost all major linear infrastructure cutting through this corridor, and even more hydropower projects in the pipeline upstream, the threats to corridor fragmentation and consequent functionality is particularly high for this corridor. Proactive management of such threats is therefore critical in the long term, particularly in terms of promoting wildlife friendly green infrastructures in high priority sections in the corridors. Meanwhile, as irrigation and hydropower projects alter the hydrological regimes of the river, environmental flow must be maintained in Karnali's riverscapes; particularly for dependent freshwater megafauna such as gharial, dolphin, mahseer as well as other terrestrial megafauna such as tigers and rhinos.

BASANTA CORRIDOR

CORRIDOR AREA
654.32 sq. km

KEY WILDLIFE SPECIES
Tiger, Leopard, Langur, River Dolphin, Deer Species

FOREST COVER
393.6 sq. km

PRIMARY HABITAT TYPES
Sal Forests and Grasslands

PRIMARY CHALLENGES
Overgrazing, Floods, River Poisoning, Encroachment, Forest Fires, Fuel Wood Collection, Postal and East-West Highway, Railway

MAJOR RIVERS AND RAMSAR SITES
Mohana, Likma, Kandra, Gauriganga, Ghodaghodi Lake

BASANTA

CONSERVATION AMIDST CHALLENGES

EKRAJ SIGDEL, PRAMOD NEUPANE, SANTOSH MANI NEPAL, KANCHAN THAPA, SHAYASTA TULADHAR

Covering an area of 654.32 sq. km, the Basanta Corridor is the second largest transboundary corridor in the Terai Arc Landscape connecting Shuklaphanta National Park and Bardia National Park through the expansive Chure foothills in the north; and adjoining Dudhwa National Park, India in the south. This transboundary linkage provides critical habitat—forests, grasslands, wetlands, and riverbanks—for the dispersal of wildlife such as tigers, elephants, and other ungulates.

Basanta, which refers to a large tract of forests in Nepali, is located in the lowlands of Terai in far western Nepal. The corridor is home to threatened wildlife, such as the tiger, Asian elephant, sloth bear, leopard, and is reported to have 226 species of birds; 10 of which are globally threatened and 18 nationally threatened. It is also known to have populations of Gangetic river dolphins along the Mohana river in the south, particularly during the high flood monsoon seasons. The Ghodaghodi Lake—a Ramsar site—is also located within the corridor along with other biologically significant wetlands and grasslands intermixed with forests.

Considering its high biodiversity value, the Government of Nepal declared it a "Protection Forest" (now Forest Conservation Area) in 2011, enabling diversification of forest management to include habitat improvement, species conservation, and forest restoration initiatives.

DESPITE ITS RICH BIODIVERSITY, THE BASANTA CORRIDOR FACES MAJOR CHALLENGES, ESPECIALLY IN TERMS OF BALANCING THE CONSUMPTIVE NEEDS AND DEMANDS OF THE HUMAN POPULATION.

ENCROACHMENT, CLIMATE HAZARDS, AND INFRASTRUCTURE

Despite its rich biodiversity, the Basanta Corridor faces major challenges, especially in terms of balancing the consumptive needs and demands of the human population. Ever-growing populations around the region and its inter-related consequences of escalating forest encroachment for human settlements, farmland expansion, overgrazing, and infrastructure development are visible issues around the corridor resulting in forest fragmentation in core areas, shrinking wildlife habitats, and increased potential for negative human-wildlife interactions. A participatory threat assessment of the Basanta Corridor in 2012 highlighted floods, erosion, sedimentation, river poisoning, and excessive grazing as the highest-ranked threats in the corridor. Additionally, factors like internal migration to the corridor and planned resettlement programs under the Government of Nepal have had substantial negative implications on the biological wealth of the corridor, triggering significant encroachment into forested areas as more and more people migrated to the area in the hope of attaining additional lands.

With the Chure forests in the north of Basanta, and Dudhwa National Park in the south, there is no direct connectivity with national parks in Nepal. However, Dudhwa National Park acts as a source site for wildlife and provides opportunities for wildlife dispersal along the Basanta Corridor. With core forest habitats and fringe areas of Basanta Corridor heavily affected by anthropogenic disturbances, the likelihood of human interaction with dispersing wildlife is greater. This coupled with ignorance among communities on wildlife behavior results in severe negative consequences such as human casualties and injuries, especially from tigers.

The corridor is bisected by the Kandra river with the Mohana river forming the southern border with India. As such, floods and riverbank cutting have emerged as major climate-induced hazards in the corridor, especially along the Kandra river where settlements and agricultural fields are threatened by annual riverbank cutting.

Eroded bank along the wetland © Muna Thapa/WWF Nepal

Forest encroachment within the corridor © Kanchan Thapa/WWF Nepal

Grazing pressure within the forest corridor © Kanchan Thapa/WWF Nepal

Postal highway expansion © Karun Dewan/WWF Nepal

During such occasions, affected communities generally either take temporary shelter on higher ground or in forested areas. Unfortunately, some communities continue to live in these areas even after floods recede, encroaching upon forested lands. Such encroachment and land-use change, invite more communities to settle nearby. Meanwhile, forest management authorities are unable to take appropriate action due to the influence of social and political parties that remain in a state of *laissez-faire*; intensified during the periods of elections, insurgency, civil unrest, and political turmoil. Consequently, almost every block of the Basanta forest has been encroached upon along its entire length.

Two East-West highways also cross through this corridor, one from the northern end—Mahendra Highway—and another from the southern end—Postal Highway. The southern flank of the corridor adjacent to the Postal Highway is heavily degraded, reducing connectivity with Dudhwa National Park in India. Furthermore, an East-West electrified railway alignment is also being planned parallel to the Mahendra Highway, which could place significant pressure on the corridor's forests. The corridor is considerably bottlenecked in several sites and needs immediate restoration efforts.

Community user group meetings on forest protection and management.

© Karun Dewan/WWF Nepal

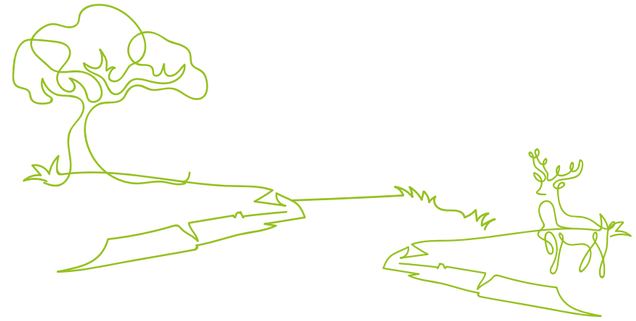
CONSERVATION EFFORTS

The Terai Arc Landscape program under the Ministry of Forests and Environment has been working on several corridor restoration programs, through livestock management, plantation, and grassland and wetland management, as well as diversifying livelihood opportunities through support to local cooperatives, green enterprises, and creation of green jobs. Under this participatory model, various community forest user groups and community forest coordination committees have been formed to improve forest management while also meeting human needs.

Support from community institutions and conservation stakeholders in the form of awareness generation, wildlife crime control, and regular monitoring of wildlife habitats have also been undertaken. Likewise, Community Based Anti-Poaching Units (CBAPU) and Rapid Response Teams (RRT) have been formed to aid forest guards and division forest officials in patrolling, wildlife rescue, and liaising on community safety in critical situations. Despite these interventions, groups still require additional capacity building to strengthen local reactive measures, especially in terms of rescuing problematic wildlife, which is an increasing issue in the area.

Continued support in capacity development, awareness, and training in other regions such as the buffer zones of Chitwan National Park and Khata Corridor has helped improve the capacity of communities, especially with the adoption of an integrated approach to manage negative human wildlife interactions by concerned authorities, conservation partners, and local communities. The integrated approach included a scholarship program, an immediate relief mechanism, positive messaging and awareness programs, among others which helped reduce backlash to conservation in the Basanta Corridor, while also ensuring the safety of both communities and wildlife. However, if current drivers of forest degradation continue to persist, there is a high likelihood of increases in such incidences in the future.

A forest cover assessment of the Basanta Corridor shows that net forest cover has increased by almost 15.22 sq. km in the last 20 years, despite net forest loss in the first 10 years (2001-2010) and continuous anthropogenic pressures within the corridor. In 2006, a female tiger with cubs was reported within the corridor—assumed to have entered from Dudhwa National Park—providing further impetus to boost restoration efforts within the Basanta corridor. Likewise, rhinos have also been occasionally recorded within Basanta. Community sightings also indicate an increasing trend of large mammal presence such as tigers within the corridor.



LOOKING AHEAD

Despite the challenges faced within Basanta, the corridor still functions as a transboundary corridor for wildlife dispersal. Given the large area of forested land and the relatively large scale of anthropogenic disturbances, moving forward the corridor could be managed under a zonation-based approach as envisioned in the Laljhadi Mohana Corridor in the west, whereby the core area is under strict protection, and the fringe areas are sustainably managed under the community forestry model. These community forestry models could be complemented with alternative income and livelihood activities such as promotion of non-timber forest products, ecotourism, forest-based micro-enterprises, and savings and credit programs to generate community stewardship. Prioritization of vulnerable, marginalized communities, and forest-dependent communities in particular will be critical for the success of conservation initiatives in the corridor.

Likewise, integrated approaches in managing negative human wildlife interactions must also be prioritized, adopting a combination of preventive measures, such as mass awareness programs, and curative measures such as quick relief funds. Similarly, local community groups such as CBAPU and RRT members need to be capacitated to strengthen rescue efforts and facilitate crowd control during escalating situations. Local governments must be sensitized and capacitated on mechanisms to leverage resources and provide quick relief funds for affected communities in the region.

In addition, collaborative efforts between decision-makers, donors, developers, and concerned stakeholders in both government-backed projects, and donor-funded projects in local, provincial and federal levels need to be strengthened to facilitate effective planning, particularly in terms of large linear infrastructure development, housing and settlement areas and industries, among others to ensure corridor connectivity is not affected. While habitat loss and degradation have been widely reported, substantial research efforts are necessary to determine the precise impacts of shrinking connectivity and deforestation triggered by challenges, particularly infrastructure development, expanding urban areas, the impact of climate change, floods, forest fires, and other disasters. Meanwhile, at the national level, policies prohibiting settlement in high conservation value sites will be necessary, alongside promotion of agroforestry and private plantation programs to revive corridor connectivity.

CASE STUDY

TRANSBOUNDARY COLLABORATION AND CORRIDOR RESTORATION

In April 2018, Chandu, a male satellite-collared tiger from Dudhwa National Park, India was tracked ranging out of the national park and venturing into the Nepal side through the Basanta Corridor. Finding itself in a relatively new area, the tiger traversed the area before settling down. This proved to be challenging for authorities on both sides of the country, in terms of ensuring safe passage for the tiger and avoiding any potential interactions that could affect local communities or the tiger.

As the tiger ventured into the Basanta Corridor, the divisional forest office in the district of Kailali was informed about the tiger's whereabouts by WWF India. A joint monitoring team from WWF India and Kailali division forest; along with community-based anti-poaching units were deployed to track the tiger on the ground and ensure the safety of both local communities and the tiger. The monitoring team was able to confirm that the tiger was using space in the northern section of the Basanta Corridor extensively. Several livestock kills were also documented during this time.

Unfortunately, the transboundary team lost the satellite signal from Chandu's collar and was unable to track him after this point. However, no conflict and/or dead tigers were recorded in the region during this time. In this situation, regular communications between the technical teams, field teams, and concerned authorities in Nepal and India, was critical in sensitizing communities on the ground and minimizing incidences of negative human wildlife interactions.

This is a prime example of how transboundary collaboration, timely deployment of joint monitoring teams, and proactive sensitization efforts can help ensure the wellbeing of both communities and wildlife, and demonstrates the value of corridor restoration. While a few local sources claim to have seen the satellite-collared tiger around Bardia National Park, this information was never verified. Bardia National Park is located roughly 50 km from the Basanta Corridor.

The background forest seen below the sun shows Dudhwa National Park, with Basanta corridor in the foreground.

LALJHADI-MOHANA CORRIDOR

CORRIDOR AREA
367.89 sq. km

KEY WILDLIFE SPECIES
Tiger, Leopard, Elephant, Deer Species

FOREST COVER
227.46 sq. km

PRIMARY HABITAT TYPES
Sal Forests, Riverine Forests, Mixed Hardwood Forests, Chirpine Forests

PRIMARY CHALLENGES
Overgrazing, Poaching, River Poisoning, Fuel Wood Collection, Sand and Gravel Mining, Postal Highway, Railway

MAJOR RIVERS
Mohana, Macheli, Dondha

LALJHADI-MOHANA

THE LAST WESTERN FRONTIER

MUNA THAPA, ANANTA RAM BHANDARI, BHARAT GOTAME, KANCHAN THAPA, SHAYASTA TULADHAR

When a lone rhino was spotted roaming the grasslands of Shuklaphanta National Park in the late 1990's, conservationists were baffled. The region had been devoid of the species since they historically roamed these lands. With the relative improbability of rhino movement from far off Bardia National Park due to a lack of contiguous forests to facilitate species movement, Dudhwa National Park in India known to host a rhino population; and connected to Nepal's Shuklaphanta National Park through a narrow strip of forests known as the Laljhadi-Mohana Corridor, was identified as the only possible source of the wandering rhino.

Significant efforts have since been made to expand shrinking populations of species and restore original assemblages of herbivores—such as rhinos—in Nepal's Terai Arc Landscape through translocation efforts. Documentation of the rhino led to reconsideration on the significance and value of the corridor as a potential habitat for rhino dispersal as well as the value of the corridor in facilitating dispersal of other big mammals such as tigers and elephants across the transboundary complex. This case was further strengthened with the sighting of rhinos, in 2005, and then 2006, which were different individuals from those later translocated to Shuklaphanta National Park in 2000.

As the only corridor connecting Nepal's Shuklaphanta National Park to India's Dudhwa National Park, the Laljhadi-Mohana Corridor is vital for species dispersal across metapopulations as well as strengthening genetic diversity of big mammal species such as tigers, rhinos and elephants. The corridor is also the last remaining strip connecting Shuklaphanta to Bardia National Park through the Chure regions in the north. Meanwhile, a series of parks and corridors across the southern transborder of Dudhwa National Park and Basanta Corridor, also connect this region to India's Katarniaghat Wildlife Sanctuary. The Laljhadi-Mohana Corridor is the third largest transboundary corridor in the Terai Arc Landscape, with 12% of the corridor falling within the Chure area. Dominated by *Sal* forests, the corridor also supports grasslands, riverine forests, chirpine forests, mixed forests and is a good habitat for important threatened flora like *Bijayasal* and *Satisal*.

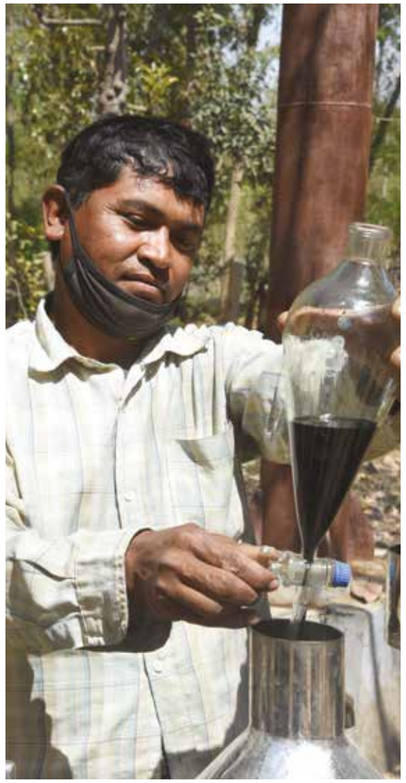
© Karun Dewan/WWF Nepal

HUMAN DEVELOPMENT AND LAND USE CHANGE

Despite spanning across 367.89 sq. km with over 28,000 households living in its periphery, species movement within the Laljhadi-Mohana Corridor is relatively limited due to anthropogenic pressures on the region. Severe human encroachment into the corridor has resulted in forest degradation, impacting forest cover and disrupting critical connectivity for wildlife dispersal. Furthermore, as national parks fall under the protected area system, essential corridors such as Laljhadi-Mohana have faced the brunt of catering to local livelihoods.

With communities around the region heavily dependent on forest resources for daily needs such as firewood, timber, and livestock grazing, population growth and land use change has resulted in conversion of large forest patches into agricultural lands or human settlements over the years, relegating the lush forests of Laljhadi-Mohana into sparse patches.

The Doke Bazaar settlement in the southern region of the corridor is a prime example of a bottleneck in terms of corridor functionality in the Dudhwa-Laljhadi-Shuklaphanta complex with a narrow strip of forests connecting the regions. Severe encroachment in the form of human settlements, agricultural activity, illegal logging and poaching, haphazard sand and gravel mining and abandoned livestock grazing across the corridor has led to environmental damage, resulting in reduced forest cover hampering wildlife movement, increased prevalence of forest fires and cases of negative human-wildlife interactions. Conservation efforts are currently focused on maintaining and restoring critical regions such as these to avoid further degradation.



Essential oil extraction of wildlife deterrant crops and replantation (plantation and fencing) initiatives. © Muna Thapa/WWF Nepal

FOREST RESTORATION INITIATIVES

To improve functionality of the Laljhadi-Mohana Corridor, early initiatives under the government-led Terai Arc Landscape Program focused on overcoming issues of deforestation, encroachment, overgrazing, illegal timber harvesting, forest fires, etc. For instance, the Western Terai Landscape Complex Project (2006-2011) led by the Government of Nepal, Global Environmental Facility (GEF), and conservation partners including WWF Nepal, focused on restoring forests through (i) improved forest management and (ii) generating community stewardship through community managed forests along the Mohana river to reestablish forest connectivity with Dudhwa National Park in the south and Chure in the north.

In line with these objectives, and in acknowledgement of the ecological importance of the corridor, the Government of Nepal declared Laljhadi-Mohana a forest protection area in 2012, with the objective of enhancing wildlife mobility and conserving biodiversity. The riverine areas along the Mohana river were restored to create a corridor connecting to Dudhwa National Park on the northern end. Meanwhile, the forest protection area was divided into zones to improve management of forests, while also catering to community subsistence needs. Under the zonation-based approach, the forest protection area was divided into three categories: (i) core zone, (ii) intensive management zone, and (iii) impact zone. While core zones are under full protection with no management activities, intensive management zones are designated for production purposes. Impact zones on the outermost peripheries are used to engage communities in participatory forest management for sustainable use.

BY TYING BENEFITS FROM FOREST RESOURCE EXTRACTION TO CONSERVATION, THE PERFORMANCE-BASED SUSTAINABLE FOREST MANAGEMENT APPROACH IS EXPECTED TO IMPROVE COMMUNITY CONSERVATION EFFORTS IN THE LONG RUN.

GENERATING COMMUNITY STEWARDSHIP

Consequently, improved forest management initiatives were complemented with programs focused on generating community stewardship such as promotion of community forestry, alternative energy like biogas, diversification of livelihoods through forest-based enterprises and strengthening of local forest and community-based organizations. While communities were initially apprehensive to changed management modalities, enhanced awareness has led to greater ownership as well as access to forest resources in a sustainable manner.

The zonation-based approach has enabled site specific management balancing the social, ecological, and economic needs for sustainable forest management. As of 2020, over 100 sq. km of forests (38% of total forest area) in the 'Intensive Management Zone' of Laljhadi-Mohana has been handed over as community forests to 103 local communities (28,000 households) living in 'Impact Zones' for protection, management, and sustainable use.

The Government of Nepal recognized sustainable forest management as one of its priority programs under the Forestry Sector Strategy 2016 (2072 BS.), which targets bringing 50% of forests in the Terai and Siwalik, and 25% of forests in the mid-hills under sustainable forest management by 2025. Sustainable forest management plays an important role in improving forest productivity, increasing forest products and ecosystem services, local livelihoods, and economy. Beyond protection of forests, sustainable forest management also plays an important role in ensuring sustainable use of forest products and forest ecosystem services. In terms of corridor functionality, along with improved forest management, creation of habitat mosaics is crucial for increased biodiversity in ecotones and wildlife dispersal.

For instance, in the core zone of Laljhadi-Mohana, forests are protected for biodiversity and ecosystem services engaging local communities. Mosaics of wildlife habitats are created through wetlands, grasslands, forests, fire lines and watch towers constructed to protect and monitor forests and wildlife. Meanwhile, within the intensive management zone, systematic production adopting sustainable forest management principles add value by capacitating community forest user groups to engage in wildlife friendly forest management practices, prioritizing access rights to resource dependent communities. The model is expected to increase conservation of community forests due to increased benefits to community through performance-based forest management practices.

By tying benefits from forest resource extraction to conservation, the performance-based sustainable forest management approach is expected to improve community conservation efforts in the long run. WWF Nepal through its Terai Arc Landscape Program has been working closely with the Department of Forests and Soil Conservation to achieve the government's sustainable forest management targets.


Blue Bull


Jungle Cat


Golden Jackal


Hare


Leopard


Spotted Deer

Camera trap pictures of wildlife in the Laljhadi-Mohana Corridor

TOWARDS CORRIDOR FUNCTIONALITY

Over 20 years of conservation effort have borne fruit through the restoration of key regions along the Mohana river, and increased corridor functionality. Conservation initiatives over the last two decades have supported institutionalization and recognition of this space as an important wildlife corridor in landscape strategy and management plans. Furthermore, recognizing the co-benefits to communities and wildlife in terms of high biodiversity, scientific and cultural value, the government of Nepal declared the corridor as a forest protection area in 2012.

The region is now a re-established corridor for dispersal of the Asiatic elephant between the transboundary regions of Shuklaphanta and Dudhwa National Park, with documented evidence of elephant dispersal. While sporadic tiger sightings have previously been recorded in the southern region, the National Tiger Survey in 2018 confirmed tiger dispersal between Shuklaphanta National Park and the northern regions of the corridor. A variety of other wildlife such as common leopard, deer, blue bull, sloth bear, wild boar and jackals have also been recorded within the corridor.

Participatory forest management approach in the outer peripheries of the corridor granting resource use and management rights to local communities, has been critical in building community awareness and stewardship, with community engagement facilitating reforestation around the region. Over 109 community forests have been handed over to local communities benefitting 125,731 people and 26,852 households. The corridor now boasts a productive forest with predominantly timber bearing forests such as Sal and Asna.

LOOKING AHEAD

It is evident that the Laljhadi-Mohana Corridor is considered functional due to its use by a variety of megafauna. Despite two decades of conservation efforts, the scale of challenges faced within the corridor remain high with respect to human pressures such as illegal resource extraction, forest encroachment, and overgrazing. Continuous engagement alongside consolidation of current efforts targeting critical spaces within the corridor will be crucial for improved management and corridor functionality in the future. With Laljhadi-Mohana being the gateway to Shuklaphanta National Park on the eastern side, buffer zone forests around the region should also be prioritized for connectivity and corridor restoration by communities in their operational plans. Additionally, despite its status as a functional corridor, increased corridor use by wildlife also means that their protection and the safety of communities living nearby needs to be ensured.

While the forest protection area approach lays a strong foundation for improved management of the corridor, development of clear implementation guidelines on the zonation-based approach alongside community awareness and stewardship will be critical steps to facilitate corridor functionality, and provide an extended habitat for big mammal dispersal. Emphasis should also be placed on ensuring that interventions in the intensive management zone should not adversely effect biodiversity value in core areas.

Conservation requires patience and continuous effort. The Khata Corridor took almost two decades to be restored and fully functional. The Laljhadi-Mohana Corridor is almost thrice the size and will accordingly require three times the effort and time. The past two decades have been critical for Laljhadi-Mohana in terms of policy transformation and community engagement, laying firm foundations for future progress. Sustainable forest management benefiting both communities and wildlife could be a new management approach for sustained corridor functionality. However, integration with the plans and policies of local, provincial, and federal governments will help ensure sustainability in the long run alongside concerted efforts from communities and conservation stakeholders.

CASE STUDY

WILDLIFE DISPERSAL THROUGH THE LALJHADI-MOHANA CORRIDOR

In May 2005, a herd of 18 elephants including cows, bulls, and calves were sighted marching into the then Royal Shuklaphanta Wildlife Reserve, marking the very first return of the species in the region after 2001. Follow up interviews with local communities later confirmed that the elephants entered Nepal through the Laljhadi-Mohana Corridor from Dudhwa National Park in India. As recently as 2020, a female elephant was recorded giving birth to a calf in the forests of Laljhadi, clearly indicating that the corridor is being used by these mammals as a dispersal route. In fact, a published study suggests that 76% of the area in Laljhadi-Mohana Corridor is used by dispersing elephants. Furthermore, sightings of other large mammals such as tigers and rhinos in the corridor have added further plausibility in terms of the functionality of Laljhadi-Mohana.

In addition to the lone rhino spotted in Shuklaphanta National Park in the late 1990's; before any of these species were translocated to Shuklaphanta from Chitwan, there was also recorded evidence of tiger dispersal through Laljhadi. Such frequent sightings of large mammals demonstrates that the Laljhadi-Mohana Corridor functions as a critical area that facilitates migration of wildlife species within prime habitat areas. As an important part of the ecological network, Laljhadi-Mohana Corridor should be retained and restored to sustain the population of large mammals in Nepal.

Degraded forests and wetlands in Laljhadi-Mohana Corridor

BRAHMADEV CORRIDOR

CORRIDOR AREA
160.32 sq. km

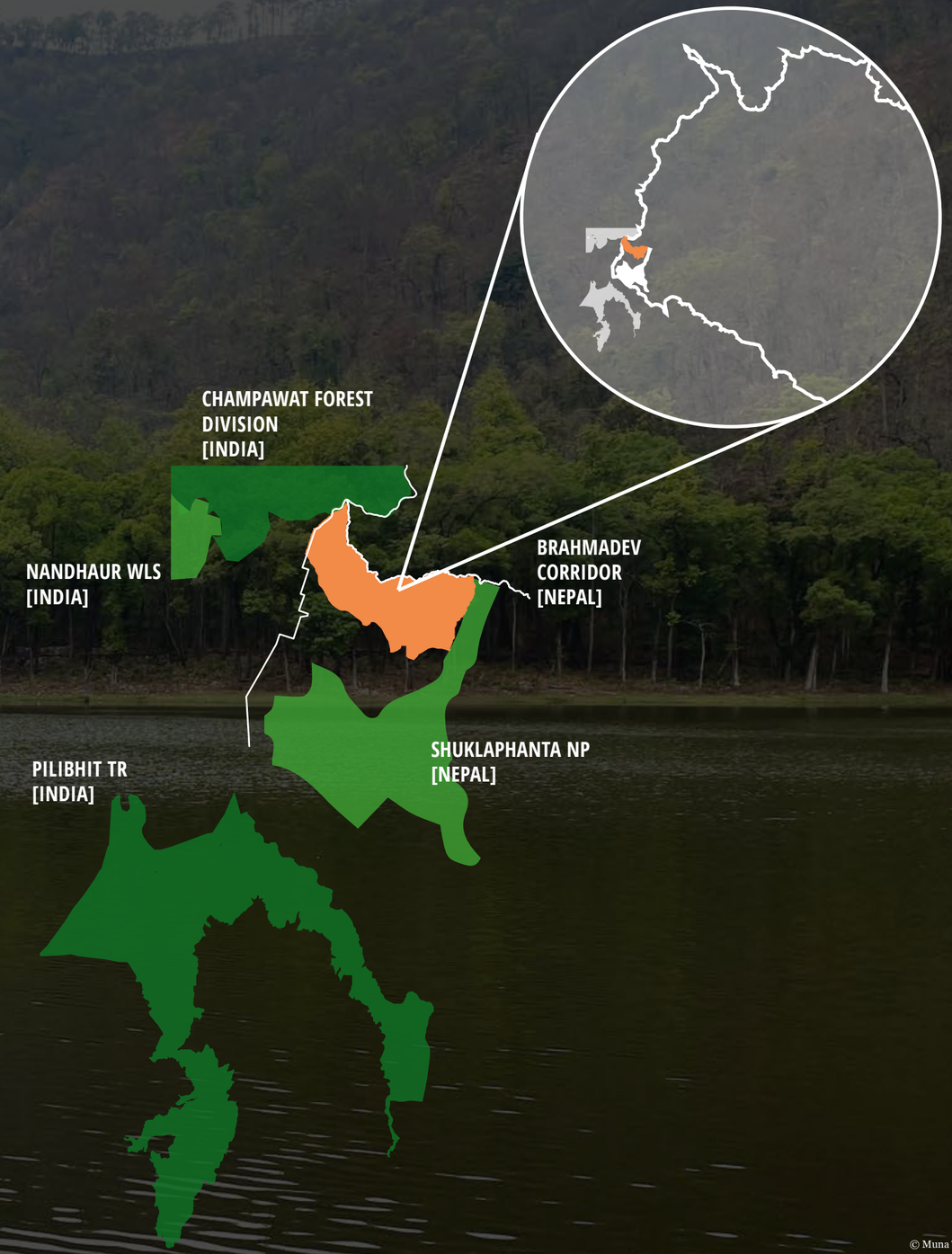
KEY WILDLIFE SPECIES
Himalayan Tahr, Four-Horned Antelope, Sambar Deer, Leopard, Elephant

FOREST COVER
140.96 sq. km

PRIMARY HABITAT TYPES
Sal Forests and Mixed Hardwood Forests

PRIMARY CHALLENGES
Drought, Landslides, Overgrazing

MAJOR RIVERS
Mahakali, Rangoon, Puntura, Syali



BRAHMADEV

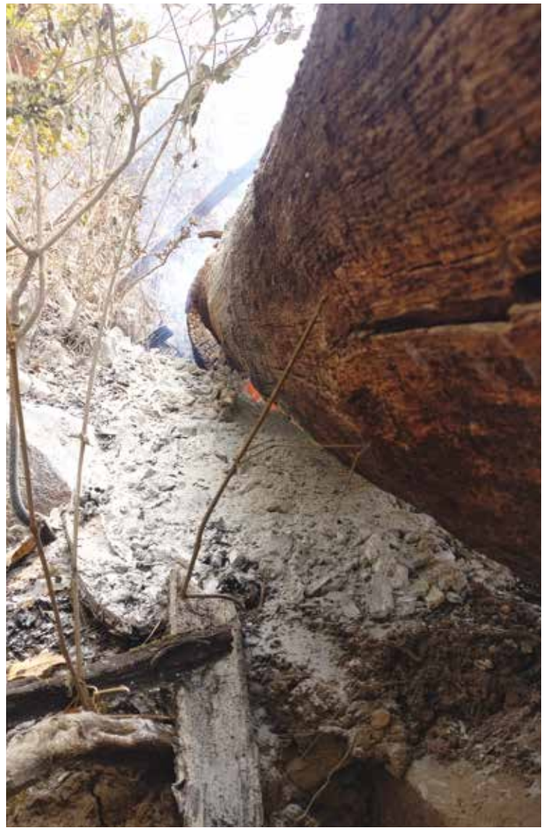
NEPAL'S TRANSBOUNDARY CLIMATE CORRIDOR

DIPESH JOSHI, KANCHAN THAPA, SHAYASTA TULADHAR

When a Bengal tiger was camera trapped at ~2,500m in the forested mountains of Dadeldhura, Western Nepal in April 2020, the conservation community was thrilled. At this time, this was the highest altitude location for tigers ever identified in Nepal; shortly surpassed a year later by a tiger sighting in Ilam, Eastern Nepal at ~3,165m. This identification of a high-altitude site for tigers in Nepal was lauded globally, but what is often missed is the vital role played by the Brahmadev Corridor. It was this critical stretch of forested land bordering the western bank of Mahakali river and spanning 160.32 sq. km, that connects Shuklaphanta National Park in Nepal with the broader Mahabharat range in Dadeldhura district. The corridor also connects this block in Nepal to the Nandhaur Wildlife Sanctuary and Haldwani Forest Division in Uttarakhand, India via the Boom-Brahmadev transboundary corridor and serves as a critical passageway for wildlife including elephants and tigers.

The forests and wetlands serve as a wildlife corridor between Terai's lowlands and the Chure hills (referred to as the Siwalik hills in India), and is the only corridor in Nepal that largely runs through the Chure. The corridor has several wetlands and streams, and numerous sightings of leopards, elephants, blue bulls and gorals have been reported along the corridor, and most recently even the tiger.

Gifted with several lakes and ponds, the Chure area in Brahmadev also has several religious and tourist destinations. Besides providing drinking water, irrigation and habitats for wildlife, these lakes and ponds also hold religious and cultural significance. For instance, water from Bara Kunda Lake is used for irrigation, while Jhilmila, Betkot, and Sidha Sarobar lakes have religious and cultural significance for local communities. Unfortunately, almost all these sites—located in forested areas along the Chure foothills—are significantly disturbed by human activity and generate huge quantities of plastic waste during religious events.



Forest fires are a major climate vulnerability factor in Brahmadev Corridor.

CLIMATE CHANGE AND POTENTIAL RANGE EXPANSION

Unlike other corridors, Brahmadev is particularly significant from a species point of view, as it connects Terai's lowlands with previously unexplored high altitude tiger habitats. The sighting of a keystone species such as the tiger in this region signifies the potential for range expansion of tiger habitats including climate refugia, beyond Nepal's known tiger ranges in the Terai.

Most tiger bearing protected areas in the Terai, including Shuklaphanta National Park, show increasing annual rainfall trends based on climatic data from 1971-2014, including positive rainfall trends in upstream Mahakali basin which can lead to flooding and inundation downstream. Despite erratic and significant increase in monsoon precipitation—occurring as extreme weather events, interspersed with extended dry periods—flagship species such as tigers remain restricted to protected areas within the Terai due to disturbances outside core areas. However, the documentation of a tiger at ~2500m, towards the north of the Brahmadev Corridor, opens possibilities for tigers and other species to shift their distribution range due to availability of forest cover and diet (including prey) further north in case of unfavorable environmental or ecological conditions in the lowland areas.

EMERGING THREATS AND VULNERABILITIES

Despite its forest cover, the Chure is a fragile landscape further aggravated by anthropogenic factors such as illegal logging, forest encroachment, infrastructure development, and overgrazing, triggering land use change along fringes and pockets within the corridor resulting in steady deforestation and habitat degradation. Furthermore, encroachment into the corridor also places communities in closer proximity with wildlife and therefore at risk from potential negative human wildlife interactions. As a relatively dry landscape, periodic dry spells also trigger an increased frequency of forest fires, which is a major threat for wildlife dispersing through the corridor.

A large part of the Brahmadev Corridor falls under the government managed national forests, and managing forest fires in core areas is close to impossible due to its remote location and inaccessible terrain. Meanwhile, another emerging threat is the proliferation of invasive species such *Lantana camara*, *Chromolaena odorata* and *Ageratina adenophora* which degrades and replaces the natural vegetation in the corridor, impacting local ecosystem integrity. Furthermore, extensive extraction of stone and boulder from streams along the foothills of the corridor is another emerging challenge for the fragile Chure landscape and downstream communities. As the area is drained by numerous seasonal rivers, sediment flows downstream increasing sediment loads in wetlands, agricultural lands, etc.

In addition, on-going and planned linear infrastructures such as roads and irrigation canals in and adjacent to the Brahmadev corridor will significantly impact wildlife movement and habitat in the area. Similarly, there are plans for the establishment of Daiji Industrial District in the foothills of Chure adjoining Shuklaphanta National Park. All these infrastructure developments, passing through the corridor is likely to cause significant deforestation, put spill over pressure on forest resources, impact rare, endangered, and protected species of flora and fauna, increase encroachment, increase poaching, illegal wildlife trade, forest fires, and above all, impact wildlife dispersal and migration patterns. Additionally, infrastructure such as the industrial area is likely to have further negative impacts like the disposal of hazardous chemicals or effluents on forest floors, agricultural land or water bodies, impacting the surrounding forests and biodiversity.


Leopard


Leopard Cat


Spotted Deer


Wild Boar


Tiger


Asian Palm Civet

Wildlife camera trap pictures in Brahmadev Corridor

Spring water source protection in Jogbuda © Muna Thapa/WWF Nepal

CLIMATE ADAPTATION ACTIONS

Considering the threats and vulnerabilities, conservation initiatives have been focused on decreasing the risks and impacts of human and climate induced disasters on both biodiversity and local livelihoods. This has primarily included local climate adaptation actions such as reclaiming degraded riverbanks to develop riverine forests, protection of local livelihoods and assets from floods and landslides through bio-engineering measures, maintenance and upgrading of small-scale irrigation canals to reduce water seepage and wastage, construction of water storage ponds for farming polyhouses, supporting climate adaptive vegetable farming, management of open grazing for corridor restoration, and management of forest fires through trainings on community mobilization, firelines and provision of safety equipment. Likewise, renewable and energy efficient technologies has also helped minimize dependency on forest resources among marginalized and vulnerable communities along the fringe areas of the corridor.

LOOKING AHEAD

The documentation of a tiger at an altitude of ~2500m in Dadeldhura, north of the Brahmadev Corridor, in 2020. is the most valuable evidence of corridor functionality. Such evidence has opened avenues for further research into understanding the value of corridors such as potential long-term use of these habitats by wildlife in case of extreme climate change events, brings the possibility of range expansion northwards for tigers and other species, and lays the groundwork in terms of building resilience to potential negative human wildlife interactions among communities. Various other species such as the yellow throated marten, red fox, hyena, common leopard, leopard cat, goral, barking deer, golden jackal, pheasant, large Indian civet, wild boar, and Indian crested porcupine, were also camera trapped along with the tiger. Furthermore, in March 2016 a female tiger was recorded near the Askot landscape, Uttarakhand India at 3,274m—as documented by Bhattacharya, A., Habib, B., 2016, in their paper “Highest elevation record of tiger presence from after India"—just across the Nepal border in Dadeldhura, provides added evidence on the value of the Brahmadev corridor for transboundary wildlife dispersal.

Given the significance of tiger dispersal at an altitude of 2,500 m, it is evident that substantial conservation efforts must be expended in maintaining the connectivity between core habitats in Nepal and India through the Brahmadev Corridor, while also connecting lowland protected areas and forests to the Chure and Mahabharat forests as potential wildlife habitat under climate change. Furthermore, given the relatively dry nature of Chure which is prone to extended dry spells, construction of small reservoirs to capture, store, and regulate water flows especially during monsoons, as well as a strategy to manage forest fires, is critical for long-term functionality of the corridor.

Likewise, wetlands along the Chure foothills need to be managed for climate change adaptation and biodiversity conservation in coordination with local municipalities and other stakeholders in order to maintain a fine balance between nature, livelihoods, and culture. Considering potential climate change impacts on human communities living around the corridor, adaptation interventions addressing livelihoods of the most vulnerable and natural resource dependent communities is vital to sustain ecosystem functions.

The President Chure-Terai Madhesh Conservation Development Committee has prepared a 20-year Chure Conservation Master Plan, 2074 B.S. with the goal of addressing poverty reduction through conservation of natural resources of the Chure. Future conservation efforts should work in close coordination with the committee to leverage funds and execute programs. Considering the roles and responsibilities of local municipalities under federal structure, coordination, collaboration, and resource leveraging with Bedkot, Bhimdutta, and Parshuram municipalities will be vital for effective management of the corridor with the technical support of Divisional Forest Offices of Kanchanpur and Dadeldhura. An enhanced multistakeholder collaboration is also key to sustaining the corridor and ecological integrity of the area considering the on-going and planned infrastructure development in the area. These developments must consider and address environmental and social safeguard concerns.

CASE STUDY

TIGER CONSERVATION AND CLIMATE CORRIDORS

Considering the importance of the adjoining forests in Dadeldhura which are relatively cooler and identified as climate refugia, this whole block connecting Shuklaphanta National Park to the Mahabharat range can be effectively managed as a climate corridor. There is a high possibility that tigers in Nepal shift or expand their distribution range further northwards facilitated by connectivity and corridors between the existing and potential habitats. The tiger records in the Brahmadev Corridor and Dadelhdura district are a testimony to this.

The large forest block that lies between the Chure and Bhabar physiographic regions have limited water sources, prolonged dry spells, and forest fires. This results in low prey density in the Chure, depriving tigers of a food source and forcing them to travel long-distances into potential new habitats. To address the drying of water sources in the Chure during the summer, artificially constructed water ponds collect water from drying springs, creeks and streams, and serve as a source for wildlife. These water ponds facilitate the dispersal of the tiger and its prey—such as barking deer and sambar—to cooler climate refugia sites in the north during extreme summer seasons, thereby providing safe passage.

Since tigers are moving northward, securing water availability along these corridors supports safe passage of carnivores in these climate vulnerable regions. The sites for water pond construction are therefore selected based on ecological, geographical, geological, and social factors. These include wildlife presence, distance from existing lakes and ponds, distance from human settlements to avoid potential disturbances, avoiding sites that require large infrastructure due to fragility of the area from potential flashfloods and landslides and human factors such community readiness and choice of site for construction.

Studies have suggested that the value of connectivity under climate change is less about compensating for habitat fragmentation, and more about facilitating climate-induced changes in wildlife dispersal and distributions. Such simple adaptative structures can provide the primary function of providing sources of water while also facilitating dispersal along the climate corridor.

Construction of embankment to manage dwindling water sources.

ACKNOWLEDGEMENTS

WWF Nepal would like to express sincere heartfelt gratitude to institutions and individuals, whose administrative, financial and technical contributions continue to be critical in enabling corridor functionality in Nepal.

© Karine Aigner/WWF US

CREATING ENABLING POLICY ENVIRONMENT

Ministry of Forests and Environment

Department of National Parks and Wildlife Conservation

Department of Forests and Soil Conservation

Nepal Police

Armed Police Force

Parliamentary Committee on Agriculture, Cooperative And Natural Resources

Ministry of Agricultural and Livestock Development

Ministry of Energy, Water Resources and Irrigation

Department of Water Resources and Irrigation

Ministry of Industry, Tourism, Forests and Environment

Social Welfare Council

LEADING IMPLEMENTATION OF CONSERVATION INITIATIVES

Parsa National Park

Chitwan National Park

Banke National Park

Bardia National Park

Shuklaphanta National Park

22-Divisonal Forest Offices (Rautahat, Bara, Parsa, Makwanpur, Chitwan, Nawalpur, Parsi, Rupandehi, Palpa, Kapilvastu, Dang, Deukhuri, Banke, Bardia, Surkhet, Kailali, Kanchanpur, Dadeldhura)

PARTNERING ON THE GROUND CONSERVATION INTERVENTIONS

Community Forest User Groups

Buffer Zone Management Committees

Buffer Zone User Committees—Chitwan, Bardia, Banke, Parsa and Shuklaphanta National Parks

Protected Forest Councils - Khata, Laljhadi-Mohana, Barandabhar

Community Forest Coordination Committees

Community-Based Anti-Poaching Units

Construction and Allied Workers Union of Nepal (CAWUN)

Central Union of Painters, Plumbers, Electro and Construction Workers Nepal (CUPPEC)

PROVIDING LEVERAGING SUPPORT

National Trust for Nature Conservation

Federation of Community Forest User Groups, Nepal

CARE Nepal

IUCN Nepal

United Nations Development Programme (UNDP)

Biogas Sector Partnership Nepal

Chure Conservation Network, Kanchanpur

SENSE Nepal

Community-Based Forestry Supporters' Network (COFSUN), Nepal

Nepal Red Cross Society

Institute of Forestry

SUPPORT TOWARDS CORRIDOR RESTORATION

Department for International Development (DFID)

IUCN/KFW

United States Agency for International Development (USAID)

Ministry for Foreign Affairs of Finland (MFA)

U.S. Fish and Wildlife Service

WWF Germany

Global Environment Facility (GEF)

Leonardo DiCaprio Foundation

Sall Family Foundation

WWF International

WWF US

WWF UK

WWF Finland

WWF Germany

WWF India

Whiskas

Richard Devereaux Foundation

Ave Fenix Foundation

Save the Tiger Foundation/ National Fish and Wildlife Foundation

The Coca Cola Foundation

Carlsberg Breweries A/S

Hoffman La Roche

CONTRIBUTORS

EDITORS

Kanchan Thapa, PhD
Head of Wildlife Programs, WWF Nepal

Shayasta Tuladhar
Head - Communications and Education, WWF Nepal

CONTENT SUPPORT TEAM

Gokarna Jung Thapa, PhD
Head - Geographical Information Systems/Remote Sensing, WWF Nepal

Kamlesh Maurya, PhD
WWF India

Shristi KC
Campaigns and Education Officer, WWF Nepal

Spriha Shrestha
Communications Officer, WWF Nepal

SPECIAL THANKS

Nilanga Jayasinghe
Manager - Asian Species, Wildlife Conservation, WWF US

Shant Raj Jnawali, PhD
Chief of Party, Hariyo Ban Program II, WWF Nepal

Sheren Shrestha
Senior Program Officer, Wildlife Programs, WWF Nepal

Shiv Raj Bhatta
Head of Conservation Programs, WWF Nepal

Smriti Dahal, PhD
Program Coordinator - Conflict, Communities and Connectivity, Tigers Alive Initiative, WWF

CITATION

Thapa, K., Tuladhar, S. (Eds.) 2021. Connecting Corridors. WWF Nepal, Kathmandu, Nepal.

CHAPTER CONTRIBUTORS

Ananta Ram Bhandari, PhD
Head of Landscape & Forest Programs, WWF Nepal

Bharat Gotame
Project Manager, GEF-ILaM Project

Dhan Rai
Former Landscape Coordinator, WWF Nepal

Dipesh Joshi
Head of Climate & Energy Programs, WWF Nepal

Ekraj Sigdel
Head of Policy & Governance, WWF Nepal

Jagadish Chandra Kuikel
Livelihoods Specialist - Hariyo Ban Program II, WWF Nepal

Kamal Raj Rai
Project Co-Manager - Protected Areas and Buffer Zones Project, Terai Arc Landscape, WWF Nepal

Kanchan Thapa, PhD
Head of Wildlife Programs, WWF Nepal

Kapil Khanal
Senior Program Officer - Biodiversity, Hariyo Ban Program II, WWF Nepal

Muna Thapa
Terai Arc Landscape - Corridor and Bottleneck Restoration Project

Pramod Neupane
Senior Program Officer – Infrastructure, WWF Nepal

Sabita Malla
Wildlife Biologist, WWF Nepal

Santosh Mani Nepal
Former Policy and Governance Director, WWF Nepal

Shayasta Tuladhar
Head - Communications and Education, WWF Nepal

Rajesh Sada
Head of Freshwater Programs, WWF Nepal

© Emmanuel Rondeau/WWF-US

WWF

Working to sustain the natural world for the benefit of people and wildlife.

together possible™ panda.org

WWF Nepal, P. O. Box: 7660, Baluwatar, Kathmandu, Nepal

T: +977 1 4434820, F: +977 1 4438458, E: info@wwfnepal.org