



WWF

ANALYSIS

2016

THE ROAD AHEAD



**PROTECTING TIGERS FROM ASIA'S
INFRASTRUCTURE DEVELOPMENT BOOM**

An Analysis for WWF by **Dalberg**

DALBERG GLOBAL DEVELOPMENT ADVISORS

Dalberg Global Development Advisors is a strategic consulting firm that works to raise living standards in developing countries and address global issues such as climate change.

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WWF'S CALL FOR COLLECTIVE GLOBAL ACTION

COULD THE IMPENDING WAVE OF INFRASTRUCTURE DEVELOPMENT ACROSS ASIA SPELL THE END OF TIGERS IN THE WILD? IS THE REGIONAL COMMUNITY READY TO ACCEPT THE LOSS OF TIGERS AND ALL THAT THEY STAND FOR AS A RESULT OF THE UNMITIGATED FRAGMENTATION AND DESTRUCTION OF THEIR HABITATS BY NEW HIGHWAYS AND TRANSPORT NETWORKS? OR ARE REGIONAL LEADERS AND RESOURCE MANAGERS READY TO MAKE BOLD DECISIONS TO MAP A FUTURE THAT NOT ONLY INTEGRATES THEIR SUSTAINABLE DEVELOPMENT GOALS WITH BIODIVERSITY CONSERVATION, BUT ALSO POSITIONS TIGERS AS THE INDICATOR FOR THE QUALITY OF THEIR DEVELOPMENT PATHWAY?

There are an estimated 3,890 tigers left in the wild today – down from around 100,000 just a century ago, primarily due to poaching and habitat loss. In 2010, tiger range countries came together to stop this decline and made a commitment to double the wild tiger population by 2022.

Although wild tiger numbers appear to be increasing for the first time in 100 years, tigers face unprecedented challenges from a vast network of new linear infrastructure planned across their landscapes. Linear infrastructure includes roads, railways, gas pipelines, power and transmission lines, and canals. The Asian Development Bank estimated that the region as a whole would need to spend US\$8 trillion on infrastructure between 2012 and 2020 in order to maintain its economic growth. A significant portion of this is likely to be on linear infrastructure, as evidenced by the fact that at least 11,000 kilometres of roads and railways are planned for construction through tiger landscapes.

As a result of linear infrastructure construction, many tiger landscapes face significant threats today, putting tigers and their persistence in the wild at risk. The scale and speed of this challenge will only accelerate as tiger range countries continue to pursue rapid economic development.

WWF calls on tiger range governments to protect tigers by minimizing the adverse impacts of linear infrastructure on tiger habitats by developing and adopting long-term spatial plans that integrate landscape ecological systems with development priorities. Governments should:

- Identify critical tiger habitats and legally designate them as inviolate areas that must remain free of any infrastructure projects and completely off limits to construction;
- Create, maintain or rehabilitate tiger corridors through formal protection and improved management in and around any infrastructure;
- Strengthen and strictly enforce environmental safeguards through all stages of the infrastructure cycle;
- Integrate the Zero Poaching framework into environmental safeguards covering all stages of the infrastructure cycle;
- Enhance enforcement and monitoring mechanisms for tigers and their prey along and adjacent to linear infrastructure, especially in high wildlife use areas.

WWF calls on multilateral banks and private investors to:

- Establish and enhance environmental safeguards to ensure all infrastructure projects are compatible with connected and sustainable tiger landscapes;
- Avoid financing infrastructure projects that are incompatible with connected and functioning tiger landscapes and make this commitment publically.

WWF calls on the public to:

- Support tiger range governments' commitment to double the number of wild tigers by 2022.

EXECUTIVE SUMMARY:

Infrastructure developments pose one of the greatest future threats to tigers and risk unravelling past conservation efforts

The midway point of the 2010-2022 Global Tiger Recovery Program to double the number of wild tigers (“Tx2”) marks the first time in a century that global tiger numbers are increasing. Poaching and habitat loss during the 20th century led to a 97 per cent fall in wild tiger numbers.¹ Following this devastating decline, tiger range countries agreed during the 2010 Tiger Summit that ‘saving’ tigers was no longer enough.² Recognizing the need for a paradigm shift in conservation action for tigers, these countries set the ambitious goal of doubling the number of wild tigers by 2022. Owing to the collective action and commitment of governments, local communities and civil society organizations, including WWF, the estimated number of tigers worldwide has increased from as few as 3,200 in 2010 to around 3,890 in 2016.³

Success to date is fragile. Tigers now face a threat potentially far greater in magnitude than those we have tackled previously: linear infrastructure.⁴

Linear infrastructure often fragments wildlife habitats, which studies have argued could be the single biggest threat to low-density and wide-ranging species such as tigers.⁵ Studies have also shown that linear infrastructure leads to increased human-tiger conflict,⁶ mortality from vehicle collisions⁷ and poaching.⁸ While there have been many linear infrastructure developments in tiger range countries in the past, it is the sheer scale and speed of future development that poses one of the greatest challenges to tigers. The Asian Development Bank estimated that between 2012 and 2020, Asia would need to spend US\$8 trillion to cover its infrastructure development needs, just to sustain economic growth.⁹ A significant portion of this amount will likely be spent on linear infrastructure, as evidenced by the fact that an additional 11,000 kilometres of roads and railways are planned for construction through tiger landscapes.¹⁰

TIGER LANDSCAPES

Tigers require large home ranges to breed and hunt. Therefore, it is vital that tiger conservation is delivered at an ecological scale relevant to the challenge – the tiger landscape. Tiger landscapes represent a move away from site-based approaches of the past that focused solely on the protection of small populations. A landscape approach recognizes that ecological processes, tiger behaviour and the genetic interaction of multiple small tiger populations across a landscape are critical for the persistence and viability of the metapopulation of tigers in that area.

Tiger landscapes are typically a mosaic of habitat

types as well as human settlements, agriculture and industry. To maintain the health of each metapopulation of tigers, every tiger landscape must be at an appropriate scale (all landscapes vary in size), incorporate areas with no human habitation and include protected tiger core sites, which are able to sustain viable breeding populations of tigers and their prey, are surrounded by buffer areas to mitigate against external threats and are linked by corridors spanning the landscape.

Unless specifically noted, the tiger landscapes referenced throughout the analysis refer to this broad ecological approach to tiger conservation.

Past conservation initiatives will no longer be sufficient on their own to protect wild tigers. Without new approaches centred on long-term sustainability, linear infrastructure development has the potential to completely unravel tiger conservation successes to date. Whereas traditional approaches to protecting tigers, such as anti-poaching measures, monitoring of tiger populations and protected area management will continue to be important, they will no longer be enough. Any forward-looking tiger conservation policy must take into account the growing threat of infrastructure developments. Effectively addressing this challenge will require new approaches and political commitments from tiger range countries, and a strong and proactive collaboration between infrastructure planners, implementers and conservation stakeholders. Without new approaches and political commitments centred on long-term sustainability and the integration of ecological systems into development planning, tiger populations will likely plateau, then plummet again toward extinction.

Sustainable planning and construction of linear infrastructure development would also safeguard the important economic, social and environmental benefits that tiger landscapes provide. Tiger landscapes are major contributors to socio-economic development, especially in India and Nepal, where they inject important income directly into remote rural areas, and have significant secondary impacts, such as job creation in service sectors. In India, for example, tiger tourism has been directly linked to jobs in 20 independent sectors, including mechanics, hotel staff, drivers, hairdressers, bakers and primary producers.¹¹

It is recommended that policymakers and investors in tiger range states take steps to protect tiger populations against harmful linear infrastructure developments, and support infrastructure that promotes long-term sustainable development. There are already some ongoing good practices, which demonstrate that ecological systems can be integrated into development planning at a regional scale. However, to achieve the goal of doubling the wild tiger population by 2022, tiger range country policymakers need to make more long-term, evidence-based decisions that better take into account the needs of tiger landscapes. This includes identifying areas crucial to tigers' survival where no infrastructure development should be allowed, and preserving corridors that are critical to tiger movement. It is also recommended that habitat rehabilitation measures, anti-poaching guidelines and monitoring of wildlife movement are integrated into planning and design processes. Multilateral development banks and investors need to adopt best practice environmental safeguards and criteria for financing linear infrastructure projects in tiger landscapes, and refrain from financing projects that are incompatible with tiger, prey and habitat conservation.



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THE VALUE OF TIGER LANDSCAPES:

Protecting tiger landscapes is critical for tiger survival and retention of the economic, environmental and social value of the landscapes

There are estimated to be just 3,890 tigers left in the wild, found across 13 countries. These tigers live in a diverse set of landscapes, from rainforests to grasslands, savannahs to mangrove forests, and high elevation habitats of the Himalayas to the boreal forests of the Russian Far East. The largest tiger population is found in India, which is home to more than half of all remaining wild tigers.¹² Bangladesh, Bhutan, Indonesia, Malaysia, Nepal, Russia and Thailand each host several hundred tigers, while only a few are found in China and Myanmar. Tigers are now functionally extinct in Viet Nam, Laos and Cambodia.¹³

Keeping tiger landscapes intact is vital for tiger survival. With home ranges reaching up to 1,000 square kilometres, it is absolutely essential that tigers have free and safe movement along large natural corridors to breed, hunt and establish their own territories. Having access to these corridors ensures genetic diversity and also provides an avenue through which tigers can respond to climatic changes, environmental shocks (such as fires, deforestation, drought and flooding) and human disturbance.¹⁴ When landscapes are fragmented, corridors can become broken or lost entirely, and tigers are increasingly wedged into smaller areas. This can lead to inbreeding, excessive fighting for territory and associated injuries and death, and increased exposure to disease outbreaks and environmental shocks.

In addition to being crucial for tigers' survival, tiger landscapes contribute to economic development. Tiger landscapes attract millions of tourists each year, and the tiger-related tourism sector provides local communities with sustainable sources of income and employment. In India, for example, three million people each year participate in wildlife tours and this figure is growing annually.¹⁵ Tiger-related tourism today is mainly concentrated in the national parks, reserves and sanctuaries of India and Nepal. Given the difficulties of finding secure employment opportunities in often remote areas, the thousands of jobs made possible by tiger-related tourism are vital for local communities.¹⁶

The environmental benefits provided by tiger landscapes benefit millions more people through water management, protection from natural hazards, sediment and nutrient retention, and carbon sequestration. Tiger landscapes provide water for drinking and irrigation for local and downstream communities. For example, water collected in the catchment area of the Leuser Ecosystem in Sumatra is used by at least four million people as well as for irrigating oil palm and pulpwood plantations downstream.¹⁷ Tiger landscapes also provide local communities with protection from natural hazards, such as floods, landslides and the impacts of climate change. Vegetation in these areas helps to slow the passage of water to nearby rivers, reduces erosion, and reduces loss of nutrients and sediment. It also helps to mitigate climate change through carbon sequestration. This will also offer added economic benefits, as and when carbon

markets develop. For instance, the value of the carbon sequestered across six of India's 50 tiger reserves is estimated to be over US\$17 million per year.^{18,19} Based on this data, the potential carbon sequestration value of all Indian tiger reserves is US\$130 million per year.²⁰

Tigers are inextricably linked to the millions of indigenous people that co-exist with them and the countless people that put high cultural value on them across all tiger range states. Indigenous people have inhabited, managed and protected tiger landscapes for generations. They depend on these areas for agriculture, non-timber forest products, fuel wood, building materials and grazing land for their livestock. For example, the Terai Arc Landscape that straddles the Nepal-India border is home to 28 million people, including eight indigenous tribes.²¹ Furthermore, tigers represent strength and power in many cultures, and are ubiquitous in traditions, mythology, literature and art across tiger range countries and beyond. In some countries, tigers are considered a national animal, while in others they have contributed to their landscapes being recognized as having universal value and listed as World Heritage Sites.

Protecting tiger landscapes and keeping them intact is therefore crucial for tigers to survive and thrive, and allows for the landscapes to retain their economic, environmental and social values. However, the value of these landscapes to tigers and the broader national and global community is jeopardized by planned linear infrastructure, which would slice tiger habitats into smaller and more isolated fragments.



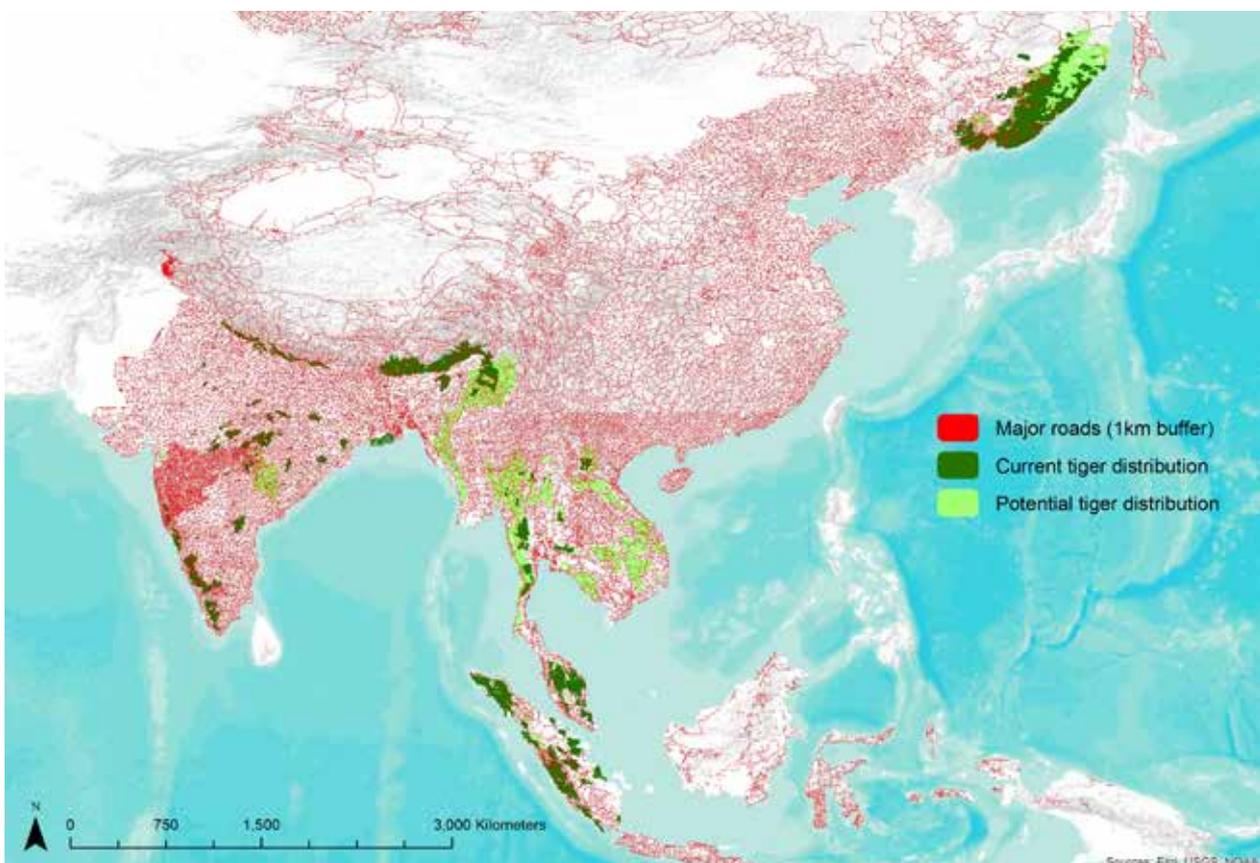
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CHALLENGES AT HAND:

Linear infrastructure developments pose one of the greatest threats to tiger populations

Over the past 100 years, global tiger populations plummeted by 97 per cent, primarily due to a combination of poaching and habitat loss.²² The number of tigers in the wild fell from around 100,000 in the early 20th century to as few as 3,200 in 2010. Since then the population has inched up to an estimated 3,890 in 2016. Tigers' range also contracted by a staggering 93 per cent over the past decade.²³ Tigers used to roam all across the Asian continent, but they now only occupy landscapes in South and Southeast Asia, northeastern China and the Russian Far East. While some populations in India,²⁴ Nepal,²⁵ Bhutan²⁶ and Russia²⁷ have seen a modest recovery in numbers in the past decade, over the same period tigers have disappeared from Viet Nam, Laos and Cambodia, and continue to decline in Malaysia, Indonesia, Thailand and Myanmar.²⁸

Tigers now face an unprecedented threat from linear infrastructure. When not planned with wider ecological considerations in mind, linear infrastructure can fragment habitats, which some have argued is the single biggest threat facing low-density and wide-ranging species such as tigers.²⁹ The resulting fragments are often too small to sustain minimum tiger populations.³⁰ Linear infrastructure also increases human-tiger proximity by facilitating access to previously inaccessible habitats. This can lead to more human-tiger



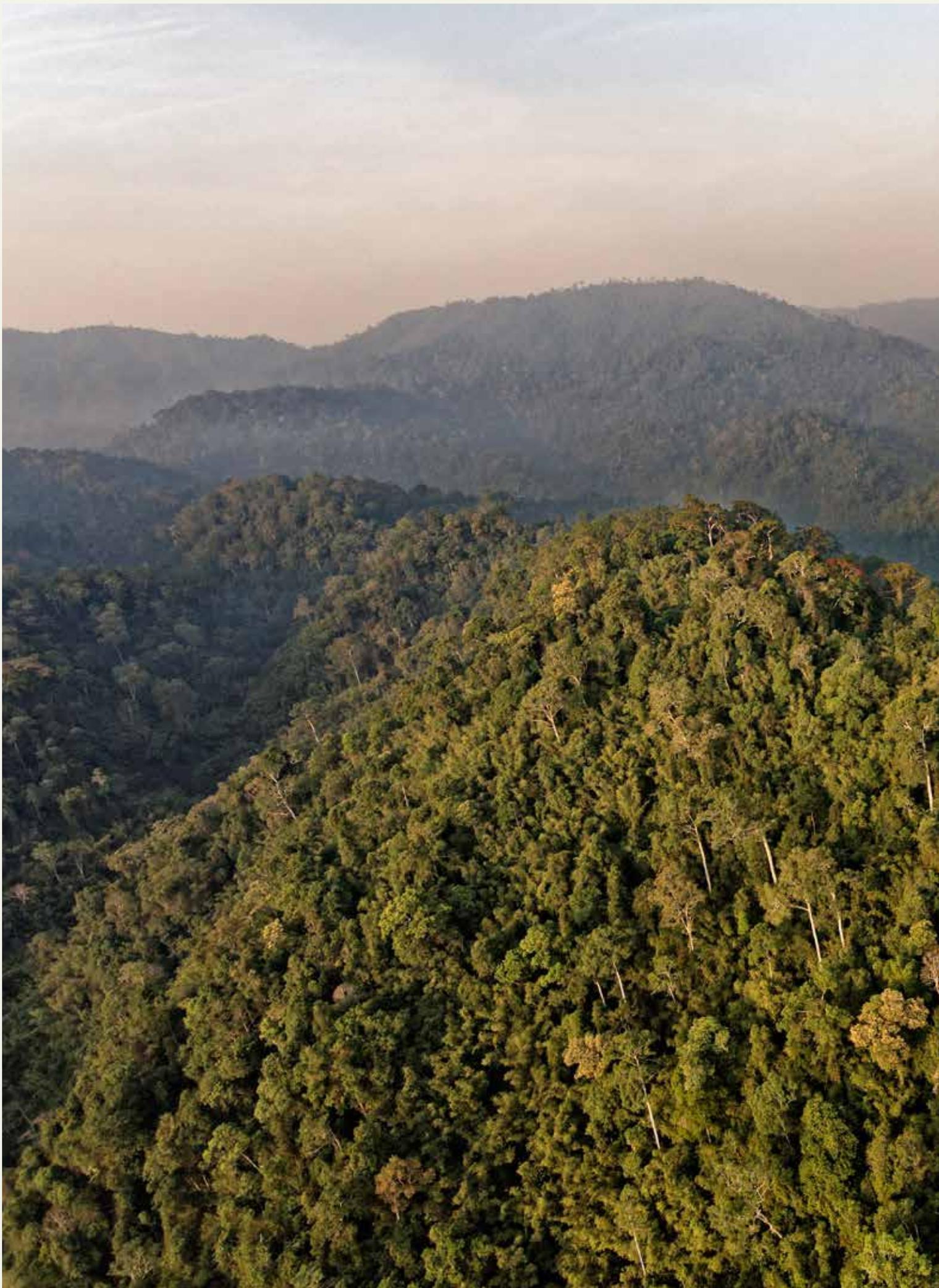
conflict,³¹ mortality from vehicle collisions³² and poaching.^{33,34} The scale of this challenge is symptomatic of the large human population of tiger range countries, coupled with rapidly expanding economies and growing numbers of rich, urban consumers.

The size and scope of linear infrastructure developments across tiger range countries will only continue to grow, as the region will need to spend US\$8 trillion on infrastructure until 2020 to meet the demands of its growing population. By 2050, Asia's urban population is projected to reach more than three billion people, which will require a concomitant increase in transportation and infrastructure. To meet this need, the Asian Development Bank estimated that the region would have to spend US\$8 trillion on infrastructure between 2012 and 2020.³⁵ Much of this investment will be spent on linear infrastructure, as evidenced by the fact that there are already an additional 11,000 kilometres of roads and railways planned for construction through tiger landscapes.

Effectively addressing this challenge will require a new level of political commitment from tiger range governments to support infrastructure that promotes long-term sustainable development. Given the unprecedented nature of the upcoming challenges facing tigers, past initiatives such as enhanced monitoring, ranger education and protected area management as well as breaking up existing illegal wildlife trade chains will no longer be sufficient to ensure their survival. Therefore, any forward-looking tiger conservation policy must take into account the growing threat of planned linear infrastructure. It is recommended that tiger range countries integrate conservation of tigers and their landscapes into the highest levels of national decision-making processes, positioning tigers and the intactness of their landscapes as key indicators of economic sustainability.

All tiger landscapes are threatened by existing and planned linear infrastructure developments. The following case studies illustrate some of the potential impacts and the work WWF is doing to mitigate them. They also outline potential steps to protect and sustainably manage these tiger landscapes.







CASE STUDY:

The Dawna Tenasserim Landscape – a single road that threatens tigers across Myanmar and Thailand



The Dawna Tenasserim Landscape (DTL), which stretches along the Thailand–Myanmar border, is home to the largest population of tigers in the Greater Mekong region.⁵⁶ The DTL covers more than 30,000 square kilometres of protected areas and its diverse forest ecosystem supports many endemic and endangered species, such as the Asian elephant and the Siamese crocodile.⁵⁷ The Thai side of the DTL is home to 200 of the estimated 250 wild tigers left in the Greater Mekong region, making it a crucial landscape for tiger conservation.^{58,59} The forest landscape also supports hundreds of thousands of local people by providing food, energy, clean water and protection from natural hazards.

The DTL’s wildlife corridors provide tiger populations in Thailand and Myanmar with critical connectivity to one another. Due to their small population, Myanmar’s tigers depend on the connection to tiger populations in Thailand for breeding to sustain their population.⁶⁰ The DTL’s forest blocks create transboundary corridors that



help tigers and other wildlife to move between ecological hotspots in each country, in particular the Western Forest and Kaeng Krachan Forest Complexes in Thailand.⁶¹

A single road planned to cut across the landscape now threatens tigers and local communities.

The future of the DTL and the wildlife it supports is threatened by a major linear infrastructure project from Bangkok in Thailand to Dawei in Myanmar that will cut directly through the DTL. The planned project includes a two- to four-lane highway,⁶² as well as railways, transmission lines and oil and gas pipelines. This infrastructure will run for 160 kilometres and will cut a 200-metre wide path through the DTL.⁶³ Construction of the highway will result in more than 18 square kilometres of deforestation, three times the area that will be paved, to allow for the main road to go through the DTL's current topography and for building smaller roads around it.⁶⁴ Although construction is yet to begin, the completed highway is expected to attract a significant amount of traffic, as it is likely to serve as a new transport corridor into and out of Asia.

The road to Dawei is likely to reduce tiger connectivity and have cascading negative effects on the broader ecosystem of the landscape.⁶⁵ Construction of the highway will hinder intra-Myanmar tiger movement, as well as cross-border movement between the two major forest complexes. The physical barrier created by the highway will isolate tiger populations and the prey they depend on, increasing the likelihood of tiger-to-tiger conflict and inbreeding.⁶⁶ Road traffic incidents and the resulting decrease in prey will likely exacerbate the risk of conflict between tigers.⁶⁷ The planned highway will also facilitate access to previously undisturbed habitats in the DTL. This is likely to increase poach-



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ers' ability to transport larger animals that would have previously been difficult to move to local and international markets.⁶⁸ Construction of the highway will also jeopardize the environmental value of the DTL, with the Myanmar section expected to lose 13 per cent of its current forest cover by 2035 – an area almost twice the size of Singapore – due to increased development and greater human access.^{69,70}

The road to Dawei serves to illustrate the need for careful upfront planning and continuous collaboration between governments, project developers and civil society organizations such as WWF.

International and local civil society organizations have been working hard to find solutions for a more sustainable road. Various organizations have mapped the biodiversity of the landscape, identified critical parts that need protection and trained local stakeholders in forest and wildlife protection.⁷¹ Together with the University of Hong Kong, WWF has created a design manual for the sustainable construction of the road.⁷² WWF has also met and engaged with several partners on the ground to ensure best outcomes, including the road developer, the Myanmar Ministry of Natural Resources and Environmental Conservation, the Ministry of Construction, regional government officials and experts from development banks and financial institutions.⁷³ WWF's recommendations have also been shared with two government agencies in Thailand, as well as government stakeholders in Nepal who are facing similar challenges.

The Dawei road illustrates the importance of collaboration between all stakeholders, including government, developers and civil society organizations, in the early stages of linear infrastructure design and investment. Although the opportunity to engage in the decision-making process about the route of the road has passed,⁷⁴ construction has not yet begun⁷⁵ so the developers and authorities still have an opportunity to modify the road design to minimize negative impacts on local communities, wildlife and the natural environment. For example, the road alignment could be better adjusted to the topography of the Dawei area and its design modified to allow for wildlife crossings, which would ensure continued connectivity between landscapes. These modifications include expanding bridges, building fences to guide wildlife towards safe crossing areas and adjusting the location of existing crossings to high-use areas.⁷⁶ The habitat around wildlife crossings could also be protected to ensure that wildlife can approach the crossings safely. It is crucial that these design modifications are agreed before development begins, as post-construction modifications can be extremely expensive.

It is recommended that all stakeholders be consulted during all the various stages of developing the Dawei road to ensure that the economic, environmental and social benefits of the landscape can be retained. Governments and project developers could benefit from consultations with civil society and local communities and should ensure their involvement in future decision-making processes. Although the project is currently being supported and funded by the governments of Myanmar, Thailand and Japan, mechanisms could be introduced to ensure that future investors in the Dawei road, such as multilateral banks, are aware of the associated environmental issues and are pressured to hold the governments of Myanmar and Thailand to account.⁷⁷

The governments of Myanmar and Thailand have reached a critical point regarding the road to Dawei. While it could generate economic benefits, the road risks damaging one of Southeast Asia's most important tiger habitats. Proper planning, design and construction of the road will ensure that the DTL can continue to conserve and grow its tiger population. Taking action now will reduce the cost of intervention and allow the governments of Myanmar and Thailand to adopt a sustainable development path, which emphasizes the importance of natural capital and tiger habitats, while ensuring economic prosperity for the region.



CASE STUDY:

The Terai Arc Landscape – a glimpse into the future of tigers in the face of rapid linear infrastructure development



The Terai Arc Landscape, one of the most biologically rich ecoregions in the world and home to at least 239 tigers, has benefitted from governments' conservation efforts in the recent past.

The Terai Arc Landscape (TAL) covers an area of 49,500 square kilometres across the largely forested border between Nepal and India and is home to at least 239 tigers.³⁶ The landscape sits at the foothills of the Himalayas in Nepal and spreads across the Indian states of Bihar, Uttarakhand and Uttar Pradesh. The area includes 15 protected ecosystems, which support one of the highest densities of tigers in the world.³⁷ The landscape is recognized as one of the 200 most biologically rich ecoregions globally,³⁸ and is the most biodiverse area of Nepal.³⁹ In addition to tigers, the TAL is also home to three other globally threatened species: the Asian elephant, the greater one-horned rhino and the swamp deer.⁴⁰

The TAL's rich biodiversity has made it a key attraction for tourists, with over a million tourists⁴¹ visiting the landscape and generating revenue for the region. The TAL also holds significant environmental value: less than one third of its area generates more than US\$1 billion in ecosystem services. The Chitwan National Park on the Nepalese side of Terai Arc, for example, is a World Heritage Site and generates annual revenue in excess of US\$1.2 million.^{42,43} The Corbett Tiger Reserve on the Indian side of Terai Arc generates over US\$1.1 million annually through tourism.^{44,45} In addition, TAL provides valuable ecosystem services to the communities living in the area.

The governments of India and Nepal have made concerted efforts to conserve tigers in the TAL in recent years, leading to an increase in the tiger population between 2010 and 2014. These efforts include effective management of human-tiger conflict, improved law enforcement and strong political will. Transport authorities have also consulted civil society to address challenges from the existing infrastructure,⁴⁶ while the government of Uttar Pradesh declared a new tiger reserve in 2008 covering around 730 square kilometres.⁴⁷ On the Nepalese side, more effective park management and law enforcement helped to achieve a 365-day period in 2013-14 when no tigers were recorded as being poached in the country.⁴⁸ This contributed to an increase in tiger numbers in the landscape.

Despite the increase in tiger numbers, their occupancy across the landscape is falling. This is due to a combination of habitats getting smaller and more isolated, and tigers increasingly avoiding, or not being able to safely access, habitats they previously roamed in. This habitat fragmentation and loss is largely due to infrastructure development and expansion of the human footprint.

While the increase in tiger numbers in Terai Arc is encouraging, there are emerging concerns that this progress is fragile, as their occupancy across the landscape has fallen. Studies have shown decreasing occupancy rates between 2003 and 2013,⁴⁹ and experts believe these may fall further in the future.⁵⁰ A decreasing rate indicates that tigers occupy less area than they did before, and that their range is reducing as unprotected habitats are cleared and disturbed by human activity. While Terai Arc's

protected areas have largely been maintained, this decrease in occupancy results from habitat loss and fragmentation severing the connection between tiger habitats, as well as urban and agricultural encroachment. Between 1999 and 2010, unplanned development in Nepal led to encroachment into almost 400 square kilometres of forested land.⁵¹ Since tigers tend to prefer corridors with intact forest cover and largely avoid those disrupted by human activity, the functionality of some wildlife corridors has been affected.⁵² With tigers becoming increasingly confined to smaller patches of habitat, their populations are predicted to plateau and ultimately fall as they begin to compete for space and inbreeding occurs.⁵³

New linear infrastructure developments along the India-Nepal border further threaten the crucial connectivity of the Terai Arc Landscape, which could lead to a collapse in tiger numbers. Construction has already commenced on a 650 kilometre highway that will run along the border, with plans to construct a second road and a railway on the Nepalese side.⁵⁴ The Indian government has been working with organizations such as WWF to mitigate the potential negative impacts through design modifications and realignment. However, an additional 5,000 kilometres of roads and railways are planned.⁵⁵ Without careful management and design modifications, these developments will dissect the North-South corridors between India and Nepal, and the East-West corridors in India, threatening the free movement of tigers.

Without careful management and coordination of planned infrastructure projects through TAL, much of the progress made to date could be unravelled.

It is recommended that the Indian and Nepalese governments and developers work together to modify the design of all linear infrastructure along the border, ensure adjacent land use is compatible with tiger corridors and that damage to habitats is avoided as much as possible. Where possible, the planned roads should be realigned to minimize negative



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impacts on vulnerable tiger habitats. In addition, flyovers and underpasses should be located at critical sites within key corridors to facilitate the movement of wildlife between protected areas and reduce the risk of vehicle collisions.

There needs to be close collaboration between stakeholders on both sides of the border to ensure the tiger landscape remains functional. Collaboration is particularly important in the development and protection of wildlife corridors and crossings, as the crossings need to align in order to avoid ecological dead ends for wildlife. Ecological monitoring must also be undertaken on both sides during construction and operation of the roads and railways to ensure the wildlife corridors remain functional.



Through concerted conservation efforts in recent years, the Terai Arc Landscape has experienced an impressive recovery in its tiger populations. However, to avoid jeopardizing these fragile gains and further reducing tiger occupancy, the Indian and Nepalese governments need to carefully manage and coordinate planned infrastructure projects across the landscape. Plans for a transboundary, sustainable transport network across this landscape must be underpinned by basic conservation tenets, including protection of key biodiversity areas and sensitive habitats from infrastructure; maintenance and restoration of wildlife corridors; and maintenance of structural connectivity across the entire landscape.



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CASE STUDY:

Sumatra – moving beyond policy design towards effective implementation to save the Sumatran tiger



The Sumatran rainforests shelter around 400 Sumatran tigers, and is the only place on earth where elephants, orangutans, rhinos and tigers coexist in the wild.⁷⁸

The Indonesian island of Sumatra is one of the most biodiverse regions on the planet and is home to the critically endangered Sumatran tiger.⁷⁹ Its six priority tiger landscapes cover approximately 75,000 square kilometres,⁸⁰ or an area larger than the country of Ireland.⁸¹ Despite this, it is estimated that there are fewer than 400 Sumatran tigers left in the wild.⁸² The rainforests of Sumatra are also home to around 100 Sumatran rhinos,⁸³ over 1,700 Sumatran elephants⁸⁴ and almost 15,000 Sumatran orangutans,⁸⁵ all of which are critically endangered. The rainforests also host more than 10,000 plant species, including the world's tallest and largest flowers – the Titan Arum and the Rafflesia arnoldii.⁸⁶

The Sumatran rainforests' ecosystem services, which include carbon storage, flood prevention services and the provision of clean water, provide enormous local and global value. Sumatra's tiger habitats overlap areas of high carbon storage and sediment retention, which are important factors in climate change mitigation and flood prevention.⁸⁷ In addition, these forests provide fresh water for local and downstream communities. For example, the Leuser Ecosystem, which stretches across northern Sumatra, is a large water catchment area that sustains the livelihoods of at least four million people by providing water for consumption, fishing and irrigation for plantations.⁸⁸

Despite ambitious policy planning on a regional level, Sumatran tigers are threatened by local land use plans that allow unsustainable infrastructure developments to take place.

Tigers in Sumatra have been threatened over the past few decades by infrastructure developments, expanding oil palm and pulpwood plantations, and relentless poaching. Since 1990, 50,000 kilometres of roads have been constructed inside Sumatra's forests,⁸⁹ fragmenting tiger habitats into small, isolated areas.⁹⁰ Around 6,500 kilometres of these roads directly endanger tigers, and at least 430 kilometres lie within protected areas.⁹¹ The expanding road network has coincided with the development of oil palm and pulpwood plantations, further diminishing tiger habitats. Studies have shown that between 2009 and 2011, oil palm plantations alone were responsible for the loss of 15 per cent of tiger habitats in Sumatra.⁹² Even in some protected tiger habitats, such as the Balairaja Wildlife Sanctuary and Tesso Nilo National Park, the forests have been almost entirely cleared for palm oil production.⁹³ This decline in forest cover, among other factors, has led to an estimated 50 per cent decline in Sumatra's tiger population from around 800 in 1985 to fewer than 400 in 2016.^{94,95} Furthermore, increased human access to tiger habitats has made tigers more vulnerable to poaching. Although the Indonesian authorities passed anti-poaching laws and recently quadrupled the maximum jail terms for poachers, the illegal killing of Sumatran tigers continues.⁹⁶ As a result of all these challenges, Sumatra's tiger populations are now at risk of extinction.



To reverse this trend and protect Sumatra's rainforests, the Indonesian government published an ambitious plan in 2010 – The Road Map for Saving Sumatra's Ecosystem: Sumatra's Vision 2020. Sumatra's Vision 2020 committed local governors to conduct ecosystem-based spatial plans, which would support sustainable development and conservation.⁹⁷ The Road Map was developed with input from the Sumatra Spatial Planning Forum (ForTRUST), comprising environmental and conservation organizations as well as representatives from universities.⁹⁸ Identifying areas for protection and restoration based on critical biodiversity and habitats, the Road Map chose areas in Riau, Jambi and West Sumatra (RIMBA) as demonstrative locations.⁹⁹ This Road Map exemplifies how all provincial governments on the island can take a long-term view and balance economic development with sustainable management of natural resources, including tiger habitats.

Despite the comprehensive Road Map, little has been done to halt unsustainable infrastructure developments in Sumatra, highlighting the fact that an elaborately designed policy is ineffective without strong coordination between regional spatial planning and local land use plans. Even though the new Road Map was designed to protect the island's biodiversity, Sumatran forests and their tigers continue to be threatened by conversion and unsustainable infrastructure developments. For example, the ongoing construction of the 2,800 kilometre Trans-Sumatra Toll Road could further isolate tiger habitats.^{100,101} Another infrastructure project involves a 50-metre wide highway that would divide the Harapan rainforest and further threaten the tigers in the area.¹⁰² Finally, the 2013 Aceh Spatial Plan is set to expand road development inside the unique Leuser ecosystem in Northern Sumatra.^{103,104} Although Sumatra's Road Map has a commendable vision and strategy, these developments demonstrate the need for strengthened coordination between regional spatial planning and local land use plans, and the will and mechanism to implement the Road Map at both levels.

Strengthened commitment to the Road Map and better coordination between national and provincial stakeholders can help secure Sumatran tiger habitats.

With the right plans in place, it is recommended that the Indonesian government now focus on strengthening stakeholder coordination to protect the remaining tigers and the island's valuable ecosystems. The 2010 Indonesian Tiger Recovery Plan outlines the activities that are needed to help achieve the goal of doubling global tiger numbers by 2022.¹⁰⁵ Similarly, Sumatra's Vision 2020 Road Map outlines the initiatives needed to sustainably manage and develop tiger habitats. Despite these plans, little progress has been made so far and provincial authorities continue to issue concession permits for development in tiger habitats.¹⁰⁶ Going forward, it is recommended that the government strengthens the coordination and alignment of effort between different stakeholders. Provincial authorities could benefit from closer coordination with the Ministries of Forestry and Public Works to ensure that the objectives of the Sumatra Road Map are taken into account when developing local land use plans. Furthermore, the Ministries of Forestry and Agriculture could work towards a common management strategy, which aims to create economic value while protecting vulnerable habitats.^{107,108}

The Indonesian government could also invest in improving connectivity between key protected tiger habitats and ensure that future linear infrastructure is planned to minimize habitat loss. Experts in this field believe that most tiger habitat patches in Sumatra are now too small to maintain viable tiger populations.¹⁰⁹ Therefore, more resources are required to restore connectivity or construct wildlife corridors between these areas. Habitat connectivity can be improved

through reforestation of small forest patches, modification of plantations as roaming zones, or increased protection in existing forest links.¹¹⁰ These changes would allow tigers to safely move between protected habitats without the risk of vehicle collisions and human conflict. Future linear infrastructure projects should consider wildlife movement patterns and incorporate mitigation approaches into their designs.

Lastly, while the Indonesian government has made progress in prosecuting some poachers, additional efforts and resources should be devoted to anti-poaching initiatives to improve patrolling coverage and effectiveness, and the law enforcement system. Anti-poaching initiatives have already proven successful and curbed some trading networks. Between 2010 and 2012, the Indonesian authorities made at least 20 seizures of tiger products, involving an estimated 50 tigers.¹¹¹ In collaboration with rangers, an additional 38 poachers and traders have been prosecuted in recent years.¹¹² However, given the sheer size of the Sumatran tiger landscapes that need to be monitored, the number of well-trained and well-equipped rangers must be increased to adequately protect tiger and prey populations.

It is not too late to save the Sumatran tiger from extinction. The Indonesian government can ensure their protection while promoting sustainable economic growth by ensuring that future infrastructure and agricultural projects are located in areas that do not further fragment tiger landscapes. Sumatra's Vision 2020 Road Map and the 2010 Tiger Recovery Plan outline the activities needed to make this goal a reality, but this can only be achieved through continued coordination between all stakeholders and commitment to put the plans into action. If these initiatives are implemented, there is a high likelihood that the decline of the Sumatran tiger can be reversed while ensuring that Sumatra's economy can prosper.



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THE PATH FORWARD:

Integrating ecological systems into development planning

Drawing on global lessons around transport networks, wildlife corridors and landscapes, the application of five key management principles to linear infrastructure projects in tiger landscapes can help decision-makers integrate ecological systems at a landscape scale with sustainable development. These principles have been distilled from global lessons and WWF's work across tiger landscapes, as well as existing best practice, such as the Sumatran Spatial Plan and the Malaysian Central Forest Spine Masterplan, both of which integrate ecological systems into development planning at a regional scale. These principles should be applied to all infrastructure activities in and around tiger landscapes.

1 Valuation of the natural capital across tiger landscapes. Tiger range governments should formalize the periodic assessment and valuation of natural capital across tiger landscapes, and begin to demonstrate the direct, indirect and non-use value of these areas. Governments and investors could use such valuations, along with a full assessment of the economic, environmental, and social costs and benefits of infrastructure projects in tiger landscapes, to inform their decision making.

2 Investment decisions that focus on long-term value. When considering investment in infrastructure projects that could affect tigers and their landscapes, tiger range governments and investors should assess investments over a long time horizon. Tiger range governments should consider developing and implementing sustainable transport networks across tiger landscapes. In addition, it is recommended that multilateral banks and investors refrain from financing projects that could harm tiger populations and damage their landscapes.

3 Governance that is representative of all beneficiaries. Local, regional, national and international stakeholders should collaborate on all development stages of linear infrastructure projects across tiger landscapes. This is particularly important for transboundary tiger landscapes.

4 Policymaking that is evidence based and transparent. Policymakers in tiger range governments should consult civil society groups, international non-governmental organizations and technical experts in creating linear infrastructure-related policies. The resulting policies should be comprehensive and holistic, and all decision outcomes should be made publicly available and be clearly communicated to relevant stakeholders.

5 Regulations that are enforced and followed. Tiger range governments should implement measures to ensure that existing and future infrastructure development regulations are upheld by all stakeholders and enforced by appropriate bodies. It is also vital that tiger range governments continue to enforce regulations pertaining to non-infrastructure related threats to tigers, such as poaching and illegal wildlife trade.

Tiger range governments are currently at a crossroads. In many places, linear infrastructure projects have already led to a reduction in tiger numbers and occupancy, as well as irreversible damage to their landscapes. However, by incorporating the above principles into future planning, design and construction processes, these governments can retain the benefits from new

infrastructure developments without jeopardizing landscape connectivity, which is essential to the survival of the tigers in the wild. By balancing conservation and sustainable development across tiger landscapes, tiger range governments can ensure that the goal of doubling the number of wild tigers by 2022 is achieved and that the success is sustained.



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Tigers in numbers



11,000

Kilometres of linear infrastructure planned through tiger landscapes

3,890

Estimated number of tigers in the wild



2022

End of Tx2 campaign to double tigers

13

Tiger range states involved in Tx2 campaign

	<p>Why we are here To stop the degradation of the planet's natural environment and to build a future in which people live in harmony with nature.</p> <p>panda.org</p>
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