



WWF

REPORT

MM

2018

JANUARY 2018

SUMMARY REPORT

GREENING CHINA'S BELT & ROAD INITIATIVE IN MYANMAR

RAPID ASSESSMENT OF OPPORTUNITIES & RISKS FOR MYANMAR'S
NATURAL CAPITAL FROM CHINA'S BELT & ROAD INITIATIVE

ACKNOWLEDGEMENTS

AUTHORS: Hanna Helsingen (WWF-Myanmar), Ben Milligan (University College London), Michele Dailey (WWF Global Science) and Nirmal Bhagabati (WWF-US)

SPECIAL THANKS TO: Karen Ellis (WWF-UK), Guido Broekhoven (WWF-UK), Emily McKenzie (WWF Global Science), Li Nan (WWF-China), A. Christy Williams (WWF-Myanmar), Nicholas Cox (WWF-Myanmar), Sami Tornikoski (WWF-Myanmar), Gaurav Gupta (WWF-Myanmar), Marie Ditlevsen (WWF-Myanmar), Dr. Ashley Brooks (WWF Tigers Alive), Thibault Ledecq (WWF Greater Mekong) and Dr. Stephen Holness (Nelson Mandela University, South Africa) for their feedback on analyses and support throughout.

DESIGN: Bridge Communications, Yangon

MAPS: Michele Dailey (WWF Global Science) and Nirmal Bhagabati (WWF-US).

Disclaimer: This publication draws on work from a number of sources and has not undergone full academic peer review. The views in this publication are based on public information and WWF and contributing authors will not be liable for damages of any kind arising from the use of this publication.

Published: January 2018 by WWF-Myanmar

TABLE OF CONTENTS

Acknowledgments	
Executive summary	1
01. Introduction: The Belt & Road Initiative	13
02. The Belt & Road Initiative in Myanmar	16
03. Opportunities & risks for Myanmar of the Belt & Road Initiative	18
04. Mapping natural capital risks along the BRI road corridors	21
4.1 Up to 24 million people could be affected by natural capital impacts of BRI road infrastructure	23
4.2 Increased erosion and water quality risks along the BRI corridors	24
4.3 Flood risks along the BRI road corridors	26
4.4 Biodiversity risks along the BRI road corridors	28
05. Ensuring a sustainable Belt & Road Initiative in Myanmar	30
5.1 Location of road infrastructure	31
5.2 Design of road infrastructure	34
06. Conclusions & recommendations for key stakeholders	37
For the Government of Myanmar	38
For investors and companies	39
07. References	40



EXECUTIVE SUMMARY

Road projects proposed as part of the One Belt One Road Initiative (BRI) in Myanmar would provide transport infrastructure to areas of the Ayeyarwady River Basin and surrounding mountain areas — home to approximately 25 million people.

These people rely on natural capital—including forests, rivers, land, and biodiversity—for a range of benefits, including clean drinking water and protection from natural disasters.

There is a risk that the benefits of BRI road projects could be undermined by substantial social, environmental and economic costs, if roads are constructed in ways that fragment ecosystems, endanger wildlife, or contribute to deforestation, landslides, flooding and pollution.

Through better road planning and design, there is a great opportunity for the benefits of the BRI to become much more far reaching.

KEY FINDINGS

SIGNIFICANT DEVELOPMENT OPPORTUNITIES FOR MYANMAR

Roads and road construction in the BRI's East–West and North–South corridors (see Figure 3) could make significant contributions to Myanmar's social, economic and infrastructure development. Roads in these corridors would connect cities and communities across Myanmar, with major population centres and markets in Bangladesh, China and India. Experience in other developing countries highlights the potential of BRI road projects in Myanmar to improve access to jobs, education and health; increase economic productivity; raise incomes; reduce trade costs and barriers; and catalyse growth of agricultural and industrial clusters.

SUBSTANTIAL RISKS TO NATURAL CAPITAL & MYANMAR'S SUSTAINABLE DEVELOPMENT

The analysis presented in this report highlights the significant extent to which BRI road infrastructure could impact on natural capital assets and associated benefits (ecosystem services) that people obtain from natural capital, including lower risk of landslides, flooding and water pollution. The report also shows how the resilience and durability of the BRI road infrastructure would potentially depend on ecosystems services, in particular flood and erosion risk reduction provided by natural ecosystems. The BRI road corridors cut through areas of the Ayeyarwady River Basin, and surrounding mountain areas that are home to approximately 24 million people (see Figure 5). These people rely on natural capital located in those areas to filter drinking water, maintain dry-season water flows, reduce risks from natural disasters, and provide other critical ecosystem services. There is a risk that benefits of BRI road projects could be offset by substantial social, environmental and economic costs, which would occur if roads are constructed in ways that fragment ecosystems, endanger wildlife, or contribute to deforestation, landslides, and pollution of land and rivers.

KEY RECOMMENDATIONS

FOR THE GOVERNMENT OF MYANMAR

NATIONAL SUSTAINABLE INFRASTRUCTURE PLAN. Undertake infrastructure planning at the national scale to help identify no-go areas, and evaluate alternative placements of broader infrastructure corridors as well as BRI road corridors. Avoid critical areas, including areas important for biodiversity and providing ecosystem services.

SUSTAINABLE INFRASTRUCTURE GUIDELINES. Consider developing guidelines or criteria or applying existing global sustainability standards, such as the SuRe® – The Standard for Sustainable and Resilient Infrastructure, to guide sustainable infrastructure planning, finance and design in Myanmar, including for the BRI.

COST BENEFIT ASSESSMENTS. Develop more detailed versions of the cost benefit assessments and risk areas highlighted in this report, and gradually incorporate these into planning processes for BRI development.

STRATEGIC ENVIRONMENTAL ASSESSMENT. Undertake a Strategic Environmental Assessment for the entire BRI to better assess economic, social and environmental risks and policies and plans required to avoid and minimize these risks.

FOR INVESTORS AND COMPANIES

BEST STANDARDS. Adopt and comply with best standards in accordance with the *"Guidance on the Building of the Green Belt and Road"* (published by Ministry of Environmental Protection of China). Consider using the SuRe® – the Standard for Sustainable and Resilient Infrastructure and other global sustainability standards and investor safeguards.

NATURAL CAPITAL ASSESSMENT. Undertake a more comprehensive assessment of natural capital and biodiversity (beyond the 3 services and 4 conservation datasets but based on highlighted risk areas included in this report) to enable robust decision-making to ensure that natural capital impacts and risks are properly considered and mitigated.

AVOIDANCE. Avoid critical areas, including areas important for biodiversity and providing ecosystem services, when deciding location of road corridors.

ENVIRONMENTAL IMPACT ASSESSMENT. Undertake high quality Environmental Impact Assessments and Environmental Management Plans for BRI road projects, with special consideration of the impacts (including cumulative) on natural capital, including biodiversity and ecosystem services.

DESIGN OPTIONS. Include design options that can enhance environmental, social and economic benefits, including buffer zones, re-vegetation of slopes and wildlife corridors.

CIVIL SOCIETY PARTICIPATION. Include and facilitate participation of Myanmar civil society at all levels and stages of project planning to avoid negative social and environmental impacts optimize benefit sharing of the BRI in Myanmar.

အကျဉ်းချုပ်

One Belt One Road Initiative (BRI) စီမံကိန်း၏ အစိတ်အပိုင်းများ ဖော်ဆောင်ရန် လူဦးရေ ၂၅ သန်း ခန့် နေထိုင်ရာ ဧရာဝတီမြစ်ဝှမ်းဒေသနှင့် အနီးအနား တောင်တန်းဒေသများတွင် လမ်းများ ဖောက်လုပ်ရန် တင်ပြထားပါသည်။

ဒေသခံများအနေဖြင့် ရှင်သန်နေထိုင်ရေးအတွက် လိုအပ်သော သောက်သုံးရေရရှိရေးနှင့် သဘာဝ ဘေးအန္တရာယ်များမှ အကာအကွယ် ရရှိရေးအတွက် သစ်တောများ၊ မြစ်ချောင်းများ၊ မြေများနှင့် ဇီဝမျိုးစုံမျိုးကွဲများ စသည့် သဘာဝ အရင်းအနှီးများအပေါ် မှီခိုနေရပါသည်။

BRI စီမံကိန်း၏ အကျိုးကျေးဇူးများက လမ်းဖောက် လုပ်မှုကြောင့် သဘာဝဂေဟစနစ်များကို ပျက်ယွင်း ခြင်း၊ တောရိုင်းတိရစ္ဆာန်များ မျိုးသုဉ်းခြင်း၊ သစ်တော ပြန်းတီးခြင်း၊ မြေပြိုခြင်း၊ ရေကြီးခြင်းနှင့် အခြားသော ညစ်ညမ်းစေခြင်းများ ကဲ့သို့သော ဆိုးကျိုးများကို ဖုံးကွယ် မျက်ကွယ်ပြုသွား စေနိုင်သည့် အန္တရာယ် ရှိနေပါသည်။

ပိုကောင်းသော လမ်း အစီအစဉ်နှင့် ပုံစံထုတ်မှုဖြင့် BRI ၏ အကျိုးကျေးဇူးများကို ယခုထက် ပိုမို များပြားကောင်းမွန် စေနိုင်မယ့် အခွင့်အလမ်းများ ရှိနေပါသည်။

အဓိကတွေ့ရှိချက်များ

မြန်မာနိုင်ငံအတွက် သိသာထင်ရှားသော ဖွံ့ဖြိုးတိုးတက်မှု အခွင့်အလမ်းများ

BRI စီမံကိန်း၏ အရှေ့နှင့်အနောက်၊ တောင်နှင့်မြောက် စင်္ကြန် လမ်းမကြီးများ (ပုံအမှတ် ၃ တွင်ရှု) ဖောက်လုပ်မှုသည် မြန်မာ့ လူမှုစီးပွားရေးနှင့်လမ်းပန်းဆက်သွယ်ရေး ဖွံ့ဖြိုးတိုးတက်မှုအတွက် သိသာထင်ရှားစွာ အထောက်အကူ ပြုပါလိမ့်မည်။ လမ်းများတလျှောက်ရှိ မြို့များနှင့် လူ့အဖွဲ့အစည်းများ ကို ဘင်္ဂလားဒေ့ရှ်၊ တရုတ်နှင့် အိန္ဒိယတို့ ကဲ့သို့သော ကမ္ဘာ့ လူဦးရေအများဆုံး နိုင်ငံများနှင့် ချိတ်ဆက် ပေးနိုင်ပါသည်။ အခြား ဖွံ့ဖြိုးဆဲနိုင်ငံများ၏ အတွေ့အကြုံအရ အဆိုပါ BRI စီမံကိန်းသည် အလုပ်အကိုင်၊ ပညာရေးနှင့် ကျန်းမာရေး အခွင့်အလမ်းများ ကောင်းမွန်စေခြင်း၊ စီးပွားရေး ထုတ်လုပ်နိုင်စွမ်းများ တိုးစေခြင်း၊ ဝင်ငွေတိုးစေခြင်း၊ ကုန်သွယ်မှု အတားအဆီးနှင့် စရိတ်များ လျော့ပါး သက်သာစေခြင်း၊ စိုက်ပျိုးရေးနှင့် စက်မှုလုပ်ငန်းများ တိုးပွားလာစေရန် ထောက်ပံ့ပေးခြင်း ကဲ့သို့သော အကျိုးကျေးဇူးများ ဖြစ်ထွန်းစေပါမည်။

မြန်မာ့ သဘာဝ အရင်းအနှီးများနှင့် ရေရှည်တည်မြဲဖွံ့ဖြိုးမှု အတွက် ကြီးမားသော အန္တရာယ်များ

BRI စီမံကိန်းကြောင့် သဘာဝသယံဇာတများနှင့် မြေပြိုခြင်း၊ ရေကြီးခြင်း၊ ရေထူညစ်ညမ်းခြင်းများ လျော့ပါးသက်သာစေခြင်းကဲ့သို့သော သဘာဝဂေဟစနစ်၏ ဝန်ဆောင်မှုများအပေါ် မည်သို့ အကျိုးသက်ရောက်မှု ရှိနိုင်မည်ကို ဤအစီရင်ခံစာတွင် သုံးသပ်ပြထားပါသည်။ အစီရင်ခံစာတွင် BRI လမ်းများ၏ ရေရှည်ခိုင်ခံ့ကောင်းမွန်ရေးအတွက် သဘာဝဂေဟစနစ်အပေါ် မည်သို့ မှီခိုနေကြောင်း ကိုလည်း ရှင်းလင်းတင်ပြထားပါသည်။ အထူးသဖြင့် သဘာဝဂေဟစနစ်မှ ရေကြီးရေလျှံမှုနှင့် မြေတိုက်စား ခံရမှုများကို လျော့ချပေးနိုင်ပါသည်။ BRI စီမံကိန်း စင်္ကြန်လမ်းများသည် လူဦးရေ ၂၄ သန်းခန့်နေထိုင်ရာ ဧရာဝတီမြစ်ဝှမ်း ဒေသနှင့် အနီးအနား တောင်တန်းဒေသများကို ဖြတ်တောက်၍ (ပုံအမှတ် ၅ ရှု) ဖောက်လုပ်သွားမည် ဖြစ်ပါသည်။ ဒေသခံများအနေဖြင့် ရှင်သန်နေထိုင်ရေးအတွက် လိုအပ်သော သောက်သုံးရေ ရရှိရေး၊ ခြောက်သွေ့ရာသီတွင် ရေရရှိစေရန် ထိန်းထားပေးမှုနှင့် သဘာဝဘေးအန္တရာယ်များမှ အကာအကွယ် ရရှိရေးအတွက် သစ်တောများ၊ မြစ်ချောင်းများ၊ ကုန်းမြေများနှင့် ဇီဝမျိုးစုံမျိုးကွဲများ စသည့် သဘာဝအရင်းအနှီးများအပေါ် မှီခိုနေရပါသည်။ အကယ်၍ လမ်းဖောက်လုပ်ရာတွင် သဘာဝဂေဟစနစ်များ ပျက်ယွင်းစေခြင်း၊ တောရိုင်းတိရစ္ဆာန်များ မျိုးသုဉ်းစေခြင်း၊ သစ်တော ပြန်းတီးစေခြင်း၊ မြေပြိုစေခြင်း၊ ရေကြီးစေခြင်းနှင့် အခြားသော ညစ်ညမ်းစေခြင်း စသည်တို့ကို ဖြစ်ပွားစေပါက လူမှု စီးပွားရေးနှင့် သဘာဝပတ်ဝန်းကျင်ထိခိုက်မှု ကုန်ကျစရိတ်များက BRI ကပေးမည့် အကျိုးကျေးဇူးများကို အရာမထင်နိုင် ဖြစ်စေနိုင်သည့် အန္တရာယ် ရှိနေပါသည်။

အဓိက အကြံပြုတင်ပြချက်များ

မြန်မာနိုင်ငံ အစိုးရအတွက်

နိုင်ငံအဆင့် ရေရှည်တည်မြဲသော အခြေခံအဆောက်အအုံဆိုင်ရာ အစီအစဉ်။ အခြေခံ အဆောက်အအုံ ဆိုင်ရာ အစီအစဉ်ရေးဆွဲမှုကို နိုင်ငံအဆင့် လုပ်ဆောင်ခြင်းဖြင့် လုံးဝမထိရနယ်မြေများ သတ်မှတ်နိုင်ပြီး BRI လမ်း စီမံကိန်း အပါအဝင် အခြားသော လမ်းစီမံကိန်းများ အနေဖြင့် အခြား အစားထိုး နေရာများကို အသုံးပြုရန် တွက်ချက် အသုံးပြုနိုင်ခြင်းဖြင့် ဇီဝမျိုးကွဲနှင့် ဂေဟစနစ် ဝန်ဆောင်မှုအတွက် အရေးကြီးသော နေရာများကို ရှောင်ရှားသွားရန်။

ရေရှည်တည်မြဲသော အခြေခံအဆောက်အအုံဆိုင်ရာ စည်းမျဉ်းများ။ သင့်လျော်မည့် စည်းမျဉ်းများ ရေးဆွဲခြင်း (သို့) SuRe[®] – ရေရှည်တည်မြဲပြီး ဒဏ်ခံနိုင်သော အခြေခံအဆောက်အအုံဆိုင်ရာ စံနှုန်းကဲ့သို့သော ရှိပြီးသား ကမ္ဘာတဝန်း ကျင့်သုံးနေသည့် စံနှုန်းများကို ပြဋ္ဌာန်းပြီး BRI အပါအဝင် အခြားသော မြန်မာနိုင်ငံတွင် ပြုလုပ်မည့် စီမံကိန်းများ၏ စီမံရေး၊ ငွေကြေးထောက်ပံ့ခြင်းနှင့် စီစဉ်ခြင်းများတွင် စည်းမျဉ်းများအတိုင်း လိုက်နာ ကျင့်သုံးစေရန်။

ကောင်းကျိုးဆုံးဖြတ်ချက်ကို သုံးသပ်ခြင်း။ ဤအစီရင်ခံစာတွင် ညွှန်ပြထားသော လေ့လာသုံးသပ်မှု ထက် ပိုမို အနုစိတ်သော စဉ်းစားသုံးသပ်ရန်လိုအပ်သည့် အချက်များကို ထည့်သွင်းပြီး BRI စီမံကိန်း၏ ကြိုတင် စီမံခြင်းနှင့် အကောင်အထည်ဖော်ရာတွင် ထည့်သွင်းစဉ်းစားရန်။

သဘာဝပတ်ဝန်းကျင်ဆိုင်ရာ ဗျူဟာကျ စစ်တမ်းကောက်ယူခြင်း။ BRI စီမံကိန်း တစ်ခုလုံးကြောင့် စီးပွားရေး ပိုမို ကောင်းမွန်လာမှုများနှင့် လူမှုနှင့် သဘာဝပတ်ဝန်းကျင်ဆိုင်ရာ ထိခိုက်နိုင်မှု များကို ဆန်းစစ်ခြင်းနှင့် ထိခိုက်မှု အနည်းဆုံးဖြစ်ရန် စီမံခြင်းနှင့် မူဝါဒများချမှတ်ခြင်းတို့ ပြုလုပ်သွားရန်။

ရင်းနှီးမြှုပ်နှံသူများနှင့် ကုမ္ပဏီများအတွက်

အကောင်းဆုံးစံနှုန်းများ။ တရုတ်နိုင်ငံ၏ သဘာဝပတ်ဝန်းကျင် ထိန်းသိမ်းရေးဝန်ကြီးဌာနမှ ချမှတ် ထားသော “ရပ်ဝန်းတစ်ခု လမ်းမတစ်ခု အစီအစဉ်အား သဘာဝ သဟဇာတဖြစ်စွာ တည်ဆောက်ရေး လမ်းညွှန်ချက်” အတိုင်း အကောင်းဆုံး စံနှုန်းများ ချမှတ် လိုက်နာရန်။ SuRe[®] (ရေရှည်တည်မြဲပြီး ဒဏ်ခံနိုင်သော အခြေခံအဆောက်အအုံ ဆိုင်ရာ စံနှုန်း) သို့မဟုတ် အခြားသော ကမ္ဘာလုံးဆိုင်ရာ တည်မြဲစံများနှင့် ရင်းနှီးမြှုပ်နှံခြင်းဆိုင်ရာ အစီအမံများကို လိုက်နာရန်။

သဘာဝအရင်းအနှီးများကိုတွက်ချက်စီစစ်ခြင်း။ သဘာဝအရင်းအနှီးများအပေါ် သက်ရောက်မှု များနှင့် ဘေးဖြစ်နိုင်ချေတို့ကို ထည့်သွင်းစဉ်းစား လျော့ချထားသည့် အမှားကင်းသည့် ဆုံးဖြတ်ချက် ဖြစ်စေရန် (ဤ အစီရင်ခံစာတွင် အသားပေးဖော်ပြထားသည့် ထိခိုက်ခံရဖွယ် ဧရိယာများကို အခြေခံ၍ ဝန်ဆောင်မှုဆိုင်ရာ အချက် ၃ မျိုးနှင့် ထိန်းသိမ်းရေးဆိုင်ရာ အချက် ၄ မျိုးထက်ပိုသုံးကာ) ပိုမို ရှင်းလင်းပြည့်စုံသည့် သဘာဝအရင်းအနှီးနှင့် ဇီဝမျိုးစုံမျိုးကွဲဆိုင်ရာ ဆန်းစစ်မှု ပြုလုပ်ရန်။

ရှောင်ရှားခြင်း။ စင်္ကြန်လမ်း နေရာ ရွေးချယ်သည့်အခါ ဇီဝမျိုးစုံမျိုးကွဲများအတွက် အရေးပါပြီး ဂေဟစနစ် ဝန်ဆောင်မှုများပေးနေသည့် ဧရိယာများ အပါအဝင် အရေးကြီးသည့် ဧရိယာများကို ရှောင်ရှားရန်။

သဘာဝပတ်ဝန်းကျင်ထိခိုက်မှုကို ဆန်းစစ်ခြင်း။ ဇီဝမျိုးစုံမျိုးကွဲနှင့် ဂေဟစနစ်ဝန်ဆောင်မှုများ အပါအဝင် သဘာဝအရင်းအနှီးအပေါ် သက်ရောက်မှု (တဖြည်းဖြည်းနှင့် ဖြစ်လာနိုင်သည်များပါ အပါအဝင်) များကို အထူး ထည့်သွင်းစဉ်းစားခြင်းဖြင့် BRI လမ်းစီမံကိန်းများအတွက် အရည်အသွေးဖြင့် သဘာဝပတ်ဝန်းကျင် ထိခိုက်မှု ဆန်းစစ်ချက်များနှင့် သဘာဝပတ်ဝန်းကျင် စီမံခန့်ခွဲမှု အစီအစဉ်များ လုပ်ဆောင်ရန်။

ဒီဇိုင်း ရွေးချယ်ဖွယ်ရာများ။ ကြားခံရံများ ထားရှိခြင်း၊ တောင်စောင်းများတွင် အပင် ပြန်စိုက်ခြင်းနှင့် တောရိုင်း တိရစ္ဆာန်သွား လမ်းကြောင်းများ အပါအဝင် သဘာဝပတ်ဝန်းကျင်၊ လူမှုရေးနှင့် စီးပွားရေးဆိုင်ရာ အကျိုးကျေးဇူး အများဆုံး ပေးနိုင်မည့် ဒီဇိုင်း ရွေးချယ်ဖွယ်များ ထည့်သွင်း စဉ်းစားရန်။

လူမှုအဖွဲ့အစည်းများ ပူးပေါင်းပါဝင်မှု။ လူမှုရေးနှင့် သဘာဝပတ်ဝန်းကျင်ဆိုင်ရာ မကောင်းသော သက်ရောက် မှုများကို ရှောင်ရှားပြီး မြန်မာနိုင်ငံတွင်း BRI စီမံကိန်း၏ အကျိုးကျေးဇူး အများဆုံး ခွဲဝေခံစားရနိုင်စေရန် စီမံကိန်း အစီအစဉ် ရေးဆွဲမှု၏ အဆင့်တိုင်း၊ အလွှာတိုင်းတွင် မြန်မာ့ လူမှုအဖွဲ့အစည်းများကို ထည့်သွင်း၍ ပါဝင်နိုင်ရေး ပံ့ပိုးပေးရန်။

执行摘要

作为“一带一路”倡议落地缅甸的一部分，公路项目将为伊洛瓦底江流域地区和周边山区提供交通基础设施。

生活在这些地区的2500万民众从森林、河流、土地和生物多样性等自然资本中获益，包括从中获得清洁饮用水以及减少发生自然灾害的风险。

但是，如果公路建设破坏生态系统完整性、威胁野生生物，或者造成森林退化、山体滑坡、洪水和污染，那么“一带一路”公路项目带来的效益可能会因为巨大的社会、环境和经济成本而受到损害。

通过更好的公路规划和设计，“一带一路”倡议的正面效益影响会更大。

主要发现

缅甸的重要发展机遇

“一带一路”倡议下在缅甸的东西和南北两条走廊（见图3）中的公路建设将为缅甸的社会、经济和基础设施发展做出重大贡献。这些公路将把缅甸境内的城市和社区与孟加拉、印度及中国的主要城市和市场相连接。其他发展中国家的经验表明，公路建设项目将推动就业、教育和卫生医疗，提高经济生产力，提高国民收入，降低交易成本和壁垒，并促进农业和产业发展。

自然资本面临的重大风险与缅甸的可持续发展

本报告的分析强调，“一带一路”公路基础设施将在很大程度上会对自然资本及其相关收益（生态系统服务）产生影响，而这些自然资本本可以降低山体滑坡、洪水和水污染的风险。本报告还说明了“一带一路”公路基础设施的气候弹性和耐用性也可能依赖于生态系统服务，特别是自然生态系统可降低发生洪水和水土流失的风险。“一带一路”公路走廊贯穿伊洛瓦底江流域地区和周边山区，在该区域约有2400万人口（见图5）。这些居民依靠当地的自然资本来过滤饮用水、保持旱季的水流量、减少自然灾害风险，并从中获得其他关键的生态系统服务。如果公路建设破坏生态系统完整性、威胁野生生物，或者造成森林退化、山体滑坡、洪水和污染，那么“一带一路”公路项目带来的效益可能会因为巨大的社会、环境和经济成本而受到损害。

主要建议

对于缅甸政府

实施国家可持续基础设施计划。 在缅甸全国范围内进行基础设施规划，从而确立禁区，并评估包括“一带一路”公路在内的基础设施走廊的位置走向。避免在对生物多样性和提供生态系统服务上具有重要意义的地区开展建设项目。

制定可持续的基础设施指南。 考虑制定开发指南或应用现行全球可持续标准，例如 SuRe®（可持续和弹性基础设施标准），为包括“一带一路”项目在内的境内可持续基础设施建设提供规划、融资和设计指导。

进行成本效益评估。 制定更为详细的成本效益评估和风险区域方案，并将其逐步纳入到“一带一路”倡议的发展规划中。

开展战略环境评估。 对整个“一带一路”项目进行战略环境评估，更好地评估经济、社会和环境风险，以及相关的政策和计划，从而避免和最大限度地降低风险。

对于投资者和企业

最高标准。 依照中国环境保护部发布的《关于推进绿色“一带一路”建设的指导意见》，采用并遵守最高标准。考量参考采用 SuRe®（可持续和弹性基础设施标准）和其他全球可持续性标准以及投资者保障措施。

自然资本评估。 对自然资本和生物多样性进行更全面的评估（不仅包括3个服务和4个保护数据集，而要以本报告中重点突出的风险区域为基础），通过强有力的决策来确保考虑并减缓对自然资本的影响和风险。

规避。 在决定公路走廊的位置时，应避免选址在对生物多样性和提供生态系统服务上具有重要意义的地区。

环境影响评估。 对“一带一路”公路项目进行高质量的环境影响评估和环境管理计划，特别要考虑对生物多样性和生态系统服务等自然资本的影响（包括累积影响）。

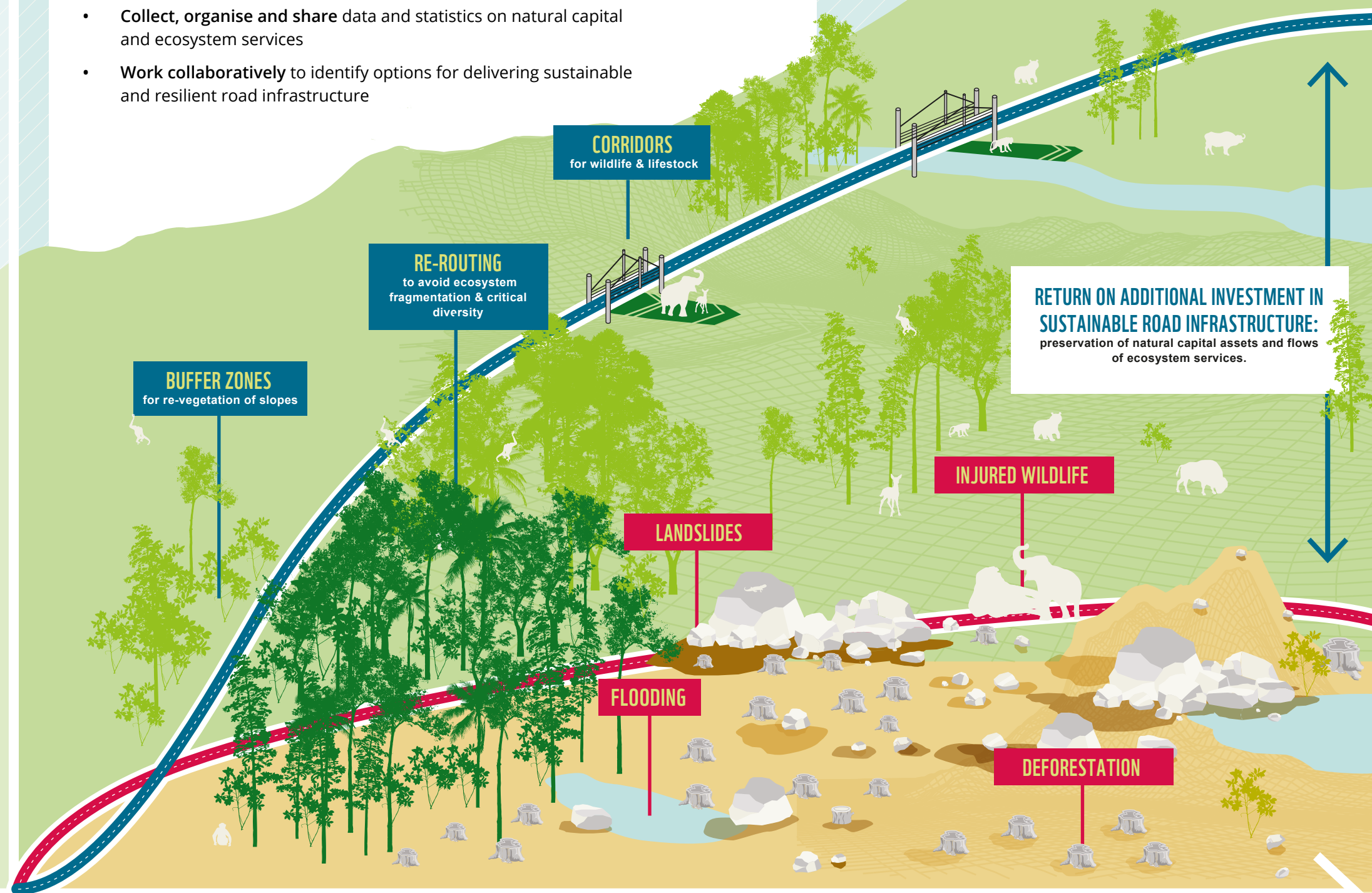
设计方案。 制定可以提高环境、社会和经济效益的设计方案，包括对缓冲区、斜坡植被和野生动物走廊的规划。

公民社会参与。 吸纳并推动缅甸各级民间社会参与项目规划的各个阶段，以避免对社会和环境造成不利影响，促进“一带一路”倡议惠及更多民众。

KEY ACTIONS

FOR GOVERNMENT, BUSINESSES,
INVESTORS, & DEVELOPMENT
PARTNERS

- Incorporate natural capital costs and impacts into environmental impact assessments, and into development and project planning
- Collect, organise and share data and statistics on natural capital and ecosystem services
- Work collaboratively to identify options for delivering sustainable and resilient road infrastructure



MAXIMISING DEVELOPMENT BENEFITS OF BRI ROAD INFRASTRUCTURE

AN ILLUSTRATIVE NATURAL CAPITAL APPROACH
FOR MYANMAR

SUSTAINABLE BRI ROAD INFRASTRUCTURE

- Lower risk of landslides, flooding & water pollution
- Higher upfront investment for road construction
- Preservation of ecosystems, and critical services provided by ecosystems to millions of people; e.g. clean drinking water, maintain dry-season water flows, disaster risk reduction

UNSUSTAINABLE BRI ROAD INFRASTRUCTURE

- Lower upfront investment for road construction
- Higher risks of landslides, flooding & water pollution
- Fragmentation of ecosystems, and decline of critical services they provide to millions of people

TIME

ABOUT THIS REPORT

The purpose of this report is to provide a rapid assessment of key opportunities and risks for Myanmar of China's Belt & Road Initiative, relating to natural capital impacts and dependencies.

THE ASSESSMENT FOCUSES ON IDENTIFYING:

- how construction of roads proposed by the Initiative could affect Myanmar's natural capital, and the benefits that these natural assets provide to people,
- how BRI road projects in Myanmar themselves depend on the ecosystem services provided by natural capital, and
- options for ensuring a sustainable BRI in Myanmar, through careful planning of the location and design of road infrastructure to minimize damage to natural capital and associated risks.

The assessment presented in this report is preliminary in nature and should be used for illustrative purposes only. It is not designed to support road planning decisions in specific locations, which would require more accurate follow up assessments.

01 INTRODUCTION: THE BELT AND ROAD INITIATIVE

The BRI has been described as 'probably the most ambitious Chinese international policy initiative in history'.¹ The Initiative's two key proposals—a "Silk Road Economic Belt" and "Maritime Silk Road"—include activities spanning at least 60 countries, which represent ~60% of the world's population and ~30% of global GDP.² On land, the Silk Road Economic Belt features several economic corridors that connect Central Asia, Russia, India, Pakistan and Europe. The Maritime Silk Road connects China's coastal ports with those in Asia, East Africa, and Europe (see Figure 2).³

The purpose of China's BRI is to promote regional economic development, underpinned by four principles: (1) *openness and cooperation*, (2) *harmony and inclusiveness*, (3) *market-based operation*, and (4) *mutual benefits and win-win outcomes for all countries*. The Initiative emphasizes investment in the development of regional infrastructure, but its official objectives are much broader—including policy dialogue, infrastructure connectivity, free trade, and people-to-people trade. These economic and geopolitical objectives are likely to shape China's foreign policy for decades to come. By 2015, participating financial institutions and companies may have raised funds exceeding US\$800 billion to support the BRI.⁴

TOWARDS A GREEN BELT AND ROAD INITIATIVE

In 2016, China's president Xi Jinping highlighted the importance of working towards a 'green, healthy, intelligent and peaceful' Silk Road, suggesting that participating countries should 'deepen cooperation in environmental protection, intensify ecological preservation and build a green Silk Road'.⁵ In 2017, the Ministry of Environmental Protection of China released '*Guidance on the Building of the Green Belt and Road*' that sets out detailed principles and objectives emphasizing cooperation, capacity building, policy dialogue, and adherence to regulatory standards.⁶ These commitments are strongly influenced by China's ambitious national blueprint for an 'Ecological Civilization', and 'major objective' in its 13th Five-Year Plan for Economic and Social Development to 'Achieve an overall improvement in the quality of the environment and ecosystems'.⁷

¹ Huang Y. 2016.

² Ibid.

³ HKTDC. 2017.

⁴ Inclusive Development International. 2016.

⁵ State Council Information Office of the People's Republic of China. 2016.

⁶ Belt and Road Portal. 2017.

⁷ United Nations Environment. 2016., Central Committee of People's Republic of China. 2016.

WHAT IS NATURAL CAPITAL?



NATURAL CAPITAL IS ANOTHER TERM FOR THE STOCK OF RENEWABLE AND NON-RENEWABLE RESOURCES (E.G. PLANTS, ANIMALS, AIR, WATER, SOILS AND MINERALS) THAT COMBINE TO YIELD A FLOW OF BENEFITS TO PEOPLE.

THE BENEFITS (ECOSYSTEM SERVICES) PROVIDED BY NATURAL CAPITAL INCLUDE CLEAN AIR, FOOD, WATER, ENERGY, SHELTER, MEDICINE, AND THE RAW MATERIALS WE USE IN THE CREATION OF PRODUCTS. IT ALSO PROVIDES LESS OBVIOUS BENEFITS SUCH AS FLOOD DEFENCE, CLIMATE REGULATION, POLLINATION AND RECREATION.”⁸

⁸ Natural Capital Coalition. 2016.

CHINA RECOGNIZES THE IMPORTANCE OF NATURAL CAPITAL

The Government of China has recognized the importance of natural capital for its own social and economic development objectives. It has established a domestic network of “Ecosystem Function Conservation Areas” to focus conservation in areas with high return-on-investment for public benefit.⁹ Ecosystem Function Conservation Areas now span more than 35% of the country.¹⁰ China has conducted an ambitious national assessment of biodiversity and ecosystem services, including food production, sandstorm prevention, soil retention, carbon sequestration, flood mitigation, water regulation and biodiversity conservation, recognizing the importance of this information for planning and policy, including infrastructure.¹¹

BRI CORRIDORS CUT ACROSS IMPORTANT CONSERVATION AREAS

The BRI area spans many important conservation areas, such as Protected Areas, key landscapes, Global 200 Ecoregions, and biodiversity hotspots. These cover the distribution range of important species, and provide many important benefits (ecosystem services) to people that underpin social and economic development. Based on the concern of potential impacts on people and nature, WWF undertook a preliminary spatial analysis of the possible environmental impacts along 6 land-based economic corridors, initially proposed for the BRI as a whole. The analysis revealed that BRI corridors overlap with 1,739 Important Bird Areas or Key Biodiversity Areas and 46 biodiversity hotspots and that potentially all protected areas in BRI corridors could potentially be impacted. 32% of the total area of all protected areas in countries crossed by BRI corridors could potentially be affected.¹²

Based on the analysis, WWF provided a number of recommendations for how the BRI could be designed and implemented to maximize the potential sustainable development benefits and minimize the potential negative impacts. Recommendations include use of system level design, direct investments towards ecological infrastructure and renewable energy, use of Strategic Environmental Assessments to support policy and planning, assess natural capital risks and opportunities, secure integrity of ecosystems along BRI corridors by establishing transboundary protected areas, enhance collaboration on biodiversity conservation, follow highest environmental and social safeguards and standards when planning, designing and implementing BRI projects and encourage civil society participation and consultation at all levels and at all stages of the BRI development.¹³

⁹ Daily G. 2013.

¹⁰ National Development and Reform Commission. 2013.

¹¹ Ouyang. 2013.

¹² WWF. 2017.

¹³ Ibid.

02 THE BELT AND ROAD INITIATIVE IN MYANMAR

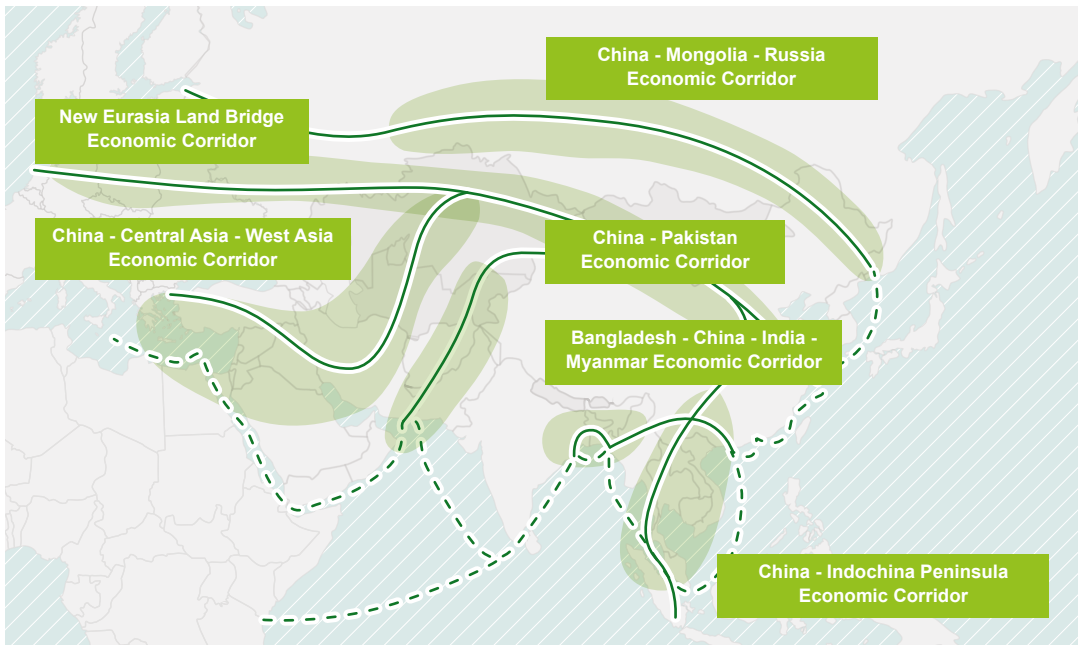
A key objective of the BRI's Bangladesh-China-India-Myanmar (BCIM) Economic Corridor is to deepen connections between China's Yunnan province and its neighbours, and between China as a whole and the Bay of Bengal. BRI objectives in Myanmar are also shaped by China's 'Two-Ocean' Strategy, which aims to secure strategic influence over sea lanes in the Indian Ocean to the west, and Pacific Ocean to the east (in particular the South China Sea and East China Sea).¹⁴ Sea lanes in these locations are vital economic and energy supply lines for China—for example they carry more than 80% by volume of China's oil imports.¹⁵

According to press reports and accounts available online, two corridors for road infrastructure in the BCIM Economic Corridor have been proposed as part of the BRI in Myanmar:

1. An *East-West corridor* connecting China through Mandalay and central Myanmar with India and Bangladesh.
2. A *North-South corridor* connecting the East-West corridor with the Indian Ocean via Yangon.¹⁶

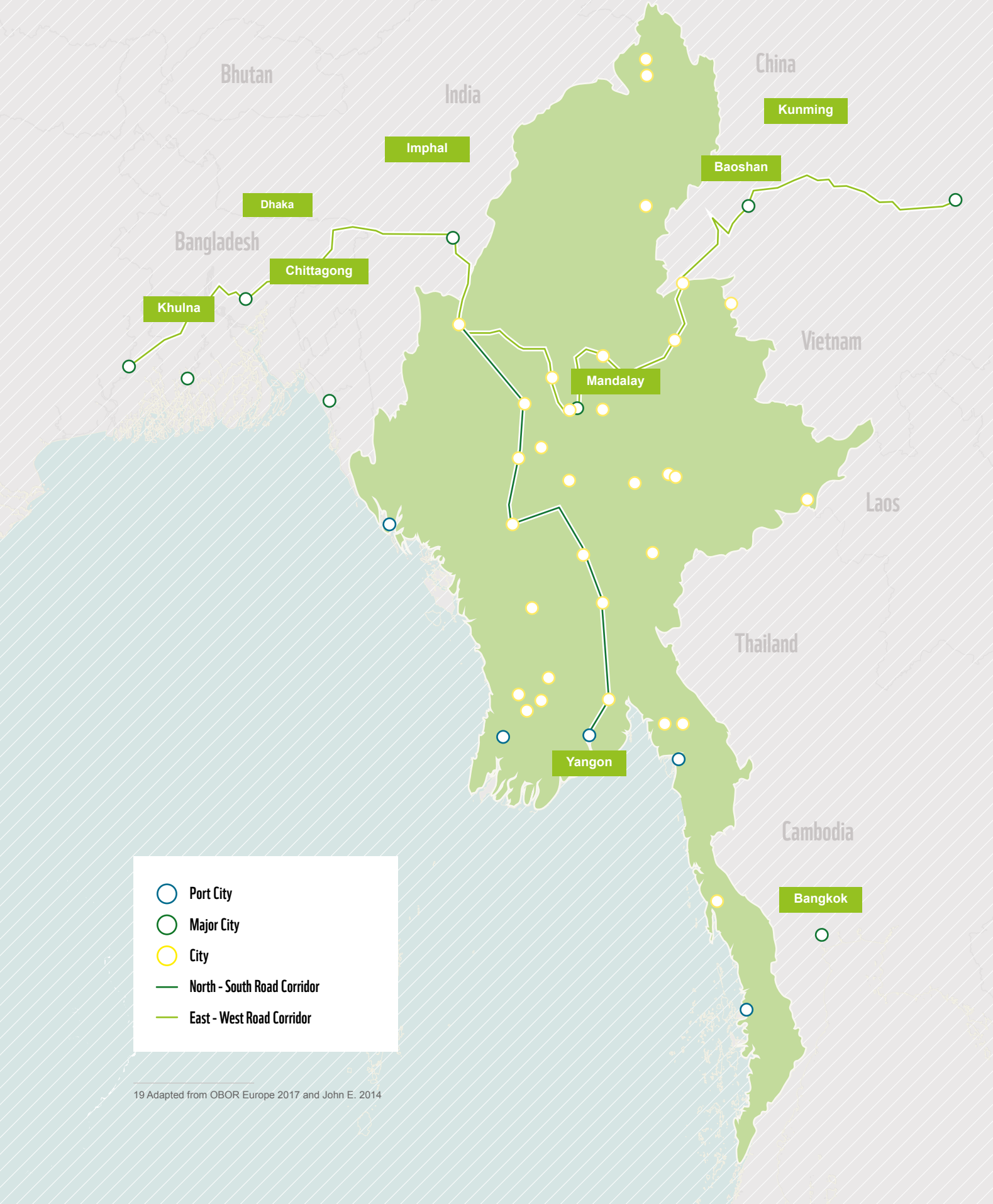
There are also plans in Myanmar to develop a US\$7.3 billion deep water port in Kyaukpyu township, Rakhine State (western Myanmar), in which a consortium led by China's CITIC Group has reportedly proposed to take a 70–85% ownership stake.¹⁷

FIGURE 2: MAJOR LAND AND SEA CORRIDORS OF THE BELT AND ROAD INITIATIVE¹⁸



¹⁴ Sun T. and Payette A. 2017., Owen N. and Schofield C. 2012.
¹⁵ Wang L. 2015.
¹⁶ OBOREurope. 2017. And John E. 2014.
¹⁷ Myanma Port Authority. 2017.
¹⁸ Adapted from HKTDG. 2017.

FIGURE 3: PROPOSED BRI ROAD CORRIDORS AND PORT PROJECTS IN MYANMAR¹⁹



¹⁹ Adapted from OBOR Europe 2017 and John E. 2014

03 OPPORTUNITIES AND RISKS FOR MYANMAR OF THE BELT & ROAD INITIATIVE

Myanmar is currently experiencing historic political, social and economic changes. The opening up of the country presents both opportunities to pursue rapid development, and risks that such development will not deliver sustainable or equitable benefits to Myanmar's people, and will deplete or damage the country's natural capital, including its rich biodiversity.

Evidence from other countries suggests that BRI road projects and associated investments offer considerable opportunities. A 2015 evidence review by the World Bank highlighted the potential of road infrastructure to deliver diverse socio-economic benefits including increased productivity, reduction of trade costs and barriers, agglomeration effects, and flow on effects for production, employment, and incomes.²⁰ According to the 2016 United Nations' State of the Least Developed Countries Report, development benefits of road infrastructure include transformation in the lives of rural communities through educational opportunities, increased access to health services, increased agricultural productivity, and higher school enrolment.²¹ Given these benefits, BRI road projects and associated investment are likely to support delivery of key policy priorities in Myanmar—including the National Comprehensive Development Plan, Agricultural Development Strategy, Promoted Sectors for Investment, and Export Development Strategy. All of these documents emphasize the importance of connecting Myanmar with its neighbours and the world, in order to pursue trade and other development opportunities.

ENVIRONMENTAL AND SOCIO-ECONOMIC RISKS RELATED TO THE BRI

The significant potential benefits of the BRI in Myanmar are however coupled with substantial environmental and socio-economic risks, as well as the dependence of BRI infrastructure on natural capital. Socio-economic development can be undermined by adverse impacts of road projects on the natural environment, or by failures to accommodate the needs and priorities of affected local communities.

²⁰ World Bank. 2015b. Adler S. 2017. Fardoust S., Kim Y. and Sepúlveda C. 2011.

²¹ United Nations Office of the High Representative for the Least Developed Countries, Landlocked Developing Countries and Small Island Developing States. 2016.

ROADS, IF NOT PROPERLY PLANNED OR CONSTRUCTED, CAN HAVE MANY NEGATIVE IMPACTS, INCLUDING:

- **INCREASED RISKS OF NATURAL DISASTERS:** in particular landslides and flooding²² with impacts on the people of Myanmar, and on the integrity of roads and other infrastructure.
- **WATER POLLUTION:** in particular through increasing runoff of soil, sediment and other pollutants.²³
- **WILDLIFE MORTALITY:** caused by collisions between vehicles and wildlife,²⁴ or by impairing the ability of wildlife to access essential food, water or habitat.²⁵
- **ECOSYSTEM DEGRADATION:** caused by spatial fragmentation, or by roads enabling unsustainable intensification of natural resource use (e.g. timber harvesting or hunting).²⁶

²² Renaud F. 2013.

²³ Mandle L., Griffin R. and Goldstein J. 2016.

²⁴ Glista D., DeVault T. L. and DeWoody J. A. 2009.

²⁵ Fahrig L. 2003.

²⁶ World Bank. 2016.

SUSTAINABLE MANAGEMENT OF MYANMAR'S NATURAL ENVIRONMENT

The United Nations Sustainable Development Goals—and Myanmar's National Comprehensive Development Plan—the government's economic policy and 2017 National Environmental Policy—all recognize that the country's development depends fundamentally on sustainable management of the natural environment. Recent studies have highlighted the extent to which Myanmar's natural environment functions as a capital asset, providing many goods and services to the country's people.²⁷

Studies have also started to identify the economic implications of the goods and services provided by Myanmar's natural capital assets, and measure the (sometimes irreplaceable) contributions to human health, well-being and development. For example, a 2013 pilot study of forest ecosystems in Myanmar concluded that these assets contribute at least US\$7.3 billion to Myanmar's economy, of which only 15% derives from extractive activities such as commercial forestry and non-wood product removals.²⁸

²⁷ WWF, 2016. And Emerton L. and Yan Min Aung. 2013.

²⁸ Emerton L. and Yan Min Aung. 2013.

MYANMAR IS VULNERABLE TO EXTREME WEATHER EVENTS

According to the Global Climate Risk Index 2017, Myanmar is one of the most vulnerable countries to climate change and extreme weather events.²⁹ The country has suffered cyclones and floods in recent years, which have severely impacted people and the economy. For example, the monsoon flooding in 2015 caused economic losses amounting to 3.1% of GDP.³⁰ Myanmar's natural capital plays an important role in mediating these risks through benefits, such as flood regulation, and is a major component of the country's wealth, alongside its institutions, communities, built infrastructure and financial assets.

²⁹ Kreft S., Eckstein D. and Melchior I. 2016.

³⁰ World Bank. 2015a.

NATURAL CAPITAL RISKS AND THE BRI

There is a risk that BRI road projects in Myanmar could damage the stock of Myanmar's natural capital assets and thereby reduce benefits provided to the country's people, increasing costs to society, the economy and the infrastructure itself. The significance of these risks is underscored by the fact that the East–West and North–South road corridors cross through areas that are home to approximately 24 million people (see Figure 5 below). These people rely on natural capital assets located in those areas (in particular forest and riverine ecosystems) to filter drinking water; maintain water during the dry season for irrigation, livestock, and human consumption; reduce risks from natural disasters; and provide other critical ecosystem services.

Myanmar's natural capital is vital for mitigating the severe impacts of natural disasters on the country's built infrastructure, including roads.

In 2015, Myanmar's average annual loss (AAL) from natural disasters represented 30 percent of its annual capital investment—almost double the same figure for Philippines (14 percent), and triple that of Cambodia (10 percent). It was also ranked first globally for Flood AAL in relation to capital investment.³¹

³¹ UNISDR. 2015., ADPC/UNICEF. 2015.

04. MAPPING NATURAL CAPITAL RISKS ALONG THE BRI ROAD CORRIDORS IN MYANMAR

The proposed BRI corridors are likely to have substantial negative social, environmental, and economic impacts, if not carefully planned and designed. The viability and integrity of the BRI infrastructure would itself be at risk from degradation of natural capital. To better understand these risks, the assessment in this report focuses on human population density, selected ecosystem services, and areas of conservation importance in Myanmar, showing their overlap with or proximity to the proposed BRI corridors and watersheds (areas of land that separates waters flowing to different rivers, basins, or seas). Given data and resource constraints, the analysis was confined to three ecosystem services that were recently assessed in a national natural capital assessment.³²

The assessment in this report identifies spatial overlaps between the East–West and North–South road corridors and:

- **POPULATION AND POPULATION DENSITY**—including identification of areas where upland ecosystems and services affect downstream population centres (see examples in bullets below)
- **ECOSYSTEMS THAT MITIGATE EROSION AND IMPROVE WATER QUALITY**—by capturing sediment run-off from surrounding land
- **ECOSYSTEMS THAT REDUCE FLOOD RISK**—by slowing or reducing water flows from surrounding land
- **IMPORTANT BIODIVERSITY AREAS**—including sites contributing significantly to the global persistence of biodiversity, also known as Key Biodiversity Areas (KBAs), intact forest landscapes, areas of higher mammal species richness, and Protected Areas.

This mapping exercise helps to identify locations in Myanmar where BRI road projects could damage natural capital, leading to (1) reduced flows of certain ecosystem services to surrounding populations, and (2) increased risks of damage to the roads themselves, for example from flooding or landslides. These impacts should be well understood in the planning, finance and design of BRI road infrastructure to maximize its development benefits and ensure the sustainability and cost-effectiveness of the infrastructure. A subset of data used to generate the maps depicting natural capital risks is summarized in Figure 3.³³ The scope of this assessment does not include intrinsic and cultural values, which are distinct from the quantifiable social and economic benefits that ecosystems provide to people. Other ecosystem services that are important in Myanmar were beyond the scope of this analysis, but should be included in future assessments.

³² WWF. 2016.

³³ See also detailed technical appendix, Dailey M. 2017.

TABLE 1: SUMMARY OF APPROACH USED TO MAP NATURAL CAPITAL RISKS

Services or circumstances mapped	Data inputs and methodology	Key limitations
5.1 POPULATION AND POPULATION DENSITY	FAO 2015 population estimates with UN -INWEH WaterBase fourth level watersheds and calculated the FAO 2015 estimated population within those watersheds that are intersected by the BRI proposed roads.	Not all populations are downstream of the potential road impacts.
5.2 SEDIMENT RETENTION BY LAND COVER	InVEST DelineateIt model to create service sheds of points along each road. InVEST sediment retention model used to calculate role of natural vegetation in retaining sediment under current climate conditions. ³	Does not include the impact of roads on sedimentation but rather how vegetation upland of a road may impact sedimentation if all converted to agriculture. Does not incorporate future climate conditions. Not calibrated.
5.3 FLOOD RISK REDUCTION	InVEST DelineateIt model to create <i>service sheds</i> of points along each road. InVEST Seasonal Water Yield used to calculate flood risk reduction provided by natural vegetation under current climate conditions. ⁴	Does not include the impact of roads on flood risk reduction but rather how vegetation upland of a road may impact flood risk if all converted to agriculture. Does not incorporate future climate conditions. Not calibrated.
5.4 BIODIVERSITY	World Database on Protected Areas (WDPA), Key Biodiversity Areas (KBAs), Intact Forest Landscapes, and IUCN Red List of Threatened Species (using mammal species ranges to create an indicator of biodiversity).	Does not include areas that may be highly diverse but lack any formal designation. Biased towards forested areas, birds, and mammals. Does not account for areas important for connectivity.
5.5 RIPARIAN AREAS	InVEST DelineateIt model to create a stream network; buffered by 500 meters to approximate the maximum riparian area required by terrestrial species.	A study of all species present and their riparian habitat needs would provide more precise buffer distances.

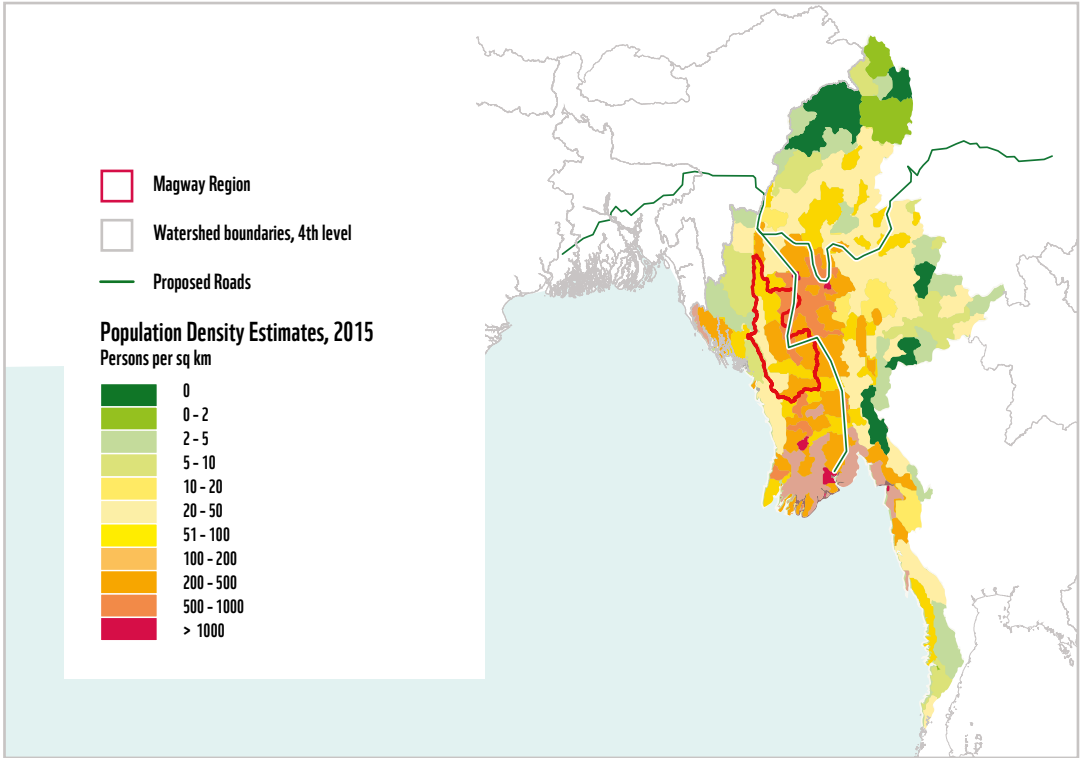
4.1 UP TO 24 MILLION PEOPLE LIVE IN WATERSHEDS INTERSECTED BY BRI ROAD INFRASTRUCTURE

Many people in Myanmar rely on surface water for drinking water. Figure 4 illustrates how some of the most densely populated areas in Myanmar are intersected by the East–West and North–South road corridors. The grey lines delineate the boundaries of modelled areas in which upland ecosystems and services affect downstream locations — for example by reducing sediment run-off or flooding.

Approximately 24 million people live in these areas and could be impacted by increased sedimentation due to upstream infrastructure development, deforestation, and other land use change.

This could affect the quantity and quality of drinking water, and flood risks. For example, in the Magway Region, which is intersected by the North–South road corridor and located downstream of the East–West road corridor, ~10% of the population of 4.2 million rely entirely on surface drinking water, making them more vulnerable to increased sedimentation.³⁴

FIGURE 4: POPULATION DENSITY OF WATERSHEDS INTERSECTED BY BRI ROAD CORRIDORS.



³⁴ World Health Organisation. 2015.

4.2 EROSION AND WATER QUALITY RISKS ALONG THE BRI CORRIDORS

Increased erosion and sediment in streams have direct impacts on infrastructure and can cause degradation of roads and bridge scouring, where sediment around a bridge structure is removed through erosion, which can cause bridge failure or collapse. Increased erosion also affects soils that underpin agricultural productivity and are often neglected in decision-making despite their critical importance for agriculture and food supply and security. Figures 5 and 6 illustrate where the upland landscapes and ecosystems regulate erosion and water quality by capturing sediment run-off from surrounding areas can impact BRI road corridors. Darker brown areas show where land cover (e.g. forests) has a larger role in retaining sediment. The assessment does not include the impact of roads on sedimentation but rather how vegetation upland of a road may impact sedimentation, if all land cover would be lost and converted into agriculture.

The North-South and East-West road corridors intersect with natural capital providing high levels of sediment retention in two key areas: north-west Myanmar and the Shan Plateau in central eastern Myanmar.

Figures 5 and 6 highlight the need for careful planning of road projects in these key areas—to (1) minimize impacts of erosion and sediment run-off on road infrastructure, and (2) ensure that landscapes and ecosystems retain their ability to provide erosion and water quality regulation across the downstream areas.

FIGURE 5: SEDIMENT RETENTION DUE TO PRESENCE OF NATURAL HABITAT ACROSS NORTH-SOUTH BRI ROAD CORRIDOR.

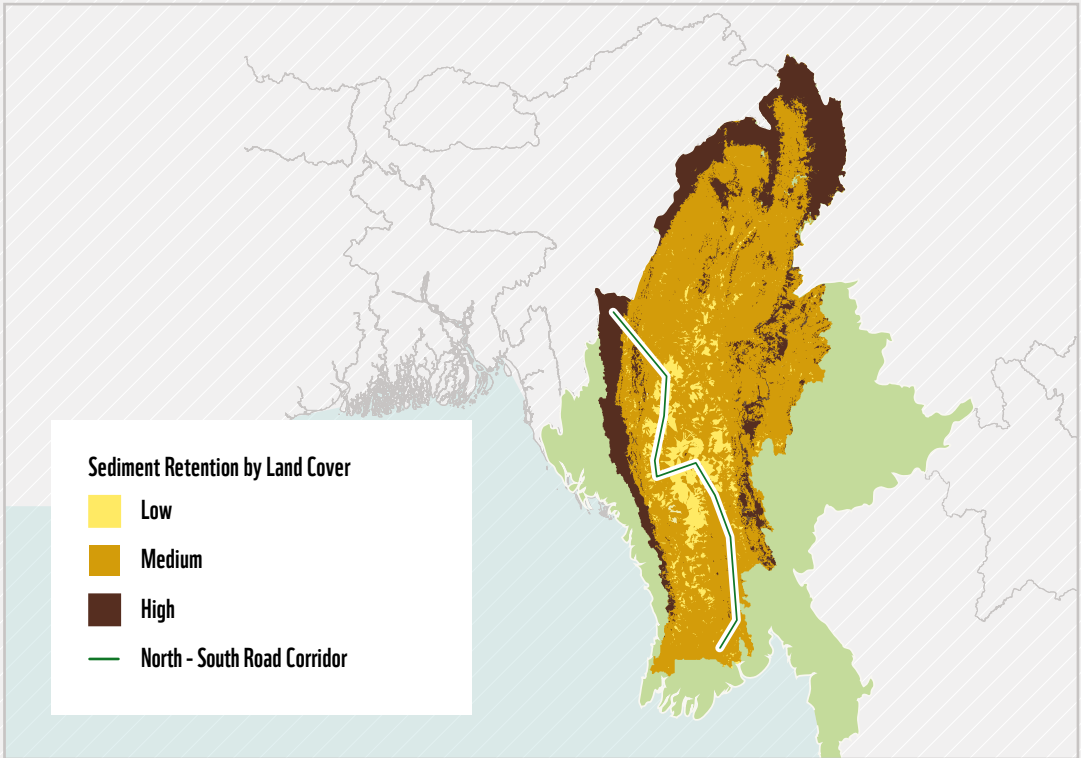
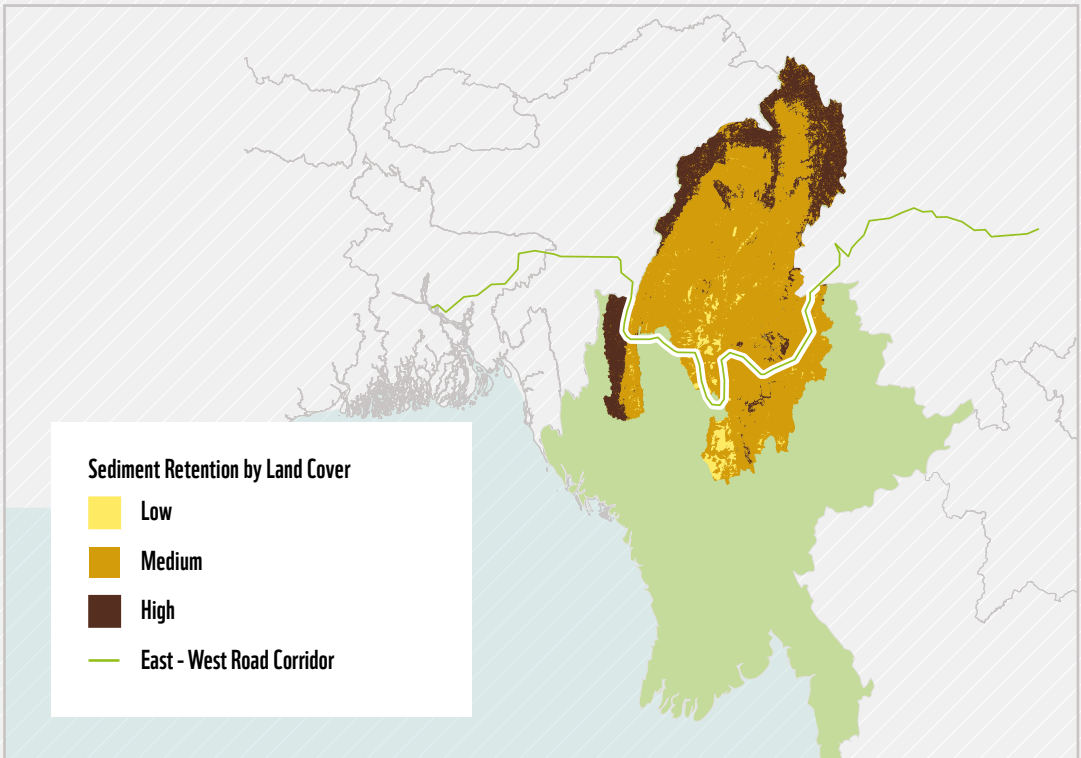


FIGURE 6: SEDIMENT RETENTION BY NATURAL CAPITAL ACROSS EAST-WEST BRI ROAD CORRIDOR



4.3 FLOOD RISKS ALONG THE BRI ROAD CORRIDORS

Monsoon flooding causes severe impacts in Myanmar—including loss of lives and livelihoods, environmental pollution, and damage to infrastructure including roads, buildings, and equipment for industry and agriculture. In 2015, Myanmar was ranked first globally for average annual capital losses (including road damage) caused by flooding.³⁵ Figures 7 and 8 illustrate where the upland landscapes and ecosystems reduce flood risk by slowing or reducing water flows from surrounding land and can impact BRI roads. Darker blue areas show where land cover (e.g. forests) provide higher levels of flood risk reduction. Figures 7 and 8 highlight areas of the BRI road corridors that are likely to be most at risk of floods, particularly in Chin state and Bago region (northern and southern ends of the North-South road). It also indicates potentially significant flood risks across much of the East-West Road, which cuts across Chin state and Shan state. There is a need for careful planning of road projects across these areas—to ensure that vital flood risk regulation services are maintained across the highlighted downstream areas.

If forests in these areas are lost, either to road construction or land use change, flood risks both to people and infrastructure investments could increase significantly.

Areas of high importance for flood risk reduction should be avoided as much as possible for road construction and in areas where the alignment cannot be changed, land use planning to avoid deforestation will be critical to protect people and the infrastructure investment from floods.

³⁵ UNISDR. 2015., ADPC/UNICEF. 2015.

FIGURE 7: FLOOD RISK REDUCTION BY NATURAL CAPITAL ACROSS NORTH-SOUTH BRI ROAD CORRIDOR.

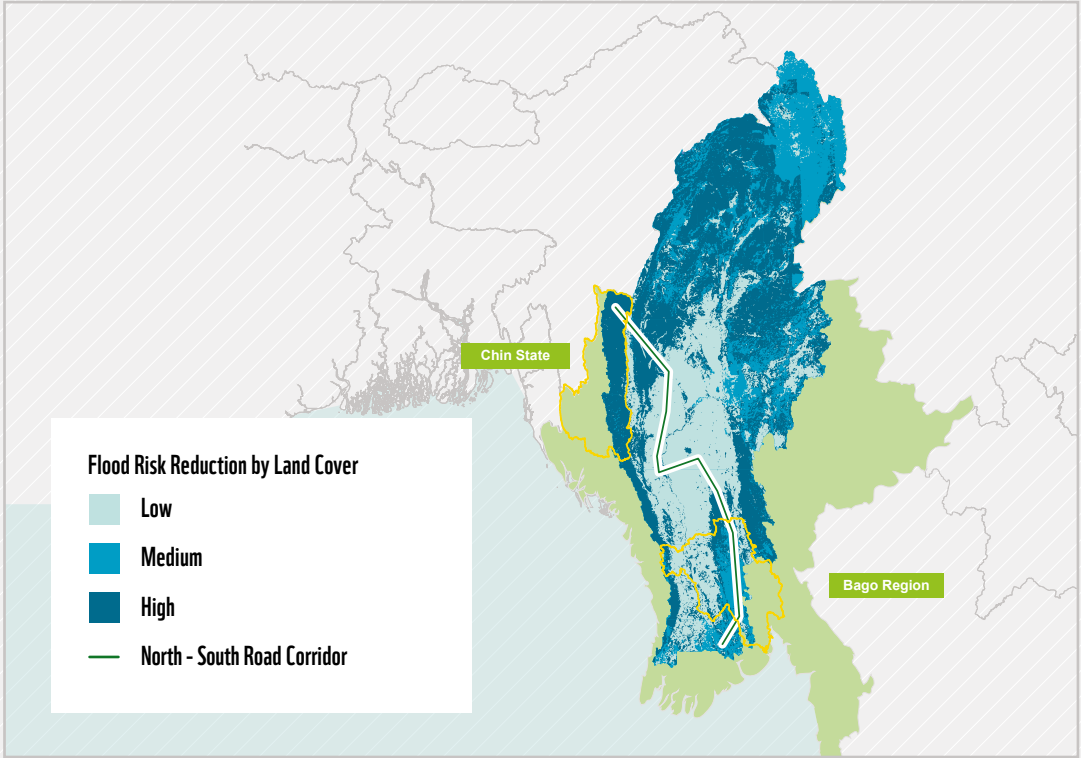
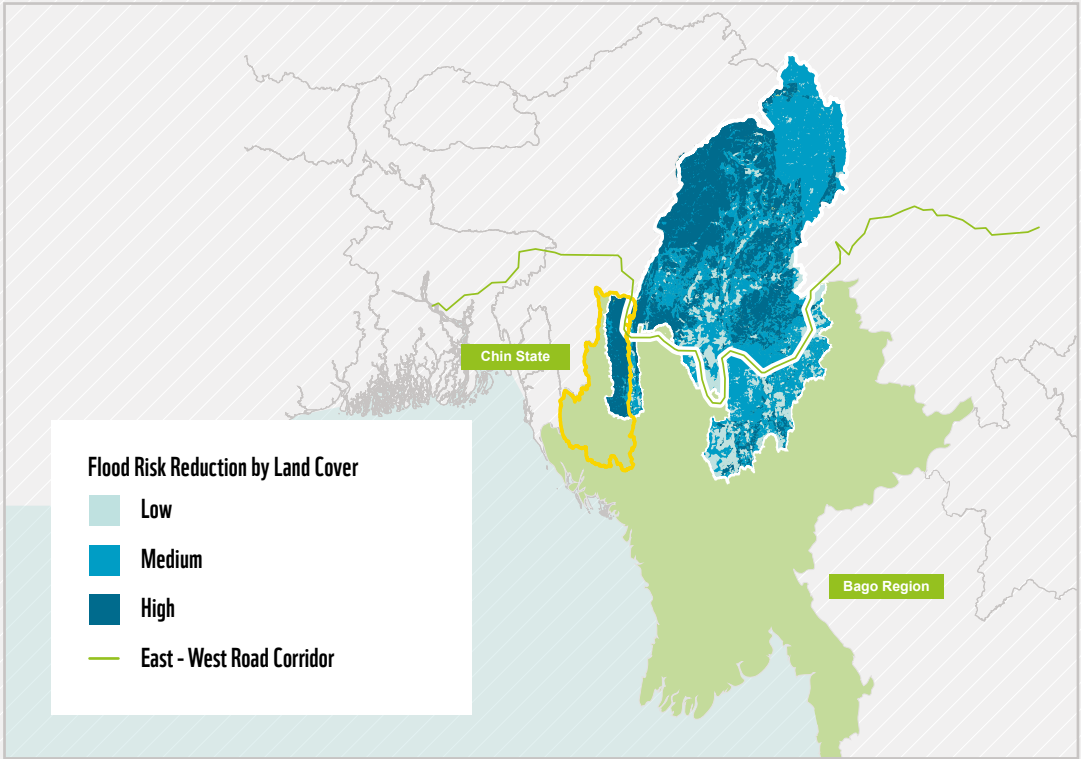


FIGURE 8: FLOOD RISK REDUCTION BY NATURAL CAPITAL ACROSS EAST-WEST BRI ROAD CORRIDOR.



4.4 BIODIVERSITY RISKS ALONG THE BRI ROAD CORRIDORS

Myanmar has a wealth of biodiversity, valuable in its own right, and as a foundation for the country's long-term prosperity. Biodiversity is a crucial contributor to ecosystem functionality, and consequently to the delivery of ecosystem services. In addition, Myanmar's ecosystems and wildlife can form the basis of a thriving ecotourism sector that should be accounted for when evaluating the costs and benefits of the BRI corridors. Infrastructure development can impact biodiversity in several direct and indirect ways, but loss of habitat due to deforestation and land use change, and increased access to important biodiversity areas facilitated by the new infrastructure present the greatest risks.

Figure 9 indicates that there are not extensive spatial overlaps between the proposed BRI road corridors, and important sites of biodiversity determined by four different designation methods: Key Biodiversity Areas,³⁶ Relative Mammal Richness,³⁷ Protected Areas designated by the Government of Myanmar, and Intact Forest Landscapes.³⁸ However, in Shan state (eastern part of the East-West road corridor), the road will cut through areas of high Relative Mammal Richness. This suggests a need for planning and design of roads to maintain wildlife corridors, and minimize risks of wildlife-vehicle collisions. In addition, the BRI road corridors also intersect with several Key Biodiversity Areas and Protected Areas that are important sites for nature-based tourism in Myanmar. Re-alignment of roads around these areas would minimize the impacts of the BRI on Myanmar's biodiversity and associated eco-tourism potential. However, more biodiversity assessments are needed to better understand potential risks and impacts related to biodiversity.

Finally, even if the BRI road corridors themselves do not directly intersect with many biodiversity priority sites, the opening up of new roads often trigger land use change in an expanding frontier around new infrastructure and as such requires careful and proactive land use planning to avoid impacts on areas important for biodiversity.

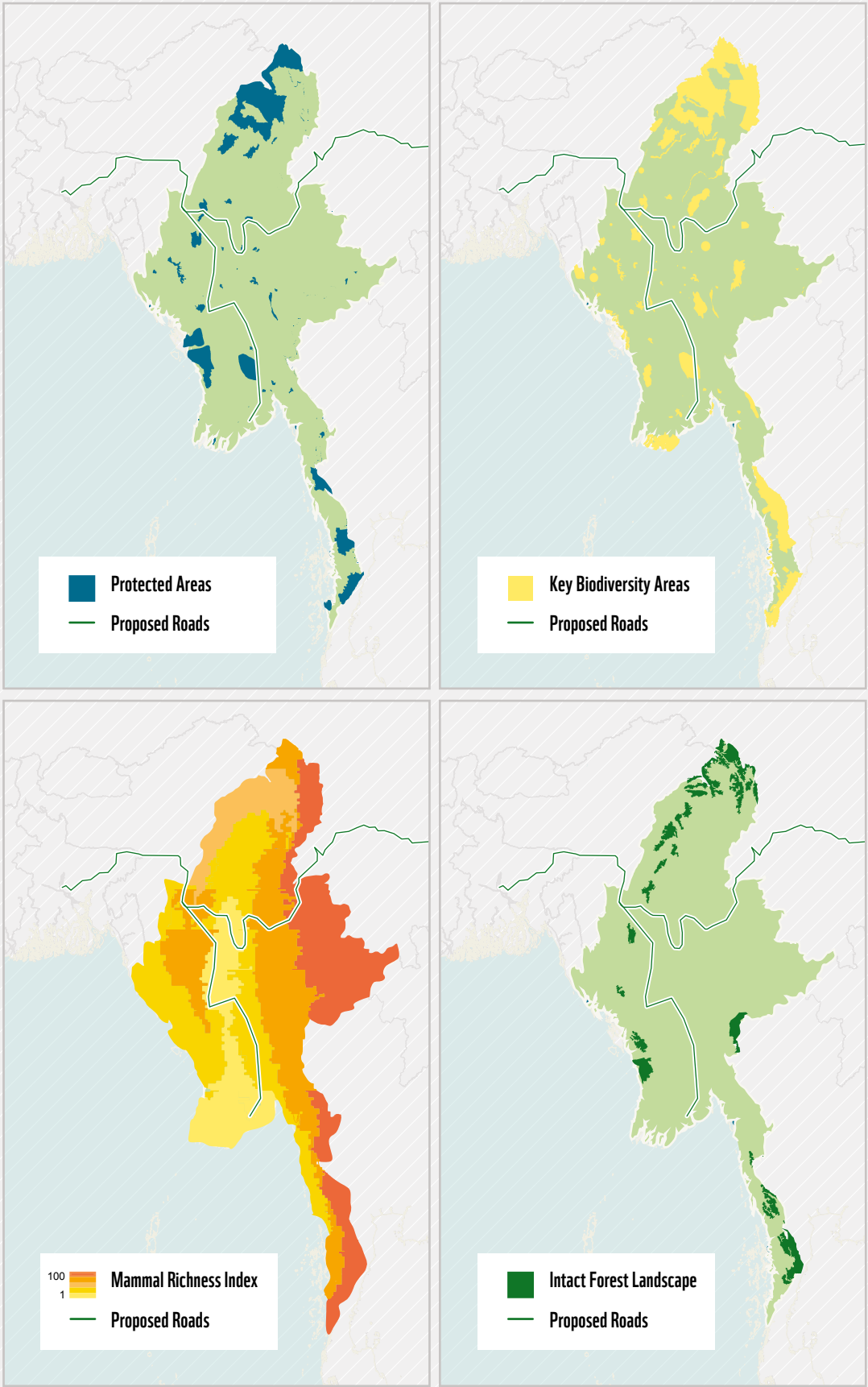
/// Avoiding areas important for biodiversity is the best way to reduce risks but if avoidance is not possible, measures must be taken to fully mitigate impacts.

36 IUCN. 2016.

37 Rovero F. Martin E., Rosa M., Ahumada J. A., and Spitale D. 2014.

38 Intact forests. 2017.

FIGURE 9: BIODIVERSITY ACROSS BRI ROAD CORRIDORS



05. ENSURING A SUSTAINABLE BELT & ROAD INITIATIVE IN MYANMAR

The findings in this report illustrate the extent to which BRI road infrastructure could impact on natural capital and the important benefits it provide to people and infrastructure itself. In some areas, these impacts on natural capital could be significant, if plans do not incorporate the risks and appropriate mitigation measures. The long-term costs and resilience of BRI road infrastructure in Myanmar also depend on ecosystems services, in particular the flood risk reduction services provided by forests. Although only a few aspects of natural capital are included in this analysis, the report highlights ways in which the BRI road corridors would impact and depend on natural capital. More comprehensive assessments would almost certainly reveal significant additional trade-offs, making it essential to conduct such assessments so that BRI investments can bring about the hoped-for benefits without incurring major economic, environmental, and social costs.³⁹

The negative impacts of BRI road projects on natural capital and Myanmar's development are likely, but need not be inevitable.

Options are available to maintain benefits flowing from both BRI infrastructure, and natural capital in the corridor areas.

These options will be highly specific to the social, geophysical, and environmental context of an area, and must be identified through careful assessments of relevant costs, benefits, synergies, and trade-offs between natural capital and infrastructure.

USING STANDARDS & TOOLS TO ENSURE A GREEN BELT & ROAD INITIATIVE IN MYANMAR

Voluntary frameworks such as the SuRe® (The Standard for Sustainable and Resilient Infrastructure) and Natural Capital Protocol can now be used by investors and project developers to support cost-effective assessments of natural capital risks and opportunities associated with BRI road infrastructure. SuRe® sets out criteria covering social, governance and environmental factors to establish an understanding of sustainable and resilient infrastructure projects and provide guidance on how to manage those aspects from both a risk management and a benefit creation perspective.⁴⁰ The Natural Capital Protocol (and related Finance Sector Supplement) provides a flexible framework for integrating natural capital risks and opportunities into private sector decision-making.⁴¹ Project developers can also take advantage of a growing range of natural capital analysis tools, for example Roads Filter, ESRforIA, InVEST, OPAL, Co\$ting Nature, and Waterworld (see Natural Capital Protocol Toolkit).⁴²

In practice, the value of natural capital and the benefits it provides need to be recognized in decision-making in order to make careful site-specific choices about the: (1) location of roads, taking into account other categories of land use and conservation priorities and (2) the design and type of road infrastructure.

³⁹ See Dailey, M., 2017 for preliminary social and economic benefit analysis including proximity to population centres, mines and highly productive agriculture, and connectivity between towns.

⁴⁰ Global Infrastructure Basel. 2017.

⁴¹ Natural Capital Coalition. 2017.

⁴² Ibid.

5.1 LOCATION OF ROAD INFRASTRUCTURE

Evidence from other countries suggests that careful planning of the location of roads minimizes adverse impacts on natural capital assets. For example, alternative alignments were evaluated for a proposed superhighway that would cut through critical forested areas in southeast Nigeria. The conclusion was that alternative alignments would reduce environmental impacts, cost less to construct, and better serve local communities and agricultural areas.⁴³ Similar analyses have been conducted for the Mekong region⁴⁴ and globally.⁴⁵ However, trade-offs between increased distance, emissions and raw material requirements also need to be evaluated to identify optimal road alignments (and these considerations were not included in this report). In practice, re-alignment decisions can vary depending on specific factors considered, including economic cost of construction, socio-economic benefits and environmental aspects. Figure 10 illustrates how less direct road alignment can, in general, maintain the integrity of ecosystem assets and services, compared to more direct alignments that fragment and damage these assets and thereby reduce associated ecosystem services but also could also increase related emissions. This highlights the importance of better understanding trade-offs for road alignment.

FIGURE 10: ILLUSTRATIVE RE-ALIGNMENT OF ROAD INFRASTRUCTURE TO PROTECT NATURAL CAPITAL ASSETS AND SERVICES.



Ecosystem asset and services degraded through habitat conversion and fragmentation

Ecosystem asset and services maintained through re-alignment

⁴³ Mahmoud M. I., Sloan S., Campbell M. J., Alamgir M., Imong I., Odigha O., Chapman H. M., Dunn A. and Laurance W. F. 2017.

⁴⁴ Balmford A., Chen H., Phalan B., Wang M., O'Connell C., Tayleur C. and Xu J. 2016.

⁴⁵ Laurance W. F., Clements G. R., Sloan S., O'Connell C. S., Mueller N.D., Goosem M., Venter O., Edwards D. P., Phalan B., Balmford A., Van Der Ree R. and Burgues Arreaet I. 2014.

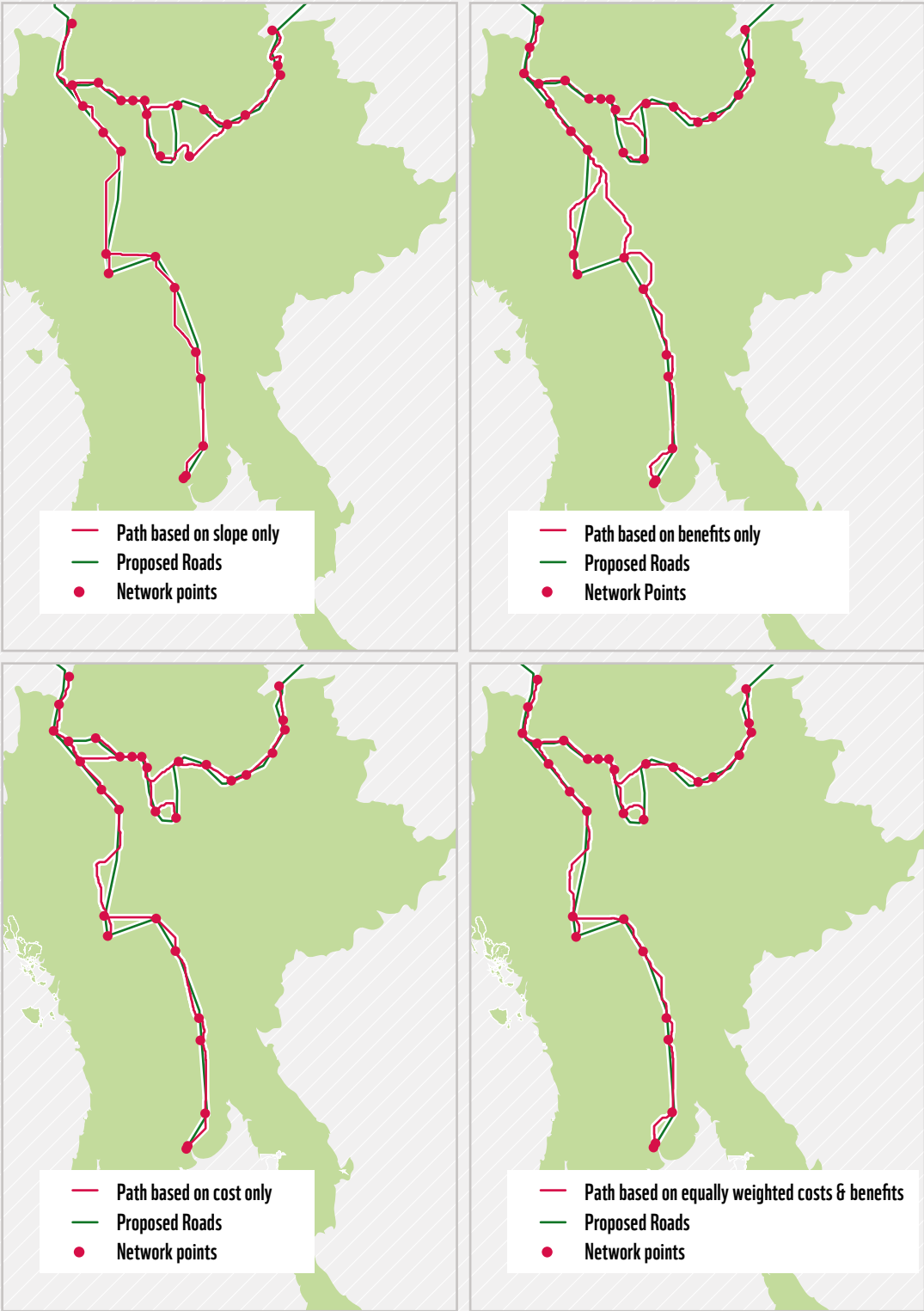
ASSESSING RE-ALIGNMENT OPTIONS TO MAXIMIZE BENEFITS

Figure 11 compares four different re-alignments of the North–South and East–West road corridors in Myanmar, which are based on different indexes and weightings of costs and benefits.⁴⁶ The first re-alignment attempts to minimize road costs per kilometre considering only the slope of surrounding terrain, as costs of road construction are significantly affected by slope. The second optimizes the alignment of the road taking into account potential socio-economic benefits, as measured by proximity of road corridors to mines, highly productive agricultural areas, and population centres. The third re-alignment attempts to avoid overlaps with important biodiversity areas, and natural capital benefits assessed in Section 5 (flood risk reduction, regulation of erosion and water quality). The fourth re-alignment combines all costs and benefits described previously and weights them equally. It is important to note that this is a coarse analysis, designed to demonstrate how considering costs and benefits together can help inform infrastructure planning. The results presented in Figure 11 are illustrative only, and are not suitable for road alignment decision-making in specific locations, which would require both a finer scale of analysis, and weighting of a greater number of costs and benefits. The results do however demonstrate clearly that the optimal alignment of a road can vary considerably, depending on which factors are considered in planning decisions.

⁴⁶ Dailey, M., 2017.

FIGURE 11: ILLUSTRATIVE RE-ALIGNMENT OF NORTH-SOUTH & EAST-WEST ROAD CORRIDORS

Based on slope of terrain as a proxy of construction cost; socio-economic benefits represented by proximity of road corridors to mines, highly productive agricultural areas, and population centres; cost connectivity for avoiding areas important for biodiversity and ecosystem services; and combined and equally weighted socio-economic benefits and biodiversity and ecosystem services impact costs.



5.2 DESIGN OF ROAD INFRASTRUCTURE

Many approaches and options are available for designing road infrastructure that minimizes impacts on natural capital. The options and approaches are becoming increasingly standardized.

Commonly used options include:

- **BUFFER ZONES**—areas of natural vegetation around a road, designed to minimize water and sediment run-off, and landslide risks, where a road is passing through high-slope areas
- **RE-VEGETATION OF SLOPES**—designed to restore sediment and water flow regulation services on slopes where these services have been degraded during or following road construction
- **WILDLIFE AND HABITAT CORRIDORS**—designed to minimize fragmentation of ecosystems by enabling wildlife to cross roads safely, and habitats to extend across road-crossed areas.

Figure 12 illustrates a real-world analysis of road design choices in the Peruvian Amazon, coupled with an analysis of impacts of those design choices in the form of loss of ecosystem services. In this case, targeted mitigation measures (buffer zones, vegetated road shoulders, slope stabilisation, etc.) applied to the Pucallpa-Cruzeiro do Sul road to Brazil enabled full retention of analysed ecosystem services across much of the road route.⁴⁷

It is important to note that the upfront cost of sustainable road infrastructure is sometimes higher, but represents an investment in greater relative returns from natural capital assets, as well as non-monetary social and environmental gains. Where it is not possible to avoid or mitigate damage to natural capital, offsetting should be considered.

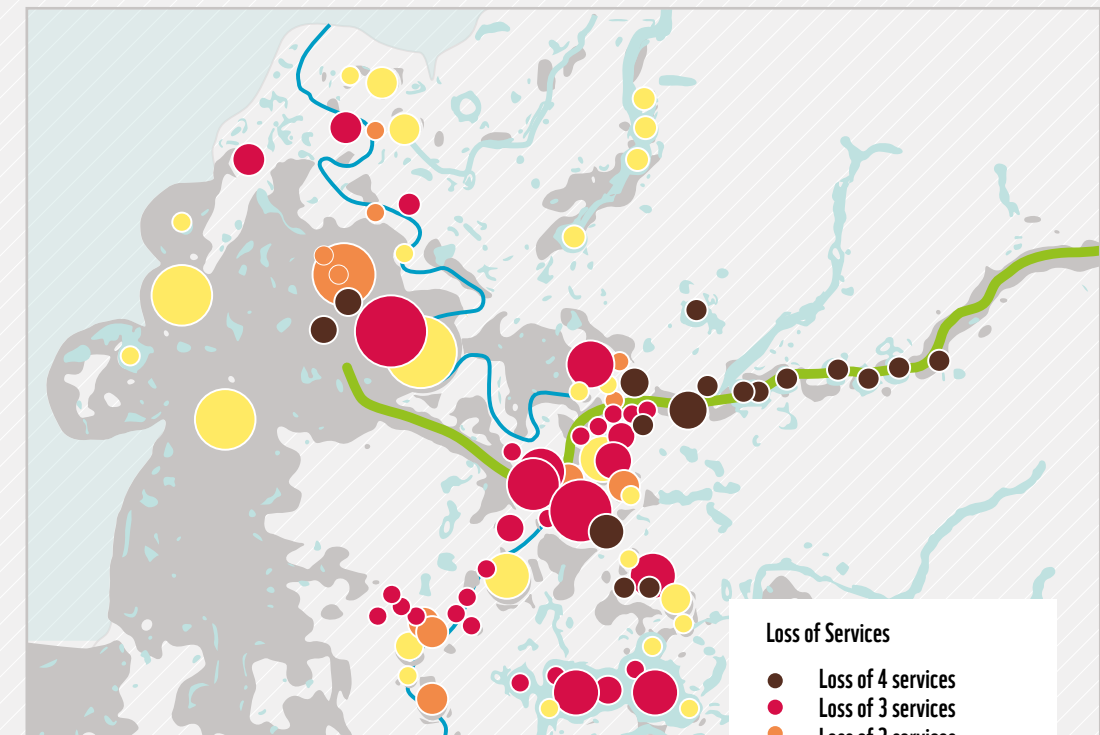
An offsetting regime requires any unavoidable environmental damage to be offset through compensation payments that are invested in the environment elsewhere.

It can also be a way to promote a net positive environmental outcome, as illustrated in Figure 14. Offsetting approaches are generally recommended only as a last resort, and can be difficult to implement in practice given the considerable challenges associated with restoration of complex ecosystems.

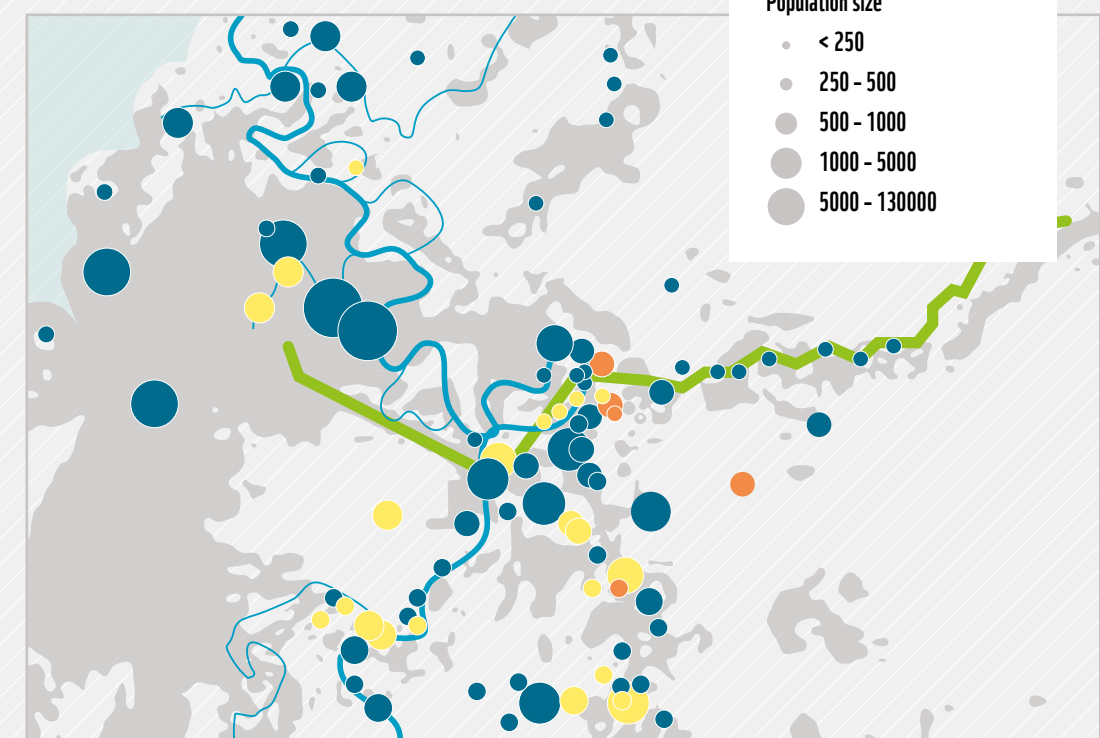
⁴⁷ Mandle L., Tallis H., Vogl A., Wolny S., Touval J., Sotomayor L., Vargas S. and Rosenthal A. 2013.

FIGURE 12: ANALYSIS OF ROAD DESIGN CHOICES IN PERU WITH HIGH (ABOVE) AND LOW (BELOW) IMPACTS ON NATURAL CAPITAL⁴⁸

Road and Associated deforestation - Impacts without mitigation



Road and Associated deforestation - Impacts with targeted mitigation
Anthropogenic areas (pastures, urban roads, mines) are shown in grey. Waterways are blue

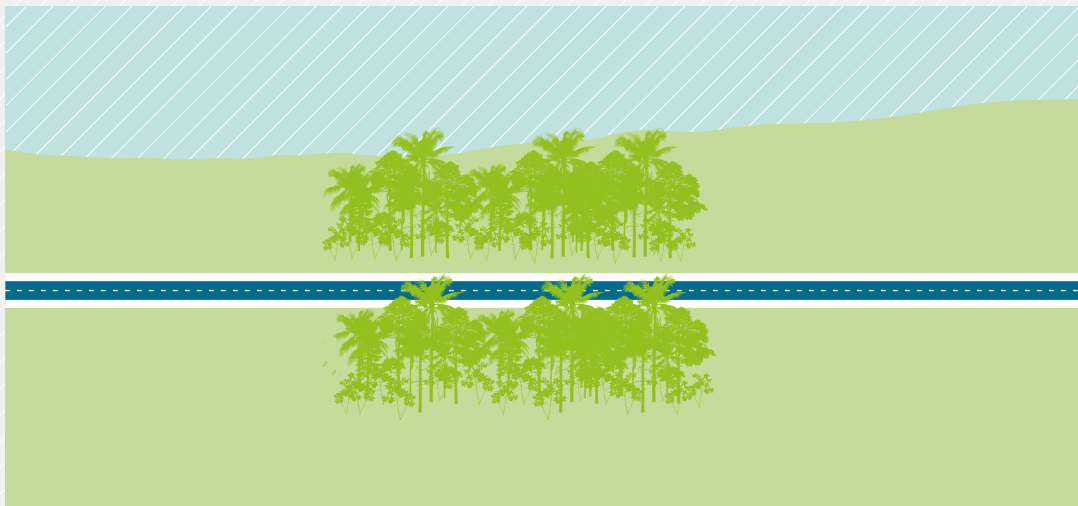


⁴⁸ Adapted from Mandle L., Tallis H., Vogl A., Wolny S., Touval J., Sotomayor L., Vargas S. and Rosenthal A. 2013.

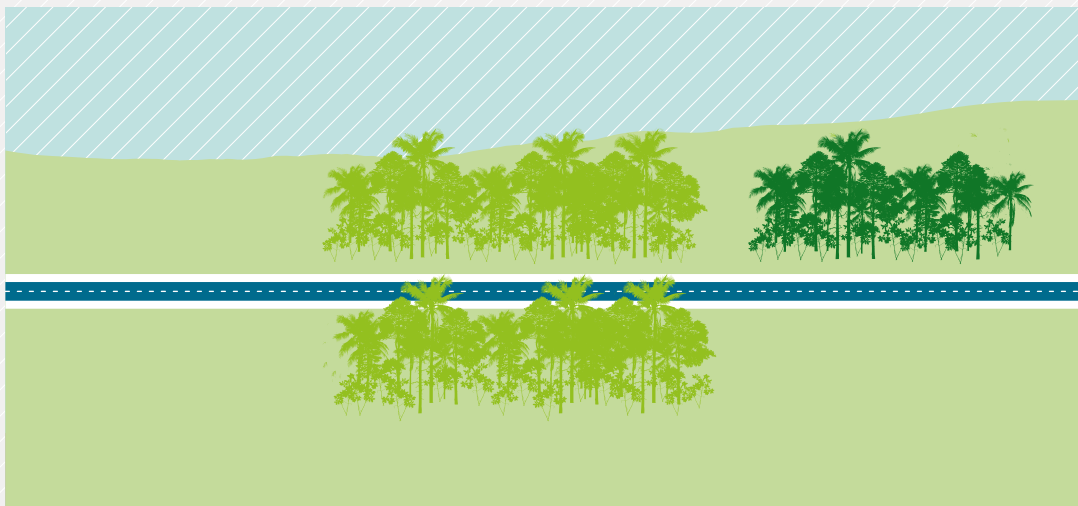
FIGURE 13: ILLUSTRATIVE APPLICATION OF IMPACT OFFSETTING FOR NATURAL CAPITAL IMPACTS OF ROAD CONSTRUCTION



Original natural capital asset (forest ecosystem)



Road construction without natural capital offsetting



Natural capital losses offset with ecologically equivalent gains

06. CONCLUSIONS & RECOMMENDATIONS FOR KEY STAKEHOLDERS

Roads in the BRI’s East–West and North–South corridors could make significant contributions to Myanmar’s social, economic, and infrastructure development. This report highlighted the extent to which BRI road infrastructure can impact on natural capital including the important benefits it provides to millions of people and infrastructure itself. It also showed how the resilience of BRI road corridors depends on ecosystem services—in particular the water and sediment flow regulation services provided by forests, which reduce risks of landslides, erosion and flooding. The analysis in this report highlighted some areas and specific locations, where potential unexpected costs could arise from the environmental impact of the proposed BRI infrastructure development. This points to the need for further more in-depth analysis and consideration of mitigation measures in these areas.

The following initial recommendations to decision-makers in the Government of Myanmar, and to investors and companies in BRI road project should be considered:

RECOMMENDATIONS

FOR THE GOVERNMENT OF MYANMAR

NATIONAL SUSTAINABLE INFRASTRUCTURE PLAN. Undertake infrastructure planning at the national scale to identify 'no-go areas' and evaluate alternative BRI corridors. Avoid critical areas, including areas important for biodiversity and ecosystem services.

SUSTAINABLE INFRASTRUCTURE DEVELOPMENT GUIDELINES. Consider developing guidelines or criteria or apply global sustainability standards, such as The SuRe® – The Standard for Sustainable and Resilient Infrastructure, to guide sustainable infrastructure planning, finance and design. Such an approach would provide benefits to the environment, economy, and society, and to the road infrastructure itself.

COST BENEFIT ASSESSMENTS. Develop more detailed versions of the cost benefit assessments in potential risk areas highlighted in this report and gradually incorporate into Government approval and planning processes for road development. Impacts on natural capital and ecosystem services should be incorporated into the earliest possible stages of planning. Support for these efforts should be sought from development partners and BRI project proponents and investors.

STRATEGIC ENVIRONMENTAL ASSESSMENT. Undertake a Strategic Environmental Assessment for the entire BRI to better assess economic, social and environmental risks and required policies and plans to avoid and minimize these risks.

ENVIRONMENTAL DATA COLLECTION. Expand collection of environmental data and information for highlighted risk areas in this report (especially related to biodiversity and ecosystem services) within existing institutional structures established to implement the National Strategy for Development of Statistics. Such activities will support decision-makers to make more comprehensive assessments of the costs and benefits of BRI road infrastructure.

POLICY DEVELOPMENT. Identify policy measures (beyond simply subsidies) that could open up greater commercial space for sustainable road construction to a high standard. Communicate these with investors and develop a dialogue on collaborative action / public/private partnerships to deliver the BRI.

CIVIL SOCIETY AND COMMUNITY PARTICIPATION. Include and facilitate participation of communities and civil society at all stages of planning, design and implementation of BRI. Collaborate with communities and civil society organisations located along East-West and North-South road corridors to conduct local needs assessments to inform decision making about alignment and design of road construction in both corridors. Such assessments are important because they can help to identify non-quantifiable cultural and social preferences regarding natural capital and road infrastructure.

INTERGOVERNMENTAL POLICY DIALOGUE. Engage in intergovernmental dialogue with environmental regulators in China to ensure that China's ambitious sustainability objectives for the BRI are complied with by Chinese companies and investors.

FOR INVESTORS AND COMPANIES

BEST STANDARDS. Adopt and comply with standards in accordance with the *"Guidance on the Building of the Green Belt and Road"* (Ministry of Environmental Protection of China) and consider using The SuRe® – The Standard for Sustainable and Resilient Infrastructure and other relevant sustainability standards and safeguards.

NATURAL CAPITAL ASSESSMENT. Undertake a more comprehensive assessment of natural capital (beyond the 3 services and 4 conservation datasets included in this report but based on identified risk areas) to enable robust decision-making to ensure that natural capital impacts and risks are properly considered. Accounting for natural capital impacts can increase the resilience of BRI road infrastructure in Myanmar and mitigate the significant associated risks to credit, reputation, regulatory compliance, and timely project delivery.

BIODIVERSITY EXPERTS. Include biodiversity experts in the project planning and design, which can help reduce risks and impacts from BRI on biodiversity in Myanmar.

AVOIDANCE OF IMPACTS. Avoid critical areas, including areas important for biodiversity and providing ecosystem services, when deciding location for road corridors.

TOOLS. Identify and use tools that can support cost-effective integration of natural capital into decision-making about BRI road projects and related infrastructure. A range of tools and approaches (e.g. The Natural Capital Protocol, Roads Filter, ESRforIA - see the Natural Capital Protocol Toolkit for more examples) can be used by investors and project developers to better assess risks and improve decision-making.

ECONOMIC VALUATION OF NATURAL CAPITAL. Quantify, where appropriate and feasible, the economic value of natural capital and integrate into BRI corridor planning and design.

COST ASSESSMENT OF FLOODS AND LANDSLIDES. Assess costs of road delay as a result of floods or landslides. If roads are toll roads, this could be one cost to include as a result of road closures.

SUSTAINABLE DESIGN. Include design options that can enhance environmental, social and economic benefits, including buffer zones, re-vegetation of slopes and biodiversity and habitat corridors.

ENVIRONMENTAL IMPACT ASSESSMENT. Undertake high-quality Environmental Impact Assessments and Environmental Management Plans of BRI road projects with special consideration of impacts (including cumulative) on natural capital, including biodiversity and ecosystem services. Assessment of impacts on flood risk reduction by natural capital could build on existing work by WWF and others.

CIVIL SOCIETY PARTICIPATION. Work with Myanmar civil society at all levels and all stages of project planning to avoid negative social and environmental impacts optimize benefit sharing of the BRI in Myanmar.

REFERENCES

Adler S. June, 2017. *Chinese Roads in India: The Effect of Transport Infrastructure on Economic Development*. University of North Carolina at Chapel Hill, US. Available at: <https://sites.google.com/site/simonalderch/>

ADPC/UNICEF. 2015. *Risk Assessment Roadmap for Myanmar*, ACDP/UNICEF, Myanmar. Available at: http://www.adpc.net/igo/category/ID937/doc/2015-x1SFw3-ADPC-Myanmar_Risk_Assessment_Roadmap.pdf

Balmford A., Chen H., Phalan B., Wang M., O'Connell C., Tayleur C. and Xu J. 2016. *Getting Road Expansion on the Right Track: A Framework for Smart Infrastructure Planning in the Mekong*. PLOS Biology. Available at: <https://doi.org/10.1371/journal.pbio.2000266>

Belt and Road Portal. 2017. *Guidance on Promoting Green Belt and Road*. Leading Group on the Construction of the Belt and Road, State Information Center, People's Republic of China. Available at: <https://eng.yidaiyilu.gov.cn/zchj/qwfb/12479.htm>

Central Committee of the People's Republic of China. *The 13th Five Year Plan for Economic and Social Development of the People's Republic of China 2016-2020*. Available at: <http://en.ndrc.gov.cn/newsrelease/201612/P020161207645765233498.pdf>

Dailey, M., 2017. *Using a Cost Connectivity model to demonstrate impacts of considering environmental costs and benefits to society and economic sectors on transportation routing*. Unpublished technical report.

Daily G. et al., 2013. *Securing natural capital and human well-being: Innovation and impact in China*. Shengtai Xuebao Acta EcolSin 33(3):677–685.

Emerton L. and Yan Min Aung. 2013. *The Economic Value of Forest Ecosystem Services in Myanmar and Options for Sustainable Financing*, WCS, Myanmar. Available at: http://www.burmalibrary.org/docs22/IMG_2013_Myanmar_forest_valuation_-_full_report.pdf

Fahrig L. 2003. *Effects of Habitat Fragmentation on Biodiversity*. *Annual Review of Ecology, Evolution, and Systematics*. Vol. 34, pp 487-515. Available at: <https://doi.org/10.1146/annurev.ecolsys.34.011802.132419>

Fardoust S. Kim Y. Sepúlveda C. 2011. *Infrastructure and Sustainable Development in Post-crisis Growth and Development: A Development Agenda for the G-20*. World Bank, Washington DC, USA. Available at: <https://openknowledge.worldbank.org/handle/10986/2533>.

Glista D., DeVault T. L. and DeWoody J. A. 2009. *A review of mitigation measures for reducing wildlife mortality on roadways*. *Landscape and Urban Planning*, Volume 91, Issue 1, pp 1-7. Available at: <https://doi.org/10.1016/j.landurbplan.2008.11.001>.

Global Infrastructure Basel. 2017. SuRe® – The Standard for Sustainable and Resilient Infrastructure. Global Infrastructure Basel, Switzerland. Available at: <http://www.gib-foundation.org/sure-standard/>

HKTDC. 2017. *The Belt and Road Initiative*. HKTDC, Hong Kong. Available at: <http://china-trade-research.hktdc.com/business-news/article/The-Belt-and-Road-Initiative/The-Belt-and-Road-Initiative/obor/en/1/1X000000/1X0A36B7.htm>

Huang Y. 2016. *Understanding China's Belt and Road Initiative: Motivation, framework and assessment*, *China Economic Review*. Volume 40, pp 314-321. Available at: 10.1016/j.chieco.2016.07.007

IDI. 2016. *Making Inroads: Chinese Infrastructure Investment in ASEAN and Beyond*, IDI, U.S. Available at: <http://www.inclusivedevelopment.net/wp-content/uploads/2016/08/Making-Inroads-China-Infrastructure-Finance.pdf>

Intact Forests, 2017. *Intact Forest Landscapes*. The IFL Mapping Team. Available at: <http://www.intactforests.org/concept.html>

International Union for Conservation of Nature (IUCN). 2016. *A Global standard for the identification of Key Biodiversity Areas*. Version 1.0. First edition. IUCN, Gland, Switzerland. Available at: https://portals.iucn.org/union/sites/union/files/doc/a_global_standard_for_the_identification_of_key_biodiversity_areas_final_web.pdf

John E. 2014. *Racing to a new prosperity*. China Daily USA. Available at: http://usa.chinadaily.com.cn/epaper/2014-06/04/content_17562090.htm

Kreft S., Eckstein D. and Melchior I. 2016. *Global Climate Risk Index 2017: Who suffers most from extreme weather events? Weather-related loss events in 2015 and 1996 to 2015*. Germanwatch, Bonn, Germany.

Laurance W. F., Clements G. R., Sloan S., O'Connell C. S., Mueller N.D., Goosem M., Venter O., Edwards D. P., Phalan B., Balmford A., Van Der Ree R. and Burgues Arreaet I. 2014. *A global strategy for road building*. *Nature*. 513, pp. 229–232. Available at: <http://www.nature.com/doi/10.1038/nature13717>

Mahmoud M. I., Sloan S. Campbell M. J., Alamgir M., Imong I., Odigha O., Chapman H. M., Dunn A. and Laurance W. F. 2017. *Alternative Routes for a Proposed Nigerian Superhighway to Limit Damage to Rare Ecosystems and Wildlife*. *Tropical Conservation Science*. Volume 10, pp. 1-10.

Mandle L., Griffin R. and Goldstein J. 2016. *Natural Capital and Roads: Managing dependencies and impacts on ecosystem services for sustainable road investments*. IADB, Washington D.C., U.S. Available at: <https://publications.iadb.org/bitstream/handle/11319/7871/Natural-Capital-and-Roads-Managing-Dependencies-and-Impacts-on-Ecosystem-Services-for-Sustainable-Road-Investments.pdf?sequence=4&isAllowed=y>.

Mandle L., Tallis H., Vogl A., Wolny S., Touval J., Sotomayor L., Vargas S. and Rosenthal A. 2013. *Can the Pucallpa-Cruzeiro Do Sul Road be developed with no net loss of natural capital in Peru? A framework for including natural capital in mitigation*. The Natural

Capital Project, U.S. Available at: http://130.211.163.122/pubs/Pucallpa_Final_Report_2013.pdf

Myanma Port Authority. 2017. *Facts and Figures. Myanmar Port Authority*. Government of Myanmar. Available at: <http://www.mpa.gov.mm/facts-figures/rakhine-stat>

National Development and Reform Commission. 2015. *Vision and actions on jointly building Silk Road Economic Belt and 21st-Century Maritime Silk Road*. Issued by the National Development and Reform Commission, Ministry of Foreign Affairs, and Ministry of Commerce of the People's Republic of China, with State Council authorization.

National Development and Reform Commission. 2013. *Opinions on Accelerating the Construction of Ecological Civilization*. National Development and Reform Commission of People's Republic of China, Beijing.

Natural Capital Coalition. 2017. *The Natural Capital Protocol Toolkit*. WBCSD, Geneva, Switzerland. Available at: <https://www.naturalcapitaltoolkit.org/>

Natural Capital Coalition. 2016. *What is natural capital?* Natural Capital Coalition. Available at: <https://naturalcapitalcoalition.org/natural-capital/>

OBOReurope. 2017. *The new Silk Road corridors*. One Belt One Road Europe, Paris, France. Available at: <http://www.oboreurope.com/en/beltandroad/one-belt/>

Ouyang Z, et al. 2016. *Improvements in ecosystem services from investments in natural capital*. *Science*. 352: 6292.

Owen N. and Schofield C. 2012. *Disputed South China Sea Hydrocarbons in Perspective*, *Marine Policy* 36(3); 809-822.

Renaud F. et al., 2013. *The Role of Ecosystems in Disaster Risk Reduction*. UNU Press, New York.

Rovero F. Martin E., Rosa M., Ahumada J. A., and Spitale D. 2014. *Estimating Species Richness and Modelling Habitat Preferences of Tropical Forest Mammals from Camera Trap Data*. *PLOS ONE* 9(10) e110971.

State Council Information Office of the People's Republic of China. 2016. *President Xi calls for building green, healthy, intelligent and peaceful' Silk Road*. Available at: <http://www.scio.gov.cn/32618/Document/1481477/1481477.htm>

Sun. T. and Payette A. 2017. *China's Two Ocean Strategy: Controlling waterways and the new silk road*, Institut de Relations Internationales et Stratégiques. Available at: <http://www.iris-france.org/wp-content/uploads/2017/05/Asia-Focus-31.pdf>

United Nations Environment. 2016. *Ecological Civilization – A national strategy for innovative, concerted, green, open and inclusive development*. Available at: <http://www.unep.org/ourplanet/march-2016/articles/ecological-civilization>

UNISDR. 2015. *Making Development Sustainable: The Future of Disaster Risk Management. Global Assessment Report on Disaster Risk Reduction*. United Nations Office for Disaster Risk Reduction (UNISDR). Geneva, Switzerland. Available at: http://www.preventionweb.net/english/hyogo/gar/2015/en/gar-pdf/GAR2015_EN.pdf

United Nations Office of the High Representative for the Least Developed Countries, Landlocked Developing Countries and Small Island Developing States. 2016. *State of the Least Developed Countries*. UNOHRLLS, New York. Available at: <http://unohrlls.org/custom-content/uploads/2016/08/State-of-LDCs2016.pdf>.

Wang L. 2015. *Sea Lanes and Chinese National Energy Security*. *Journal of Coastal Research: Special Issue 73 - Recent Developments of Port and Ocean Engineering*: pp. 572 – 576.

World Bank. 2016. *Minimizing Ecological Damage from Road Improvements in Tropical Forests*. World Bank Policy Research Working Paper 7826, Washington D.C. Available at: <http://documents.worldbank.org/curated/en/923931474289798602/pdf/WPS7826.pdf>.

World Bank. 2015a. *Myanmar Floods and Landslides: Post Disaster Needs Assessment*. World Bank, Myanmar. Available at: <http://www.worldbank.org/en/country/myanmar/publication/myanmar-floods-and-landslides-post-disaster-needs-assessment>

World Bank. 2015b. *Transport Policies and Development*. World Bank Policy Research Working Paper 7366, Washington D.C. Available at: <http://documents.worldbank.org/curated/en/893851468188672137/pdf/WPS7366.pdf>.

World Bank. (2011) *Infrastructure and Sustainable Development in Post-crisis Growth and Development: A Development Agenda for the G-20*, World Bank, Washington D.C. Available at: <https://openknowledge.worldbank.org/handle/10986/2533>.

World Health Organisation (WHO). 2015. *UN-Water Global Analysis and Assessment of Sanitation and Drinking Water*. WHO/FWC?WSH/15.76. Available at: http://www.who.int/water_sanitation_health/monitoring/investments/glaas/en/

WWF. 2017. *The Belt and Road Initiative, WWF Recommendations and spatial analysis*. WWF International. Gland, Switzerland. Available at: http://awsassets.panda.org/downloads/the_belt_and_road_initiative__wwf_recommendations_and_spatial_analysis__may_2017.pdf

WWF. 2016. *Natural connections: How natural capital supports Myanmar's people and economy*. WWF-Myanmar. Yangon, Myanmar. Available at: www.myanmar-naturalcapital.org

