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natural capital PROJECT

Natural connections:

How natural capital supports Myanmar’s people and economy

ACKNOWLEDGEMENTS

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FOREWORD
FOREST DEPARTMENT

Nature helps protect us, and we must protect it in turn. Myanmar has a wealth of natural capital – water, land and biodiversity that provide our people with vital benefits and form the basis of our prosperity. These benefits, or ecosystem services, include food, clean water, flood regulation, coastal protection from storms, and much more. Understanding where Myanmar's natural capital is located and how it benefits people and infrastructure can help inform better land-use planning, economic decision-making and conservation efforts.

Historically in Myanmar, we have understood how we benefit from nature, especially from forests and the vital role they play in protecting slopes and water catchments, control of soil erosion and protection of downstream agriculture, as outlined in the National Forest policy in force since 1995. Though traditionally it has been difficult to quantify and assess the value of these services. Tools such as InVEST, which is used for the assessment presented in this report, help us map and better understand them.

This report represents the first national natural capital assessment for Myanmar and an analysis of an initial set of key ecosystem services. Our assessment shows where and how nature supports people and their livelihoods, and highlight different economic sectors. This initial assessment is aimed at mapping and quantifying where and how Myanmar's natural ecosystems provide clean and reliable drinking water, protect people and infrastructure from natural hazards, and support the efficient functioning of reservoirs and dams. Our study also evaluates how climate change is likely to affect these services. As Myanmar is one of the most vulnerable countries in the world to the ill effects of climate change, ensuring through sustainable management that our natural capital continues to protect us becomes even more important.

Many areas of the greatest biodiversity in Myanmar also provide vital ecosystem services. Because of their critical importance for people and wildlife, protecting these areas, and managing them sustainably, should be matters of the highest priority. I hope this initial assessment will support efforts for land use planning, infrastructure development and conservation across the country.

We depend on nature and we now know better *how* we depend on nature. It is up to us to use this information to ensure that these incredibly valuable ecosystems can continue to support Myanmar's people and biodiversity for generations to come

Director-General
Forest Department
Ministry of Natural Resources and Environmental Conservation

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FOREWORD WWF AND PARTNERS

The ecosystems that surround us are essential to our survival and well-being, and are the bedrock of a sustainable economy. Increasingly, we can map the most important forests, coastal habitats and other ecosystems and show how they support us. This is crucial in order to prioritize the use of resources and sustainably manage our natural world. Together with the Forest Department and partners from the Natural Capital Project at Stanford University and the Center for Climate Systems Research at Columbia University, WWF took on the challenge of mapping where and how Myanmar's natural capital contributes to clean and reliable drinking water sources, reduced risks from floods inland and storms along the coasts, and to maintaining the functioning of reservoirs and dams by preventing erosion.

This report shows where natural capital provides the greatest benefits to people and communities through ecosystem service provision. The assessment can support planning and promote development across and within key sectors, including energy, transport, agriculture and health, and reinforce climate resilience and adaptation planning. It can support decisions that launch Myanmar on a more sustainable and inclusive path toward development. This is even more important in the face of climate change, as Myanmar is one of the world's most vulnerable countries. Ecosystems in countries afflicted with climate change play an even greater role in protecting us against natural hazards, rising temperatures and greater rainfall variability.

Myanmar is home to globally important and unique biodiversity, some species being found only in this country. Many of its ecosystem service hotspots not only benefit people and their communities, but also serve as a habitat for wildlife. Our conservation efforts therefore sustain nature's gifts to the Myanmar people, while protecting its extraordinary wildlife.

This is the first national natural capital assessment done for Myanmar. More ecosystem services should be assessed and more local data should be used in future mapping efforts. With increasing knowledge and experience and a wider range of models available, we are better equipped. This can also help make nature and its value more visible in development planning and national economic accounting systems. WWF will continue to support conservation in Myanmar to ensure a future where natural capital is valued and people live in harmony with nature.

A. Christy Williams
On behalf of partners from the Natural Capital Project and the Center for Climate Systems Research.

EXECUTIVE SUMMARY

Myanmar's natural assets – including its forests, soils and coastal waters and the biodiversity they embody – makes up its natural capital, providing critical benefits to the Myanmar people, helping to protect them against natural hazards and ensuring reliable sources of clean water for drinking and irrigation as well as opportunities for ecotourism. Myanmar's natural capital is also the source of other tangible and intangible benefits that support human well-being and underpin economic development. To secure those benefits, we need to understand which areas and ecosystems best serve the people and infrastructure dependent upon them, as well as how these benefits can be protected or enhanced in the face of climate change.

The assessment presented in this report shows where and how Myanmar's natural capital contributes to clean and reliable drinking water sources, reduced risks from floods inland and storms along the coasts, and to maintaining the functioning of reservoirs and dams by preventing erosion. The results highlight areas that provide high levels of ecosystem services, where natural capital provides the greatest benefits to people and infrastructure. This initial assessment has focused on identifying important ecosystem service provisioning areas that benefit the greatest number of people at a national scale, emphasizing benefits to cities and other large population centres. Benefits to rural populations and to vulnerable subgroups are critical as well, and they should be considered in greater detail as a next step.

In addition, many of these areas important for ecosystem services provision coincide with areas important for biodiversity conservation. The effective management of these areas of synergy can help guarantee benefits to Myanmar's people, infrastructure and wildlife not just now, but for decades to come.

Securing natural capital is especially important in the face of climate change. As rainfall becomes increasingly variable and extreme events like heavy storms and droughts more frequent and intense, the role of forests in protecting rivers and streams from sediment will become more central in maintaining the quality of drinking water and improving the functioning of reservoirs and dams. The value of other ecosystem services will also become more apparent. Importantly, although climate change might make these services more valuable, the locations of hotspots areas important for ecosystem service provision are not expected to change over the next several decades for the services assessed here, so that protecting these areas would provide long-term benefits. While conservation of existing natural capital alone cannot eliminate the impacts of climate change, protecting and enhancing natural capital benefits is a critical component of climate change adaptation.

Incorporating natural capital information into planning and development processes can ensure that its benefits are put to work in the service of the people and for the prosperity of the economy. Natural capital assessments can support planning and development across and within key sectors, including energy, transport, agriculture, and health, while strengthening climate resilience and promoting adaptation planning. The natural capital assessment provided here can support development and management decisions that launch Myanmar on a more sustainable and inclusive path toward economic development.

INTRODUCTION

Myanmar has a wealth of natural capital: three of the most pristine rivers in the region, one of the largest deltas in the world, many forest areas still intact and species such as the Indochinese tiger, Asian elephant and Irrawaddy dolphin. Natural capital, including biodiversity, arable lands, forests, and rivers, underpins all economic activity and human well-being in Myanmar. When managed well, this natural wealth provides benefits known as ecosystem services. These include clean water for drinking, irrigation and energy production, protection from natural hazards such as flooding and landslides, and opportunities for nature-based tourism, to name just a few. The development and resource management decisions that Myanmar makes in the coming years will have long-term consequences for the country's natural capital and its prospects for sustainable and inclusive growth.

NATURAL CAPITAL, INCLUDING BIODIVERSITY, ARABLE LANDS, FORESTS, AND RIVERS, UNDERPINS ALL ECONOMIC ACTIVITY AND HUMAN WELL-BEING IN MYANMAR.

According to the 2015 Global Climate Risk Index (Kreft et al. 2016), Myanmar is the second most vulnerable country to climate change in the world. Safeguarding and enhancing Myanmar's natural capital can play an important role in building resilience to climate change. Myanmar is also experiencing a rapid economic, social and political transition. After decades of isolation, the country is opening up, increasing opportunities for all. Myanmar has a unique chance to learn from the mistakes of other countries and manage its natural capital in a more sustainable way. By pursuing a green economy approach – meeting social and economic needs while sustainably managing its natural capital – the country can ensure that nature can continue to provide benefits for generations to come.

Natural capital assessments provide information on where and how nature supports people's lives and livelihoods, as well different sectors of the economy. These assessments identify where ecosystem service benefits originate, and how they can be sustainably managed. Understanding the role of natural capital is essential for making decisions that secure these assets for economic and social development. When natural capital and ecosystem services are not accounted for, development decisions may lead to the unintentional loss of these benefits, thus undermining security, prosperity and economic development. The degradation of natural capital can incur costs for water treatment, erosion control, infrastructure maintenance and disaster relief.

Natural capital assessments can support many areas of development policy and planning, including spatial planning and zoning, infrastructure siting and urban planning. They provide valuable information across many stages of the development planning and implementation process, from national and regional planning to project design to monitoring *(Figure 1)*. Natural capital assessments can be used to:

- Identify key ecosystem service source areas for sustaining benefits to people, infrastructure and other investments;
- Support coordinated government decision-making by elucidating synergies and trade-offs between the needs and impacts of different sectors and supporting the design of policies that minimize trade-offs;
- Reveal the ways that plans, policies or projects both depend on and impact natural capital, so that natural capital can be secured or enhanced in support of desired development outcomes;
- Contribute to climate resilience and adaptation planning; and
- Identify and prioritize conservation activities to benefit both people and biodiversity.

This report provides an initial national natural capital assessment for Myanmar. It is aimed at mapping and quantifying where and how Myanmar's natural ecosystems provide clean and reliable drinking water, protect Myanmar's people and infrastructure from natural hazards, and support efficient reservoir and dam functioning. It examines the provision of these benefits under current climate conditions and under scenarios of future climate change for the coming decades. This information can support strategies and policies intended to guide Myanmar toward a more sustainable development path. As illustrated in *Figure 1*, this natural capital assessment can be used to inform land use planning, assess cumulative and project-level impacts of investments, and develop environmental management plans for addressing these impacts.

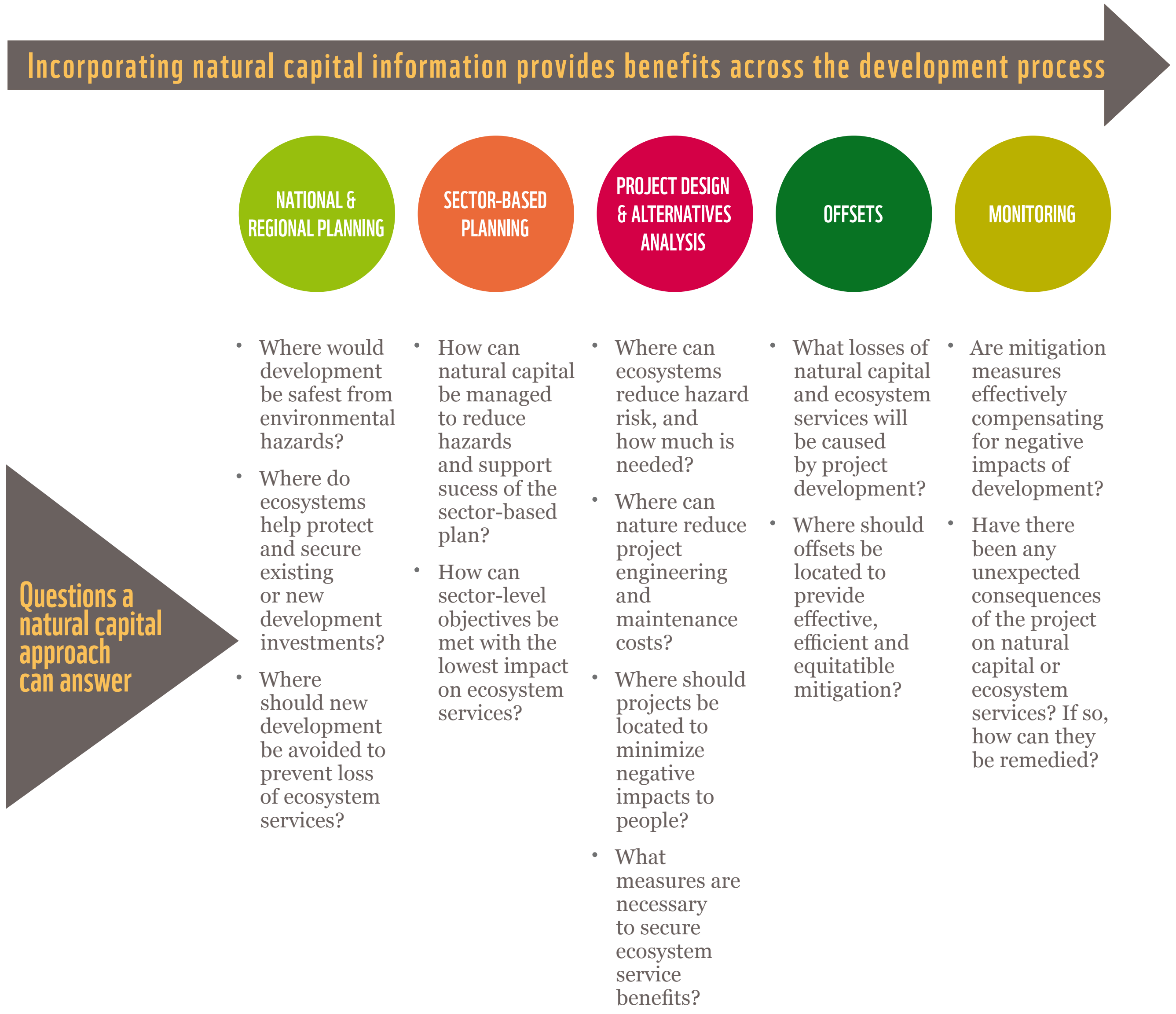


Figure 1.
Examples of how a natural capital-based approach can be used to mainstream environmental information throughout the development planning process, contributing to more effective and efficient development decisions.

OBJECTIVES

The main objectives for this assessment are to identify where key ecosystem services are produced within Myanmar, how climate change is likely to affect these ecosystem services, and to identify the amount and location of overlap between areas of high ecosystem service provision, Key Biodiversity Areas (KBAs) and existing protected areas.

THIS ASSESSMENT HAS THREE MAIN OBJECTIVES:

1. Identify ecosystem service provisioning areas that provide important benefits to people and infrastructure, which could be lost if not considered as part of development planning

2. Understand if and how key ecosystem service provision areas are likely to shift under future climate change scenarios, so that natural capital can be managed in a way that is robust to climate change and its benefits secured for current and future generations.

3. Identify the amount and location of overlap between areas of high ecosystem service provision, Key Biodiversity Areas (KBAs) and existing protected areas. Where ecosystem service provision overlaps with KBAs, protecting natural capital has an especially strong potential to benefit both people and biodiversity. These areas of overlap could be a high priority for conservation, especially where they occur outside of existing protected areas.

HOW THE ASSESSMENT WAS COMPLETED

This natural capital assessment combines physical, biological, and socio-economic data, including aspects such as land use, vegetation type, soils, climate, infrastructure, and demographics. The current land use/land cover map was based on a custom classification of 2013 Landsat imagery using Google Earth Engine (Dixon, 2015). The InVEST suite of models (Sharp et al. 2016) was used to map and quantify the biophysical provision of ecosystem services. These results were combined with data on the location and needs of people and infrastructure to assess demand for and delivery of ecosystem service benefits.

Climate information came from downscaled climate projections for Myanmar produced by the Center for Climate Systems Research at Columbia University (CCSR 2016). This included projections of temperature and precipitation for the 2020 (2011-2030) and 2040 (2031-2050) time periods based on 20-year averages, and projections of sea-level rise for the 2020 (2020-2029) and 2050 (2050-2059) time period based on 10-year averages. To capture uncertainty in climate projections, a high and low climate scenario was evaluated for each time period.

Temperature and precipitation projections were developed using the NASA Earth Exchange Global Daily Downscaled Projections (NEX-GDDP) dataset released in 2015. It used outputs from 21 models and two Representative Concentration Pathways (RCPs), representing potential trajectories of greenhouse gas emissions. The 25th percentile results for RCP 4.5 were used as a low climate change scenario, while the 75th percentile results for RCP 8.5 were used as a high climate change scenario. For sea level rise, 24 models were used from Coupled Model Intercomparison Project 5 (CMIP5), along with other data sources and methods that account for land-based ice loss and changes in land water storage. The low estimate for sea level rise was derived from the 25th percentile of the combined RCP 4.5 and 8.5 model outcomes, and the high estimate was derived from the 75th percentile of the combined RCP 4.5 and 8.5 outcomes.

Detailed information on the data and methods used in this natural capital assessment can be found in the associated technical report (Wolny et al. 2016). The results presented here should be seen as a starting point from which the set of ecosystem services assessed can be expanded, the input data improved, and the focal areas and questions refined based on the development decisions in question and the needs of the Myanmar government and other decision makers.

The following set of ecosystem services were chosen based on their relevance in Myanmar, and the availability of the necessary data and models to evaluate them at a national scale:

- sediment retention for water quality
- regulation of dry-season water availability
- reduced flood risk
- protection from coastal storms


RESULTS

1. NATURAL CAPITAL ENHANCES THE AVAILABILITY OF CLEAN, RELIABLE SOURCES OF DRINKING WATER FROM RIVERS AND STREAMS

SEDIMENT RETENTION BY NATURAL ECOSYSTEMS ENHANCES DRINKING WATER QUALITY

Forests and other vegetation hold soil in place, reducing erosion and keeping sediments out of streams and rivers. One of the ways that people benefit from this sediment retention service is through improved drinking water quality. Sediments can carry disease-causing pathogens, as well as damage water-delivery infrastructure. To assess where forests and natural vegetation are most important for maintaining clean sources of drinking water, information was combined on where forests retain sediments and where this sediment retention benefits people downstream who rely on rivers and streams for drinking water.

ONE WAY THAT PEOPLE BENEFIT FROM SEDIMENT RETENTION IS THROUGH IMPROVED DRINKING WATER QUALITY

Myanmar's 2014 census data[1] was used to map where households that rely on rivers and streams for their drinking water depend on sediment retention services provided by watersheds upstream (Map 1a). The InVEST Sediment Delivery Ratio model was then used to map where loss of forests and other natural ecosystems would lead to the greatest increases in erosion and therefore in sediment in waterbodies downstream, if converted for agriculture (Map 1b). This model estimates soil retention and loss using spatial data on land use, topography, soils, and climate. Natural vegetation plays an especially important role in retaining and trapping sediment on steep slopes or when it is located downslope of high-erosion areas like agriculture. Combining the information from Maps 1a and b shows where maintaining forests and other natural ecosystems will secure the greatest sediment retention services for the greatest number of surface water-dependent households (Map 1c). Subsequent analyses could focus on benefits to rural households or other beneficiary groups of interest.

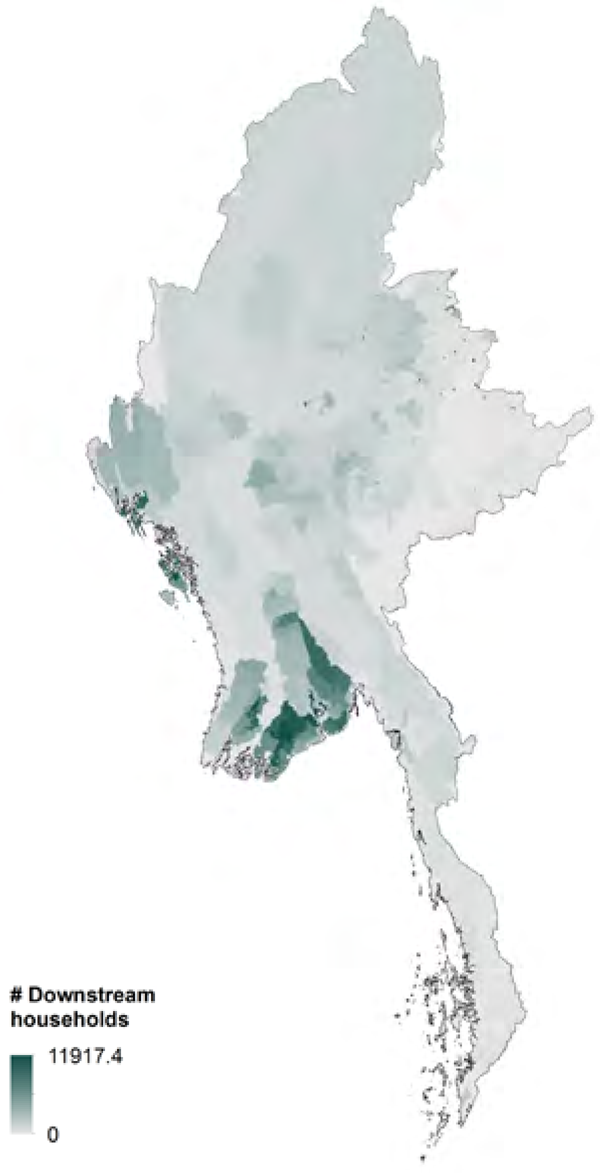
1 Some areas were not enumerated in the 2014 census, and not all villages have yet been associated with GPS coordinates and so their upstream watersheds could not be mapped. Because of this, these results likely underestimate the level of service provision in these areas, particularly Kachin, Rakhine and eastern Shan states.

IMPACT FROM CLIMATE CHANGE ON SEDIMENT RETENTION SERVICES

On average, the intensity and amount of rainfall is likely to increase in the coming decades (Maps 1e-h), leading to greater levels of erosion and greater amounts of sediment in rivers and streams on an annual basis, even without any changes in land use. Climate projections demonstrate this, showing how sediment will increase, especially under the high climate scenario in both the shorter term and out to mid-century (through the 2040s) (Maps 1g-h).

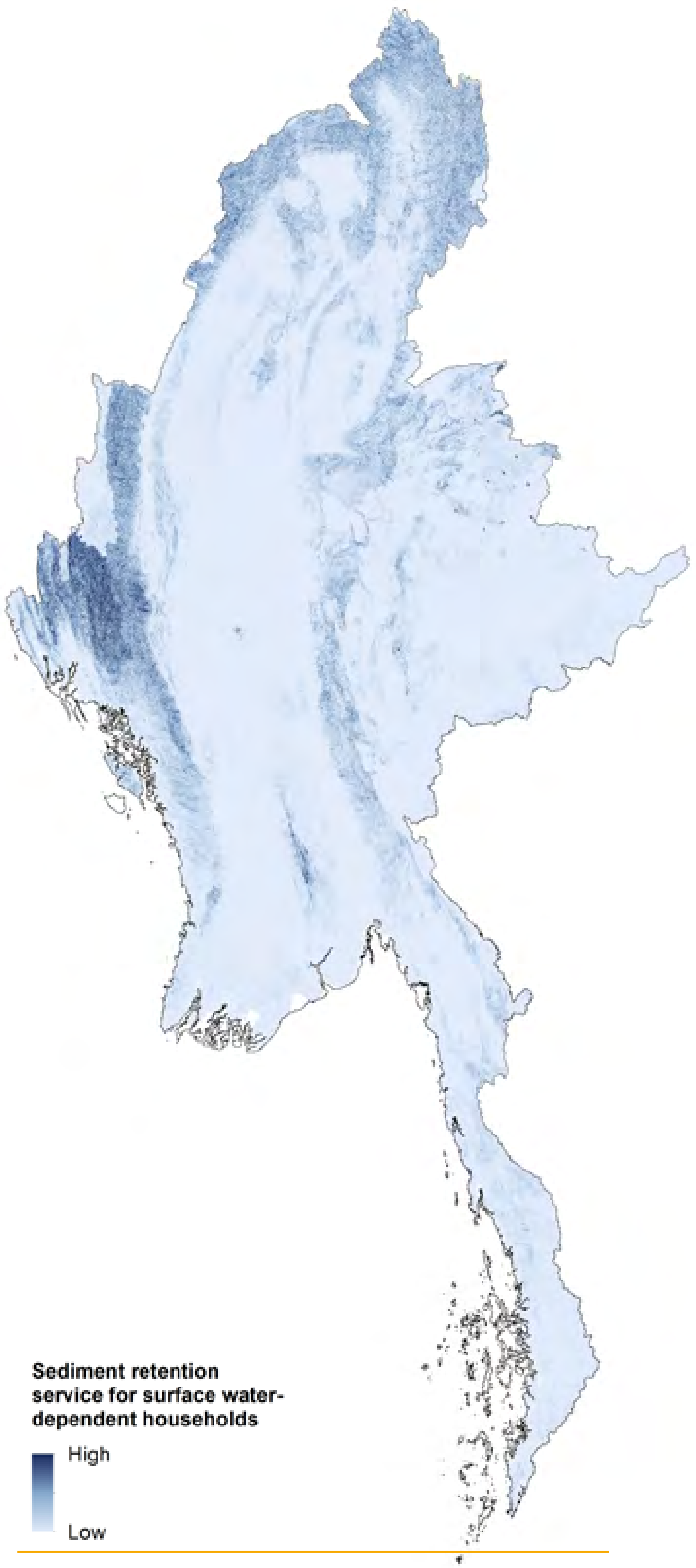
As precipitation in Myanmar is generally expected to become increasingly variable, intense, and increase overall with climate change, the amount of sediment that forests and other ecosystems prevent from reaching rivers and streams is also expected to increase. In the case of the high estimate of climate change for the 2040s (RCP 8.5, 75th percentile, 2031-2050), avoiding loss of natural vegetation will on average keep 23% more sediment out of waterways as compared to the benefits provided under historical climate conditions. Under the low estimate for this time period (RCP 4.5, 25th percentile, 2031-2050) in which annual precipitation decreases slightly relative to historical conditions, natural ecosystems would retain 4% less sediment on average. For the 2020s (2011-2030), this ranges from at 8% decrease under the low estimate (RCP 4.5, 25th percentile), to a 15% increase under the high estimate (RCP 8.5, 75th percentile). These projections suggest that an increase in sediment retention services is more likely, but with some uncertainty particularly for the near term scenario (2020s) which show a larger range of potential changes in rainfall.

It is also important to consider whether areas most important for maintaining clean drinking water now are likely to change with climate change. While the amount of erosion is likely to change along with changes in mean annual rainfall considered here, the most important areas for sediment retention do not change (Maps 1i-l). This means that protection of natural capital in areas important under current conditions will remain important sources of ecosystem service benefits to these same households into the future. However, changes in the size and location of population centres, and in their drinking water sources, could lead to areas that are currently less important for drinking water quality becoming more or less important in the future, as the number and location of surface water-dependent households downstream change. Ecosystems themselves may also be affected by climate change, with changes in function or location. This would also affect service provision and could be explored in future assessments.

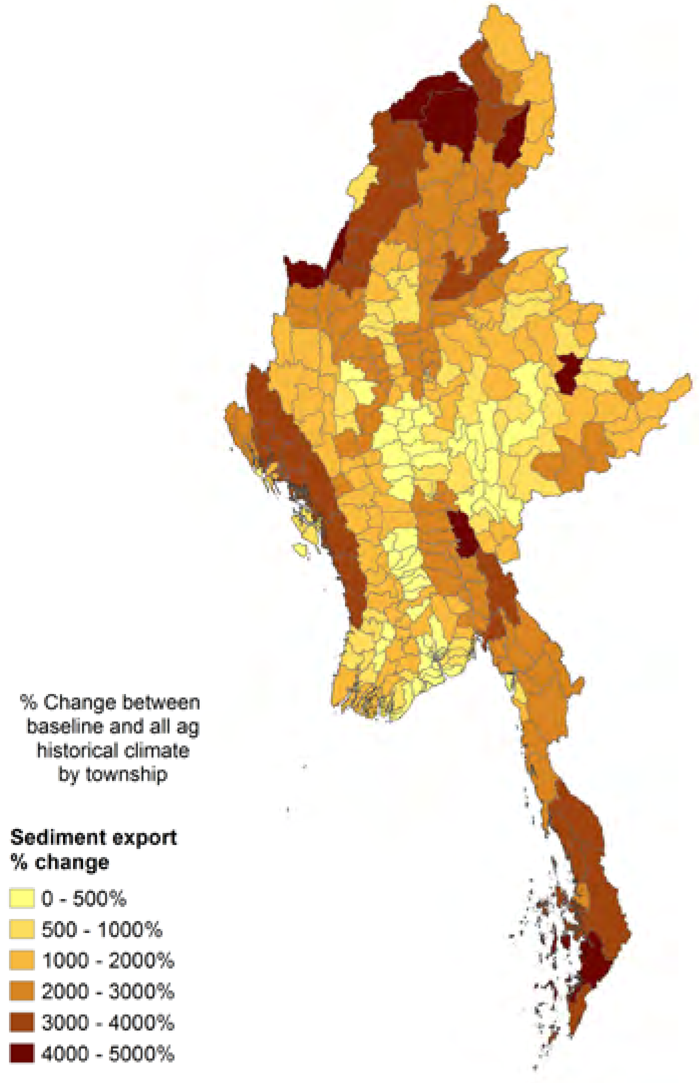


Map 1a.
Number of downstream households that use surface water for drinking. *Higher values indicate that those areas are valuable for providing service to more people.*

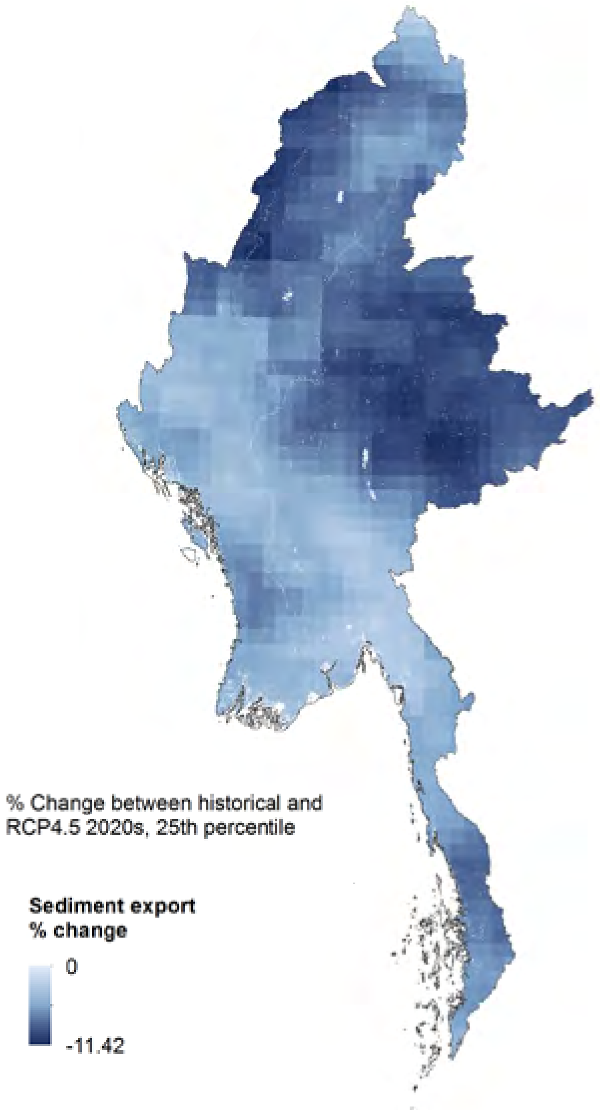
Map 1b.
Sediment retention by natural vegetation, comparing the current landscape with a landscape that is all agriculture. Higher values indicate that natural vegetation is playing a greater role in preventing erosion.



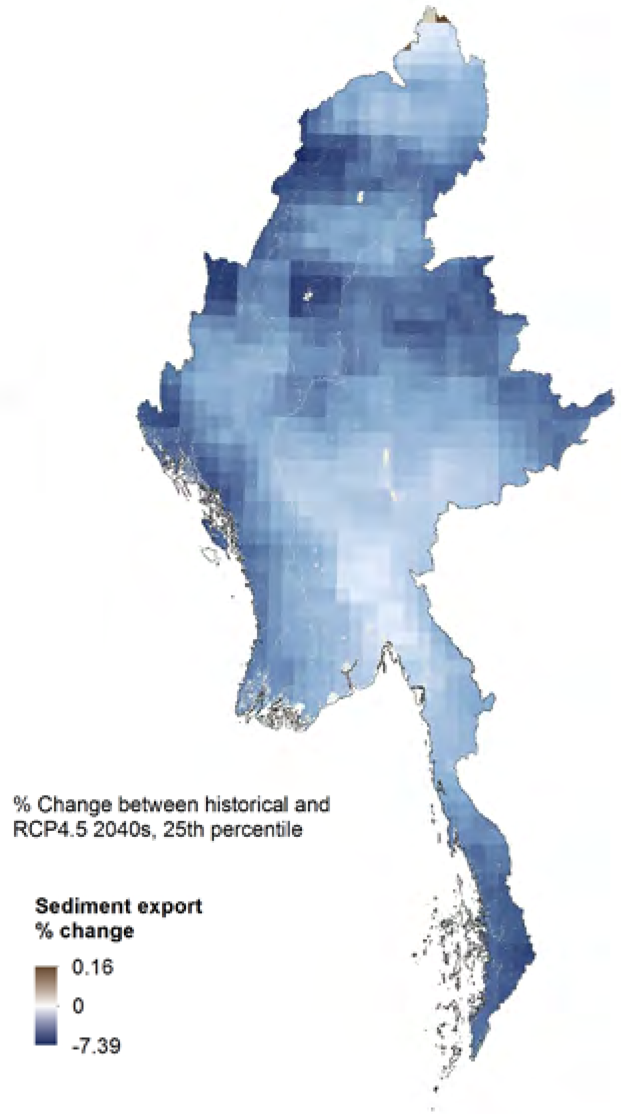
Map 1c.
Natural vegetation provides the service of sediment retention to downstream households that use surface water for drinking. *Higher values indicate that natural vegetation is reducing erosion to provide clean drinking water to the greatest number of people.*



Map 1d.
This shows how an increase in erosion due to the loss of natural vegetation may impact different townships, for the people who live there and use surface water for drinking. *Darker townships would experience a greater percent increase in sediments in surface drinking water sources if upstream vegetation is converted to agriculture. This map is under current climate conditions. A similar pattern is seen for climate change scenarios, indicating that land use change is a more dominant driver of erosion than climate change effects.*

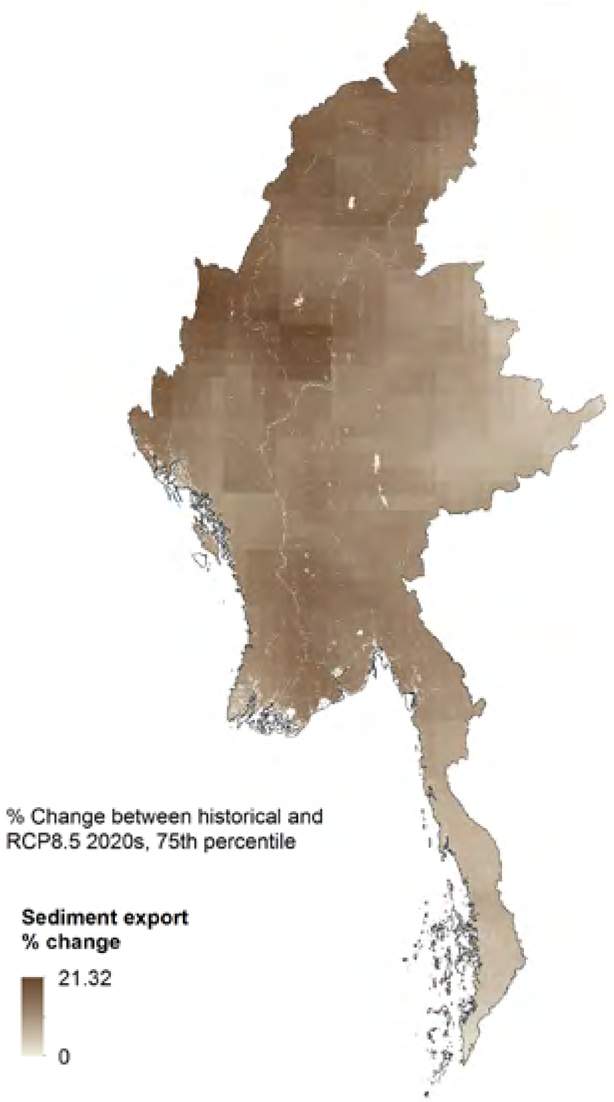


Map 1e.
Percent change in sediment export between historical climate conditions and low climate change estimate (RCP 4.5, 25th percentile, 2011-2030).

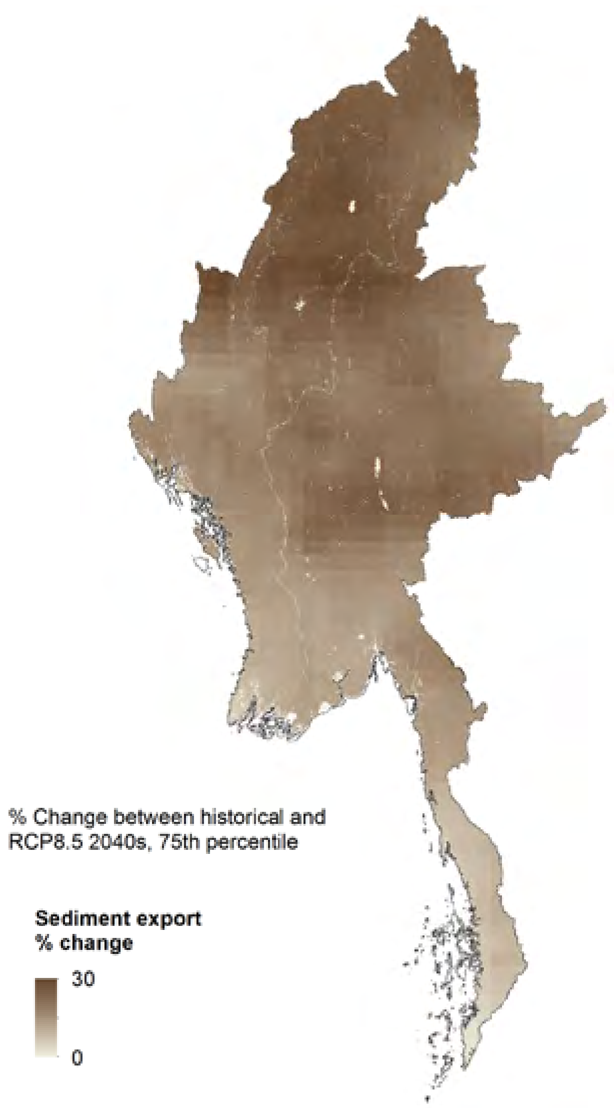


Map 1f.
Percent change in sediment export between historical climate conditions and climate change estimate (RCP 4.5, 25th percentile, 2031-2050).

CLIMATE PROJECTIONS SHOW THAT SEDIMENT IN WATERWAYS WILL INCREASE, ESPECIALLY UNDER THE HIGH CLIMATE SCENARIO IN BOTH THE SHORTER TERM AND OUT TO MID-CENTURY (THROUGH THE 2040S) (MAPS 1G-H).



Map 1g.
Percent change in sediment export between historical climate conditions and high climate change estimate (RCP 8.5, 75th percentile, 2011-2030).



Map 1h.
Percent change in sediment export between historical climate conditions and high climate change estimate (RCP 8.5, 75th percentile, 2031-2050).

Map 1i.
Sediment retention by natural vegetation, *comparing the current landscape with a landscape that is all agriculture,* ***under low climate change estimate RCP 4.5, 25th percentile, 2011-2030.*** *Higher values indicate that natural vegetation is playing a greater role in preventing erosion.*

Map 1j.
Sediment retention by natural vegetation, *comparing the current landscape with a landscape that is all agriculture,* ***under low climate change estimate*** *RCP 4.5, 25th percentile, 2031-2050. Higher values indicate that natural vegetation is playing a greater role in preventing erosion.*

ON AVERAGE, THE INTENSITY AND AMOUNT OF RAINFALL IS LIKELY TO INCREASE IN THE COMING DECADES (MAPS 1E-H), LEADING TO GREATER LEVELS OF EROSION AND GREATER AMOUNTS OF SEDIMENT IN RIVERS AND STREAMS ON AN ANNUAL BASIS, EVEN WITHOUT ANY CHANGES IN LAND USE.

Map 1k.
Sediment retention by natural vegetation, comparing the current landscape with a landscape that is all agriculture, under high climate change estimate RCP 8.5, 75th percentile, 2011-2030. Higher values indicate that natural vegetation is tplaying a greater role in preventing erosion.

Map 1l.
Sediment retention by natural vegetation, comparing the current landscape with a landscape that is all agriculture, under high climate change estimate RCP 8.5, 75th percentile, 2031-2050. Higher values indicate that natural vegetation is playing a greater role in preventing erosion.

2 FORESTS PROMOTE WATER AVAILABILITY IN THE DRY SEASON BY REGULATING BASEFLOWS

FORESTS AND OTHER NATURAL ECOSYSTEMS REGULATE THE SEASONAL FLOW OF WATER DOWNSTREAM BY INCREASING INFILTRATION AND RECHARGING SOURCES OF GROUNDWATER.

Forests and other natural ecosystems regulate the seasonal flow of water downstream by increasing infiltration and recharging sources of groundwater. Vegetation serves to slow down water as it runs off of the landscape during the rainy season. This allows more water to be stored in the soil so that it can release slowly during the dry season, supporting baseflow in streams. People living downstream of these areas benefit from increased stream flows during the dry season, which provide drinking water, irrigation for winter and summer crops, and other uses. To assess where forests and natural vegetation are most important for promoting the availability of drinking water in the dry season, information was combined on where forests regulate dry-season base flows and where people downstream depend on rivers and streams for their drinking water.

Myanmar's 2014 census data was used to map which parts of the landscape contribute to regulating drinking water for the greatest number households downstream who depend on rivers and streams for drinking water *(Map 2a, identical to Map 1a)*. Then the InVEST Seasonal Water Yield model was used to map where loss of forests and other natural ecosystems would lead to the greatest reductions in dry-season flows downstream by reducing infiltration *(Map 2b)*. This model estimates base flows using spatial data on land use, topography, soils and climate. Combining the information from Maps 2a and b shows where protecting natural ecosystems is most important to maintaining dry season flows for the greatest number of households downstream who depend on rivers and streams for their drinking water (Map 2c). Subsequent analyses could focus on identifying areas benefitting rural households in particular or households most vulnerable to water scarcity. A similar analysis could be completed to assess the importance of natural ecosystems to maintaining irrigation water supply, with information on the location of water withdrawals for irrigation.

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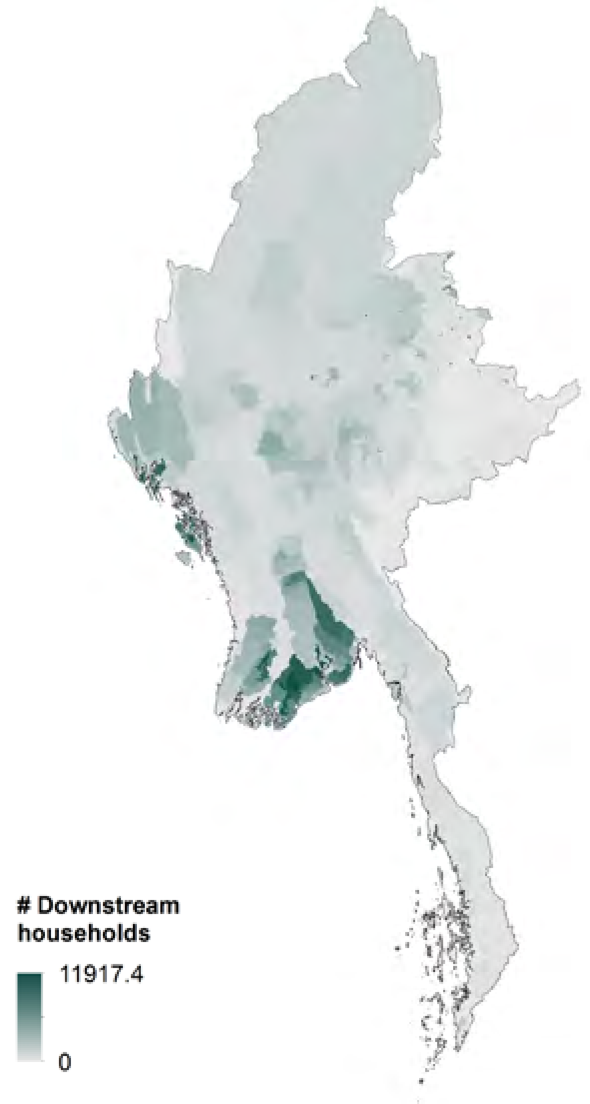
IMPACT FROM CLIMATE CHANGE ON THE PROVISION OF BASEFLOW REGULATION SERVICES

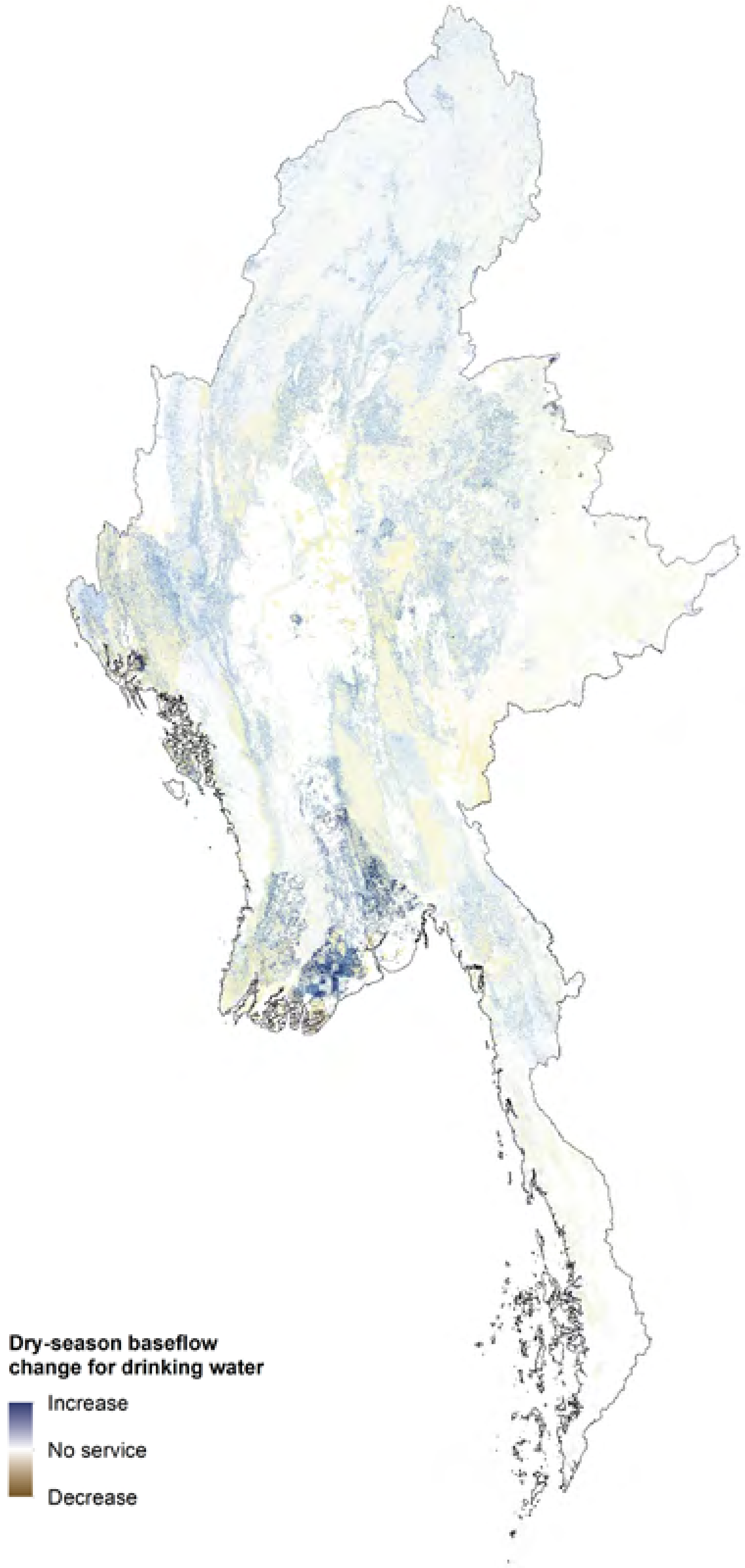
An assessment was also done to determine whether areas most important for maintaining dry-season water availability were likely to change with climate change (Maps 2d-g). Climate change information for both precipitation and temperature were used to generate inputs to the model – precipitation is used directly, and both precipitation and temperature are used to estimate evapotranspiration. In general, the areas where forests and other natural vegetation contribute most to maintaining dry-season flows downstream did not change across climate scenarios. Again, this means that protection of natural capital in areas important under current conditions will remain important sources of ecosystem service benefits to downstream households the coming decades. However, degradation of ecosystems caused directly by changes in climate could compromise their ability to deliver services, and thus there should be an increased effort in monitoring ecosystem change coupled with weather and climate data. Furthermore, changes in the size and location of population centres, and in their drinking water sources, could change the pattern in the future as demand of dry-season water availability changes in magnitude and space.

In certain, limited circumstances, conversion of natural vegetation to agriculture could result in an increase in dry-season base flows, if the reduction in infiltration is offset by reductions in crop evapotranspiration. These changes depend in part on the crop type and agricultural management practices. Loss of forests to other land uses, such as mining, industrial or urban areas can also have complex effects on hydrology. More detailed, realistic scenarios of land use change can be incorporated into natural capital assessments to explore the outcomes of specific development options under consideration.



Map 2a.
Number of downstream households that use surface water for drinking *(based on census data).*

Map 2b.
Baseflow difference between the current landscape and one where everything is turned into agriculture for current climate. ***High values of increase indicate the value of natural vegetation for providing dry-season baseflow.***



Map 2c.

Value of natural vegetation for providing dry-season baseflow to people who use surface water for drinking. *(map 2a * map 2b). Current climate. Shows which places are not only providing baseflow, but are providing it to the greatest number of people.*

Map 2d.

Baseflow difference between current landscape and one where everything is turned into agriculture, under low climate change estimate RCP 4.5, 25th percentile, 2011-2030. (similar to 2b.) ***High values of increase indicate the value of natural vegetation for providing dry-season baseflow.***

Map 2e.

Baseflow difference between current landscape and one under complete conversion to agriculture, under low climate change estimate (RCP 4.5, 25th percentile, 2031-2050.) ***High values of increase indicate the value of natural vegetation for providing dry-season baseflow.***

Map 2f.
Baseflow difference between current landscape and one under complete conversion to agriculture, under high climate change estimate (RCP 8.5, 75th percentile, 2011-2030.) ***High values of increase indicate the value of natural vegetation for providing dry-season baseflow.***

Map 2g.
Baseflow difference between current landscape and one under complete conversion to agriculture, under high climate change estimate (RCP 8.5, 75th percentile, 2031-2050.) ***High values of increase indicate the value of natural vegetation for providing dry-season baseflow.***

3. NATURAL CAPITAL REDUCES RISKS FROM NATURAL HAZARDS SUCH AS COASTAL STORMS AND FLOODING TO PEOPLE AND INFRASTRUCTURE

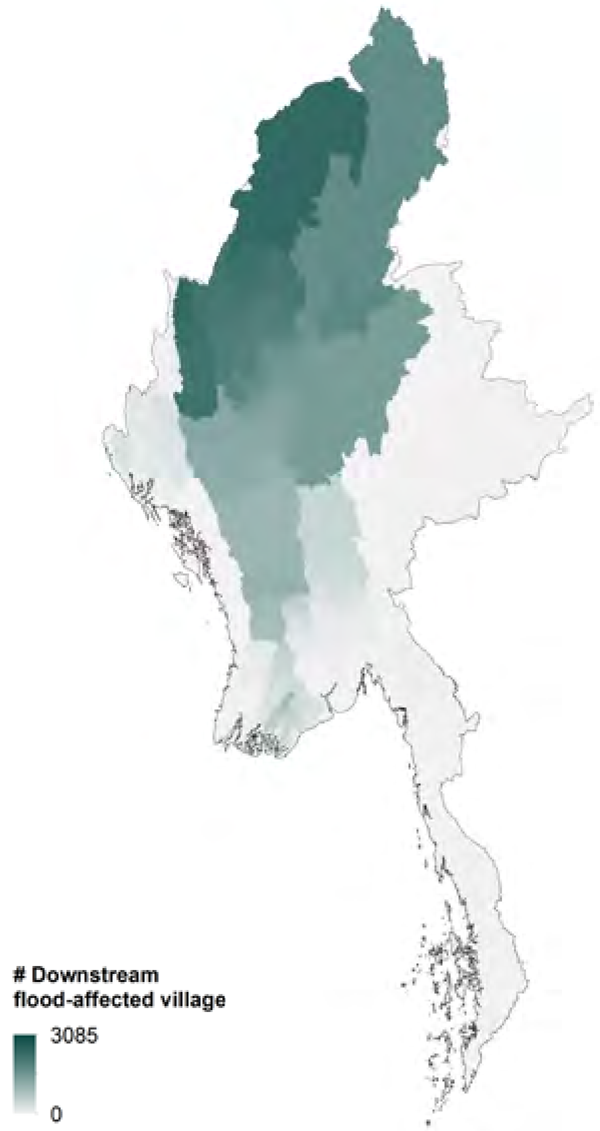
FLOW RETENTION BY FORESTS AND OTHER NATURAL ECOSYSTEMS REDUCES DOWNSTREAM FLOOD RISK

Forests and other ecosystems can decrease flood risk by increasing water storage and evaporation between storm events. When forests and natural ecosystems are lost to mining and agriculture or replaced with paved surfaces, the frequency and magnitude of flooding downstream can increase, putting people, their livelihoods and property at risk. Climate change increases this risk. To assess where forests and natural vegetation provide flood risk reduction services, information was combined on where ecosystems retain flows and where this flow retention benefits people downstream at risk of flooding. Specifically, benefits to villages that were affected by flooding in 2015 are considered here.

The upstream watersheds contributing to the risk of flooding for those villages that experienced flooding in 2015 (MIMU 2015) were mapped to determine the areas that potentially provide benefits to the greatest number of villages (Map 3a). The InVEST Seasonal Water Yield model was then used to map where loss of forests and other natural ecosystems would lead to the greatest increases in flood risk by reducing infiltration and increasing the rapid flow of water to downstream areas (Map 3b). This model estimates flow retention using spatial data on land use/land cover, topography, soils and climate. Combining the information from Maps 3a and b shows where maintaining natural ecosystems is most important to preventing an increased risk of flooding for the greatest number of villages downstream (Map 3c). A similar assessment could be used to examine where restoration or improved land management practices could contribute most to reducing flood risk.

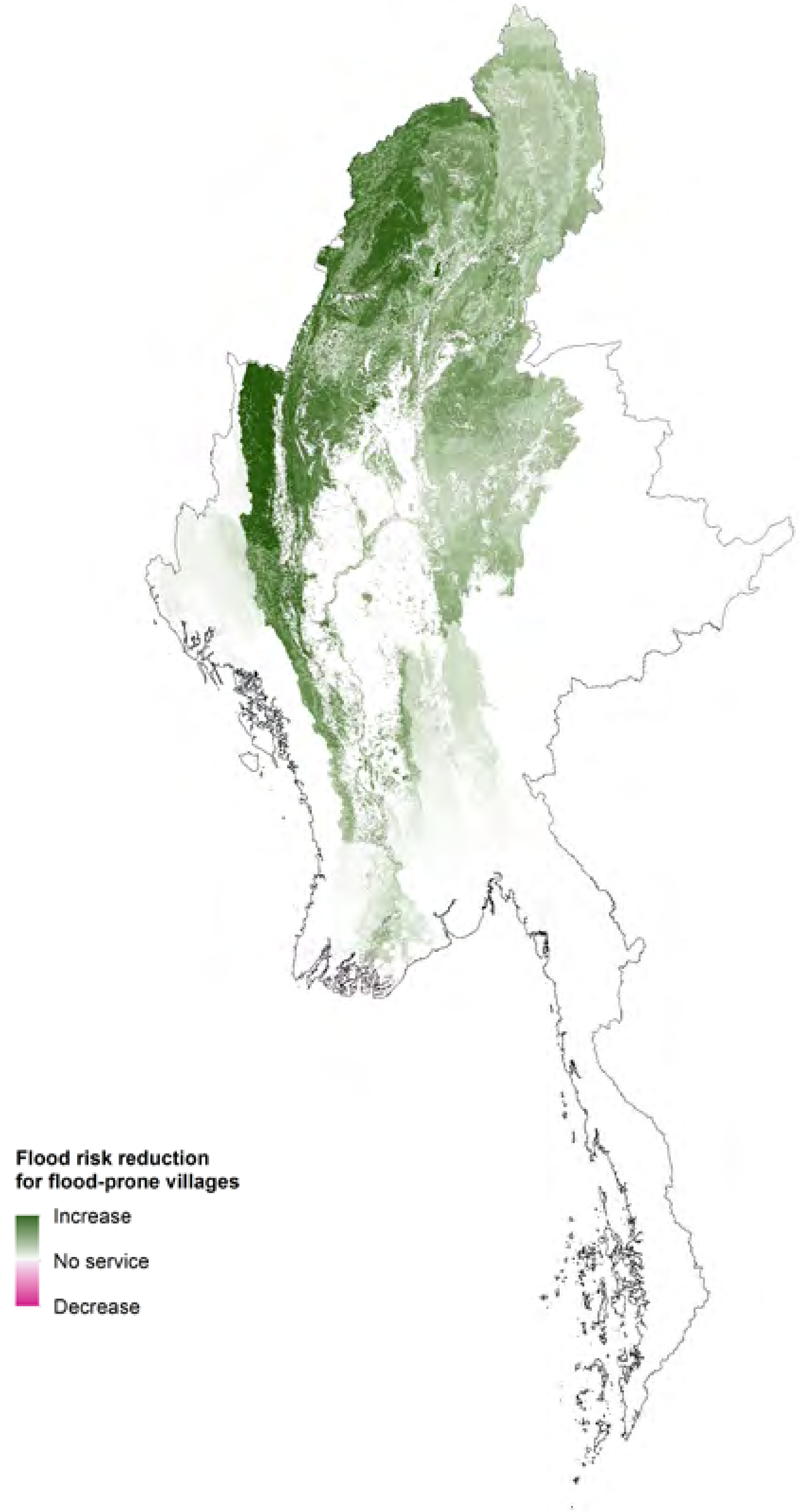
IMPACT FROM CLIMATE CHANGE ON THE LOCATION OF AREAS PROVIDING FLOOD RISK REDUCTION SERVICES

An assessment was also done to determine whether areas most important for reducing flood risk were likely to change with climate change (Maps 3d-g). While projected increases in rainfall during the wet season have the potential increase flood risk in the coming decades, this assessment suggests that the most important areas of the landscape for minimizing risk do not change. While the amount of flood risk reduction service these areas provide in the future will depend in part on the balance between changes in precipitation and changes in temperature, protection of natural capital in areas important under current conditions is likely to continue to play an important role in reducing flood risk for these population centres in the future. It is important to keep in mind that the creation of new population centres and other demographic changes means that areas that are currently less important for reducing flood risk could become important in the future, as demand for flood reduction services increases or shifts in location. Ecosystems will also be directly affected by increasing climate change over the coming decades, which will alter their ability to provide services.



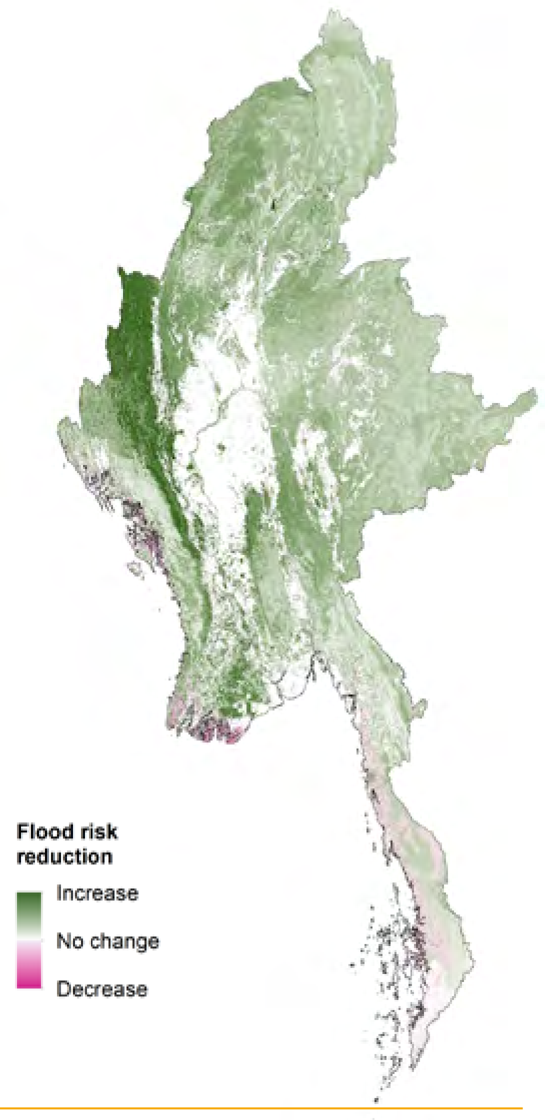
Map 3a.
Number of villages located downstream of each point that were affected by flooding in 2015.

Map 3b.
Difference in flood risk reduction provided by vegetation between the current landscape and one that has been turned into all agriculture, for current climate. ***High values of increase indicate where natural vegetation is contributing the most to reducing flood risk.***

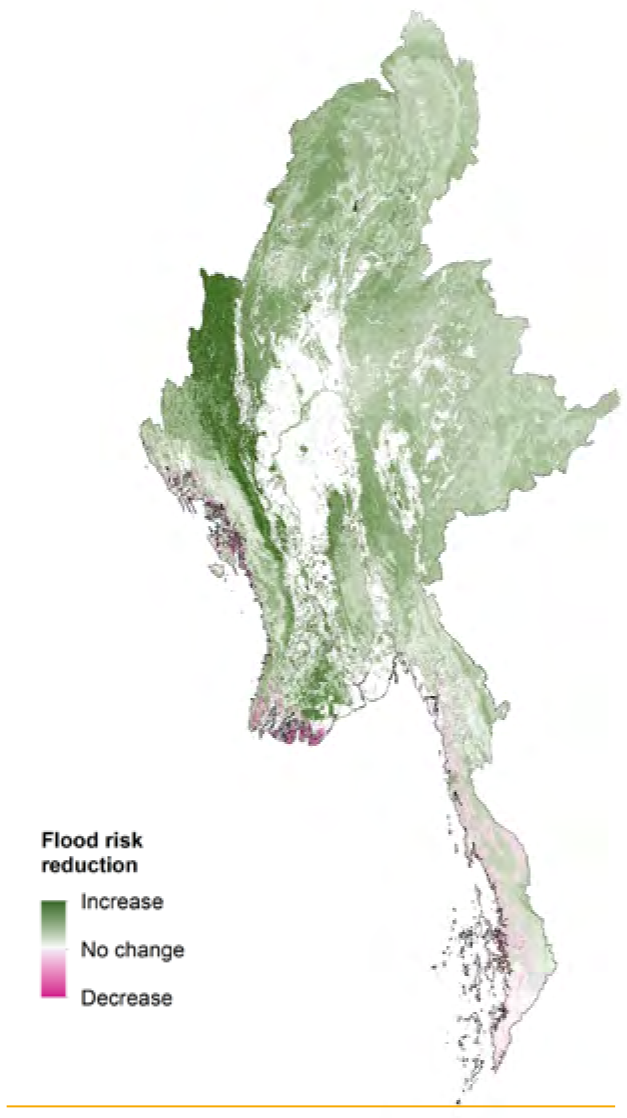


Map 3c.
Flood risk reduction provided by natural vegetation, which benefits the greatest number of villages downstream that were affected by flooding in 2015. *(Map 3a * Map 3b.) Current climate. High values of increase indicate where natural vegetation is contributing the most to reducing flood risk.*

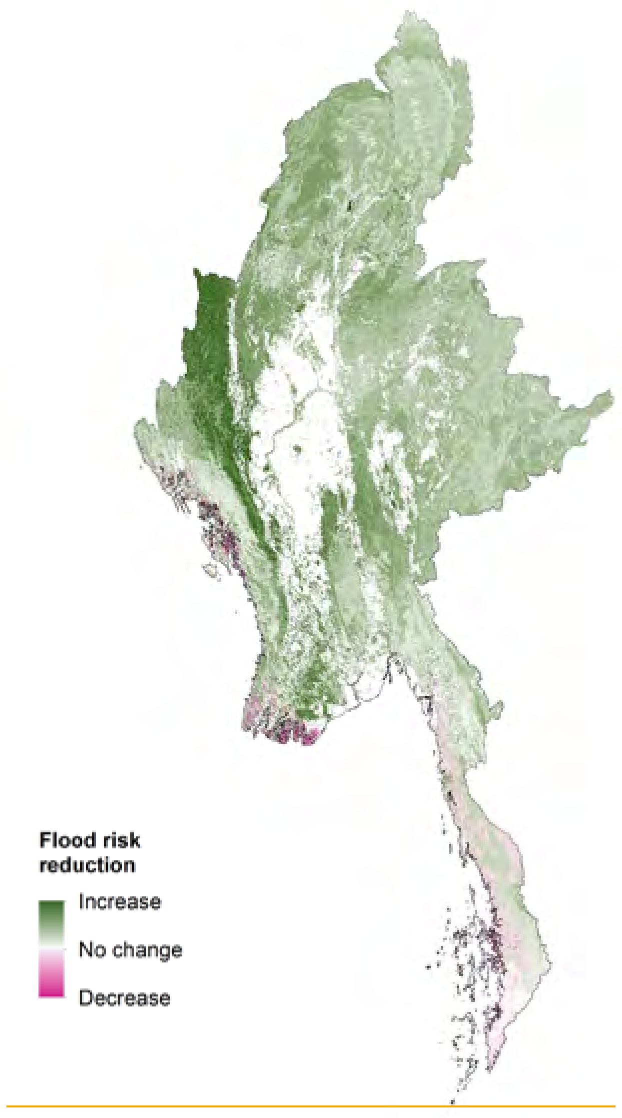
Map 3d.
Difference in flood risk reduction provided by natural vegetation between the current landscape and one that has been turned into all agriculture, for low climate change estimate (RCP 4.5, 25th percentile, 2011-2030.) ***High values of increase indicate where natural vegetation is contributing the most to reducing flood risk.***



Map 3e.
Difference in flood risk reduction provided by natural vegetation between the current landscape and one that has been turned into all agriculture, for low climate change estimate (RCP 4.5, 25th percentile, 2031-2050.) ***High values of increase indicate where natural vegetation is contributing the most to reducing flood risk.***



Map 3f.
Difference in flood risk reduction provided by natural vegetation between the current landscape and one that has been turned into all agriculture, for high climate change estimate (RCP 8.5, 75th percentile, 2011-2030.) ***High values of increase indicate where natural vegetation is contributing the most to reducing flood risk.***



Map 3g.
Difference in flood risk reduction provided by natural vegetation between the current landscape and one that has been turned into all agriculture, for high climate change estimate (RCP 8.5, 75th percentile, 2031-2050.) ***High values of increase indicate where natural vegetation is contributing the most to reducing flood risk.***

4 MANGROVES AND OTHER COASTAL HABITATS PROTECT PEOPLE AND INFRASTRUCTURE FROM COASTAL STORMS

Coastal habitats – especially mangroves, but also seagrass beds and coral reefs – reduce the exposure of coastlines to erosion and inundation by decreasing the strength of wind- and wave-generated currents and stabilizing sediments. In this way, these habitats protect coastal populations, property and infrastructure from storms. To assess where mangroves and other coastal habitats in Myanmar are most important for reducing the vulnerability of coastal populations to storms, information was combined on where and how coastal habitats reduce coastal exposure, and where people live along Myanmar's coastline, who benefit from coastal protection provided by habitats.

WorldPop data (WorldPop 2015, Map 4a) was used to map population density along coastlines. The InVEST Coastal Vulnerability Model was then used to map where loss of coastal habitats would lead to the greatest increases in shoreline exposure to erosion and inundation (Map 4b). This model uses geophysical information about the coastline, habitat maps and storm characteristics to calculate the relative exposure of the coastline and the role habitats play in reducing exposure. Combining Maps 4a and b shows where coastal habitats provide the greatest benefits in reducing coastal exposure for the largest number of people (Map 4c). This analysis was repeated for particularly vulnerable subsets of the coastal population – specifically, the young and elderly segments of the population, who are at increased risk of mortality following cyclones and storm surge, and households living in homes constructed from building materials other than concrete or brick, which are especially susceptible to damage. The location of the most important habitats did not differ from Map 4c, so results are not shown here.

Map 4a.
Role of coastal habitats (mangroves, sea grass, coral) in reducing coastal exposure to erosion and storm surge under current climate conditions.
Higher values = greater role in reducing exposure. Patterns do not change under the sea-level rise scenarios evaluated here.

Map 4b.
Distribution of people living along the coast, who may benefit from the services provided by coastal habitats.

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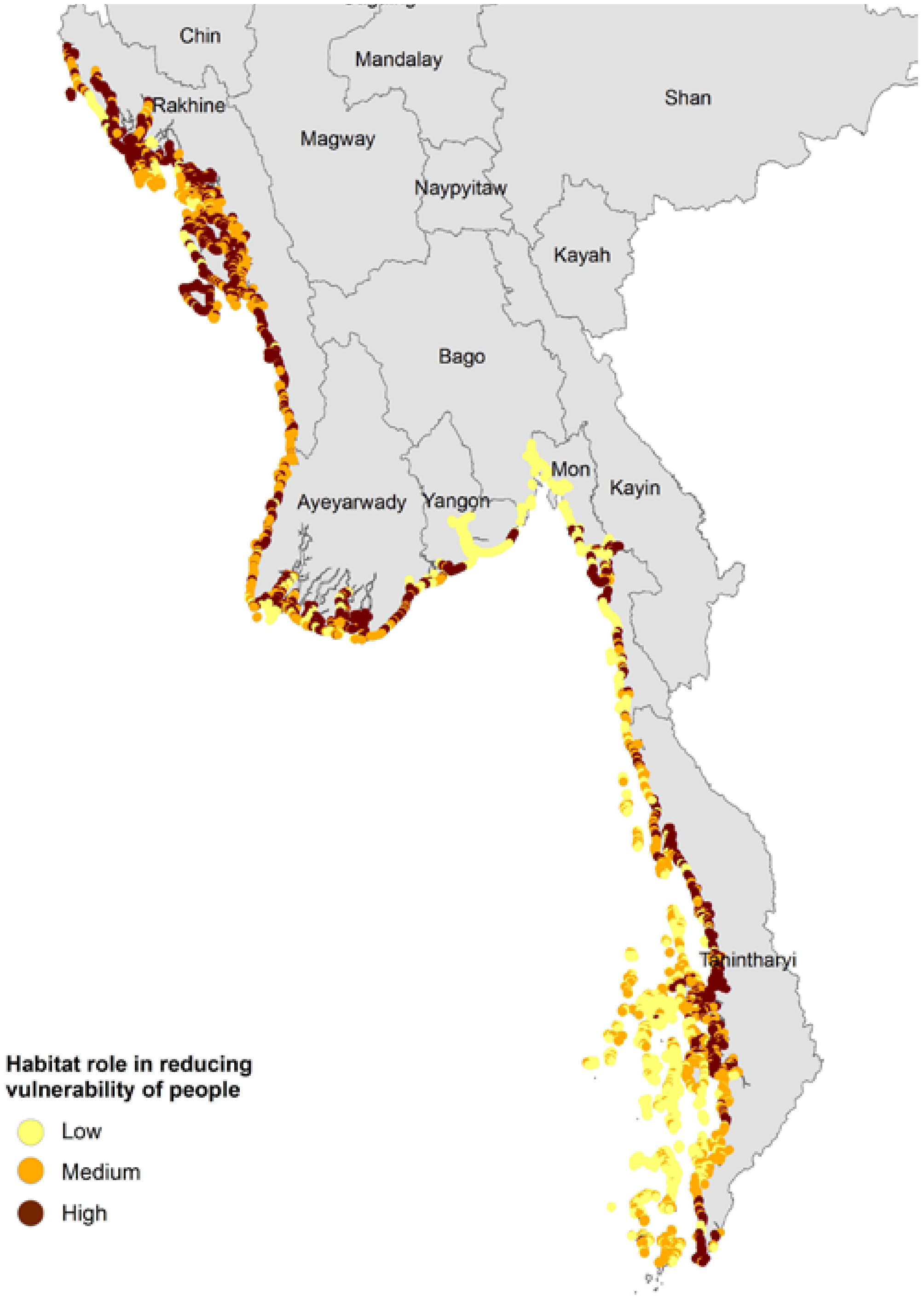


Map 4c.
Coastal habitats reduce risk of erosion and storm surge for populations living on the coast under current climate conditions. *Higher values = greater role in reducing exposure for the greatest number of people. Combination of map 4a and map 4b. Patterns do not change under the sea-level rise scenarios evaluated here.*

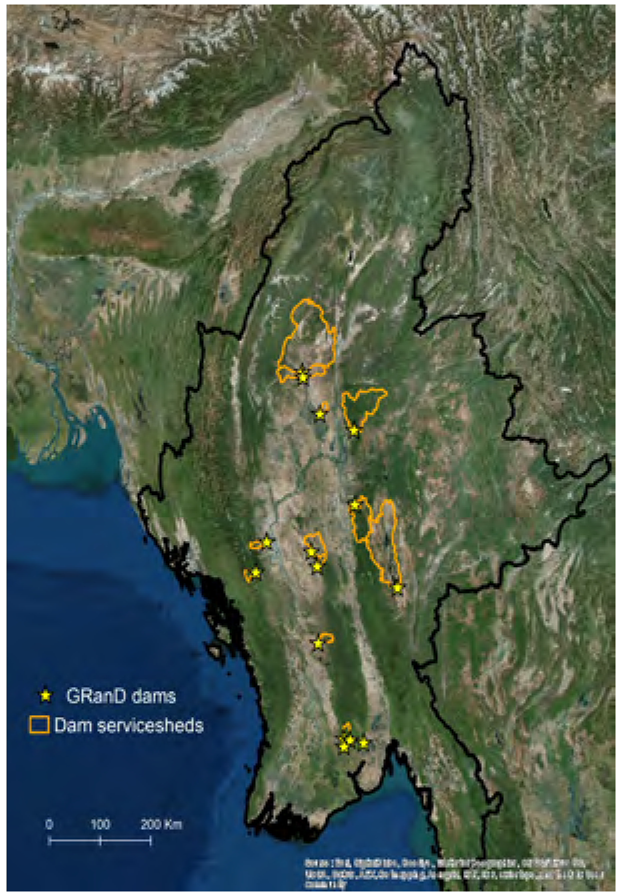
IMPACTS OF SEA-LEVEL RISE ON THE LOCATION OF COASTAL PROTECTION SERVICES

Because the magnitude of sea-level rise over the next several decades is expected to be similar along Myanmar's coastline, the areas of habitat that are most important for reducing coastal vulnerability did not change. The InVEST Coastal Vulnerability model is a relative ranking model, so it does not provide information on the magnitude of change in provision of coastal protection services under sea-level rise. The sea-level rise projections used also did not account for land subsidence, which likely varies along the coast and could alter these conclusions. These are all areas that could be explored with more sophisticated models.

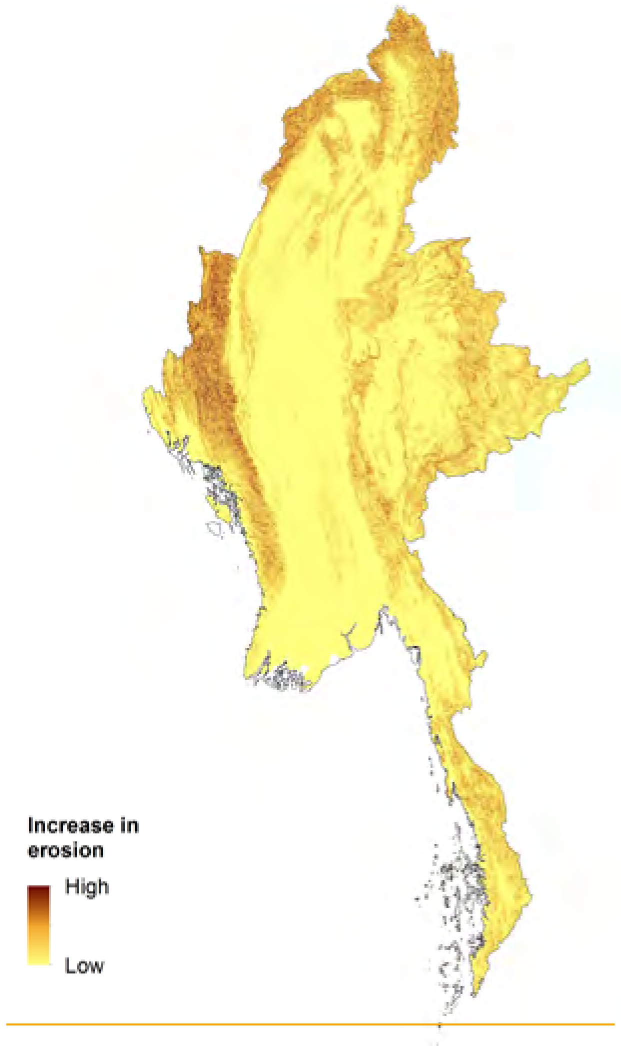
5. NATURAL CAPITAL SUPPORTS FUNCTIONING OF INFRASTRUCTURE INVESTMENTS

SEDIMENT RETENTION SERVICES MAINTAIN RESERVOIR AND DAM FUNCTIONING

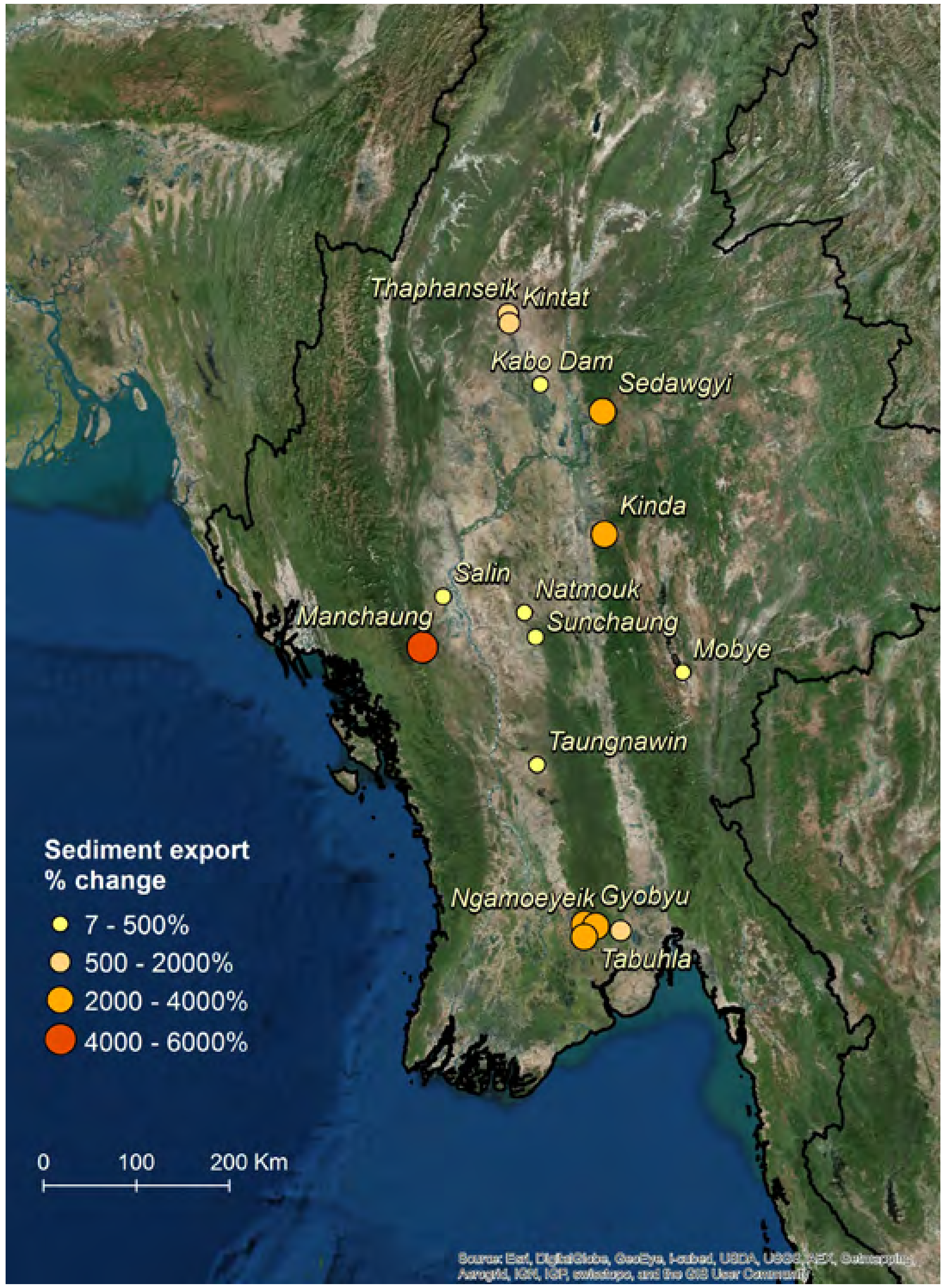
As previously described, vegetation holds soil in place, reducing erosion and keeping waterways free of sediment. This sediment retention service not only contributes to clean drinking water, it also helps to maintain the functioning of dam and reservoir infrastructure. When sediment accumulates in reservoirs behind dams, this reduces the water-holding capacity of the reservoir and limits turbine effectiveness. Reservoirs that are a source of irrigation or drinking water can no longer supply the intended volume, and dams that are used for hydropower production may not produce energy at the target rate. Deforestation upstream of dams and reservoirs can therefore reduce reservoir lifespans or lead to increased maintenance costs to dredge sediment.



Map 5a.
Location of several major dams, and the associated watersheds that flow into them.



Map 5b.
Increase in erosion predicted if the current landscape is entirely converted to agriculture.



Map 5c.
Increase in sediment export predicted for each of the dams, if the land within their watersheds is allowed to degrade/change to all agriculture. *This pattern is the same across climate change scenarios.*

MANAGING NATURAL CAPITAL TO PROMOTE SEDIMENT RETENTION UPSTREAM OF DAMS AND RESERVOIRS WILL CONTINUE TO PROVIDE BENEFITS TO DAM AND RESERVOIR FUNCTION IN THE COMING DECADES.

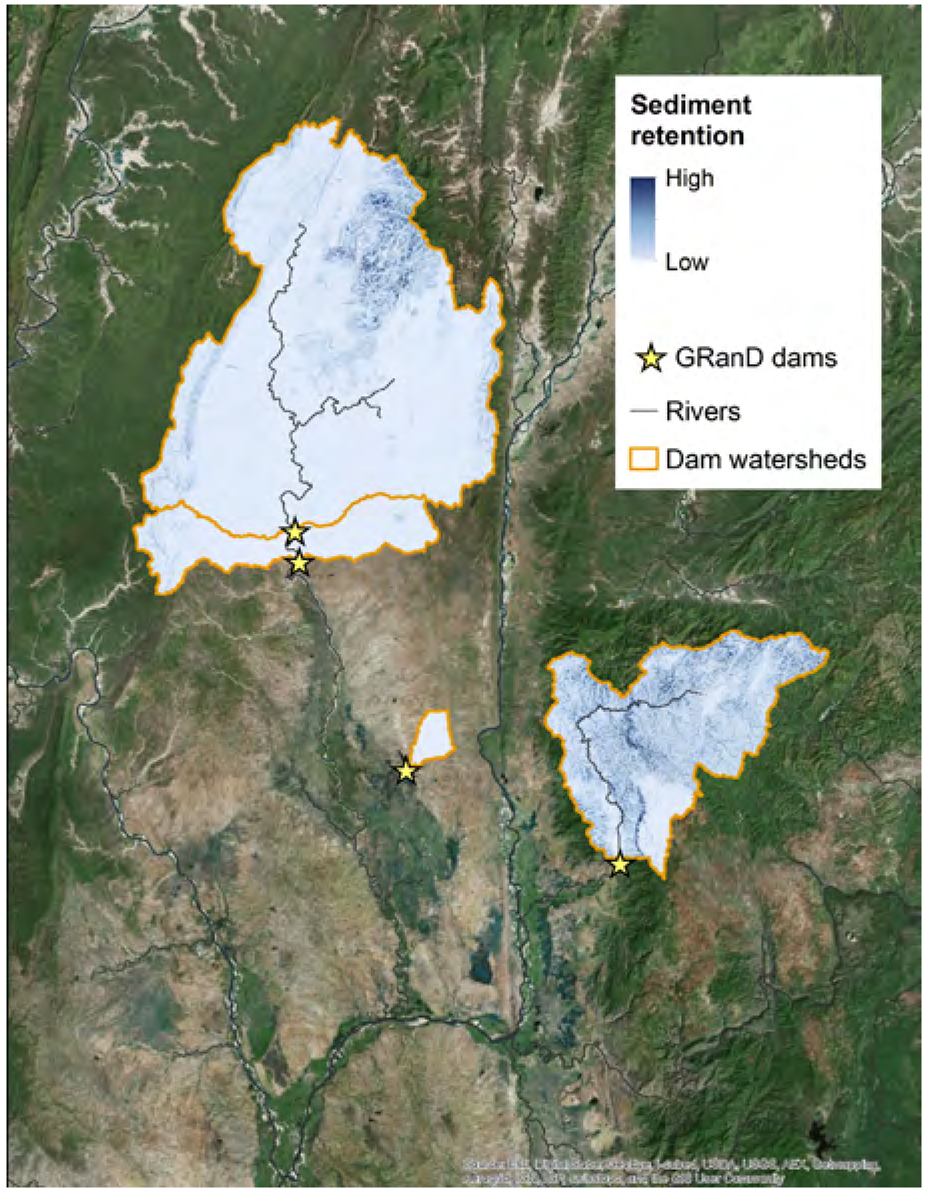
An assessment was done to see where forests and other natural vegetation are most important for keeping sediments from reaching major dams and reservoirs in Myanmar. To do this, information was combined on where ecosystems retain sediment and where this sediment retention occurs upstream of dams and reservoirs, and therefore provides a benefit to this infrastructure by maintaining its function and reducing maintenance costs.

The Global Reservoir and Dam (GRanD) database (Lehner et al. 2011) was used to map the location of 15 major dams within Myanmar and determine the upstream watersheds that govern sediment loads reaching the dams (Map 5a). As previously described, the InVEST Sediment Delivery Ratio model was used to map where loss of forests and other natural ecosystems to agricultural expansion would lead to increases in erosion and therefore in sediment in streams and rivers downstream (Map 5b, same as Map 1b in the drinking water quality section). To determine which dams were at the greatest risk of increased sediment levels from deforestation, Maps 5a and 5b were used to calculate the percent increase in sediment reaching the dam, if all the upstream vegetation were converted to agriculture (Map 5c).

While loss of all vegetation upstream is an extreme scenario, it provides an initial estimate of which dams are at greatest risk. These results could be refined with more realistic scenarios of land use change reflecting specific development plans under consideration. Similar analyses could be repeated with more comprehensive data on existing dams and reservoirs. Such an analysis could also be conducted for new dams under consideration, both to evaluate relative risks to planned infrastructure and to identify and manage areas important for retaining sediment upstream of these dams. For example, Map 5d shows as an example the sediment retention services within the contributing watershed for several dams, highlighting the most important areas retaining sediment upstream. Maintaining sediment retention services in these places would be especially beneficial to maintaining the lifespan and functioning of the dams and reservoirs.

IMPACTS OF CLIMATE CHANGE ON SEDIMENT RETENTION SERVICES FOR DAMS AND RESERVOIRS

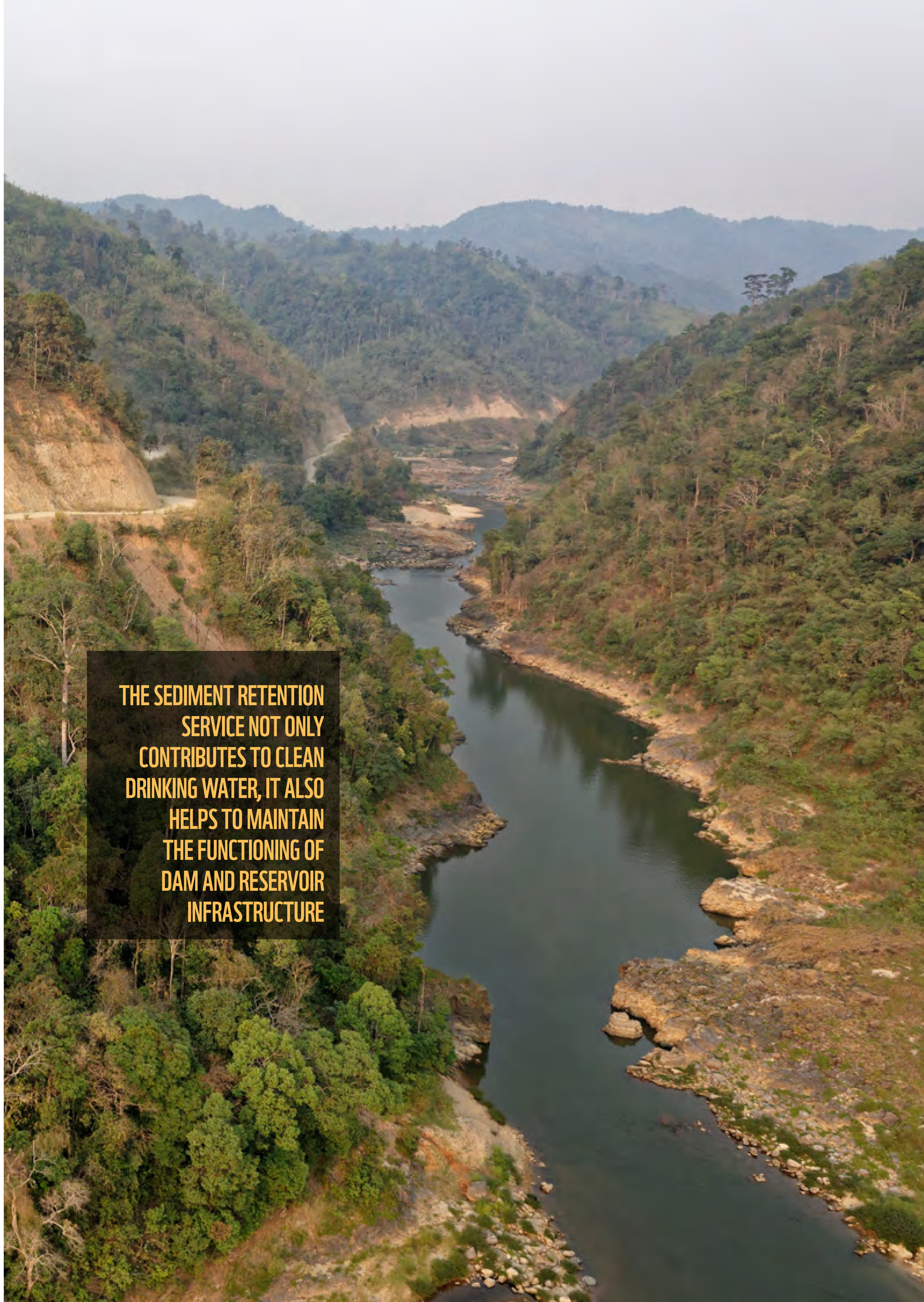
Changes in precipitation patterns are likely to lead to increased sediment loads reaching dams and reservoirs under future scenarios of climate change, even if deforestation were to be halted (Table 1). As previously described in the section on drinking water quality, the areas providing the greatest amount of sediment retention service did not substantially shift with climate change. The dams that are at greatest risk of increased sediment loads from loss of natural vegetation upstream also did not change under the climate scenarios evaluated (Map 5c). This means that managing natural capital to promote sediment retention upstream of dams and reservoirs will continue to provide benefits to dam and reservoir function in the coming decades.



Map 5d.
Sediment retention within 4 selected dams (Thaphanseik, Kintat, Kabo and Sedawgyi.) ***Higher values indicate places where natural vegetation is keeping sediment out of streams, and thus out of the dams/reservoirs.***

DAM NAME	PERCENT CHANGE IN SEDIMENT LOADS UNDER TWO EMISSIONS SCENARIOS			
	RCP 4.5, 2020s, 25th percentile	RCP 8.5, 2020s, 75th percentile	RCP 4.5, 2040s, 25th percentile	RCP 8.5, 2040s, 75th percentile
Alaingni	-5.4	16.1	-2.0	18.5
Gyobyu	-5.8	16.5	-2.7	18.6
Kabo	-7.9	19.9	-5.0	24.7
Kinda	-8.7	15.2	-2.8	24.7
Kintat	-9.0	17.1	-5.5	28.6
Manchaung	-5.5	16.3	-4.7	22.3
Mobye	-8.9	15.1	-2.0	25.7
Natmouk	-7.7	16.4	-2.3	24.4
Ngamoeyeik	-6.0	16.6	-2.8	18.8
Salin	-6.1	16.4	-4.0	23.1
Sedawgyi	-9.2	17.2	-4.7	25.2
Sunchaung	-7.1	16.8	-2.0	25.1
Tabuhla	-5.7	16.6	-2.7	18.6
Taungnawin	-6.6	17.4	-3.1	22.2
Thaphanseik	-9.0	17.0	-5.4	28.8

Table 1.
Change in sediment loads reaching dams under future climate scenarios. *Positive numbers indicate an expected increase in sediment reaching dams under the future climate scenario relative to baseline historical conditions, while negative numbers indicate a decrease.*



THE SEDIMENT RETENTION SERVICE NOT ONLY CONTRIBUTES TO CLEAN DRINKING WATER, IT ALSO HELPS TO MAINTAIN THE FUNCTIONING OF DAM AND RESERVOIR INFRASTRUCTURE

6. OVERLAP BETWEEN IMPORTANT ECOSYSTEM SERVICE PROVISIONING AREAS, KEY BIODIVERSITY AREAS AND CURRENT PROTECTED AREAS

Biodiversity underpins natural capital and the provision of ecosystem services. However, the relationship between biodiversity and ecosystem services is often not straightforward. Those places that are most critical for biodiversity conservation are not necessarily the most important places for ecosystem service provision, and vice versa. To understand the degree to which biodiversity conservation priority areas coincide with the areas providing ecosystem services identified in this natural capital assessment, the overlap between Key Biodiversity Areas (KBAs; Wildlife Conservation Society and Birdlife 2013), currently protected areas and important ecosystem service provisioning areas was examined.

In addition to considering the overlap between KBAs, protected areas and the provision of individual ecosystem services (sediment retention for drinking water quality, regulation of dry season baseflows for drinking water availability, and reduction of flood risk for the 2015 flood-affected villages), areas that are important across all three services were evaluated. These maps were created by normalizing and adding the levels of service provision across services to highlight the areas with the greatest combined service provision across services (Map 6k).

The overlap of KBAs with important ecosystem service providing areas shows that KBAs have value for the ecosystem service benefits they provide, in addition to their value for biodiversity conservation (Maps 6a, c, e, l and o). Marine KBAs in particular (Map 6o) encompass much, but not all, of the habitats most critical for protecting coastal populations from storms. Many of the areas of greatest ecosystem service provision on the terrestrial side, at least for the services assessed here, fall outside of the terrestrial KBAs. However, there is a high degree of overlap between priority corridor areas and important ecosystem service providing areas (Maps 6b, d, f and m), in part because these corridors cover a greater proportion of the country. Conservation efforts in these areas would benefit both biodiversity as well as the people and infrastructure that depend on the natural capital located there. While many KBAs are part of Myanmar's existing or planning protected area network (Map 6g), these corridor areas are largely not protected, putting their biodiversity and ecosystem services at risk if not managed carefully. To secure the ecosystem service benefits provided by these areas, mechanisms such as payment for ecosystem services or other incentives could be considered, depending on the feasibility and appropriateness of establishing additional protected areas.

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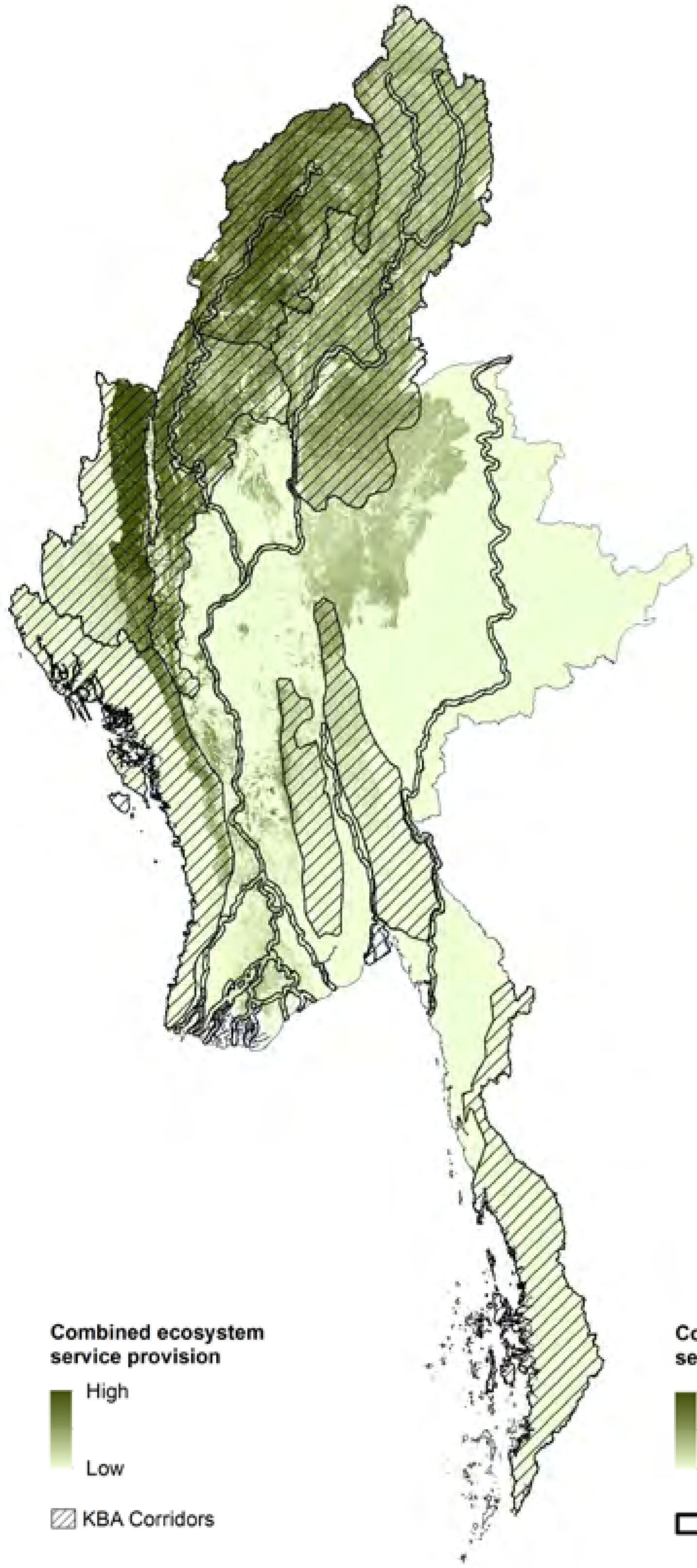
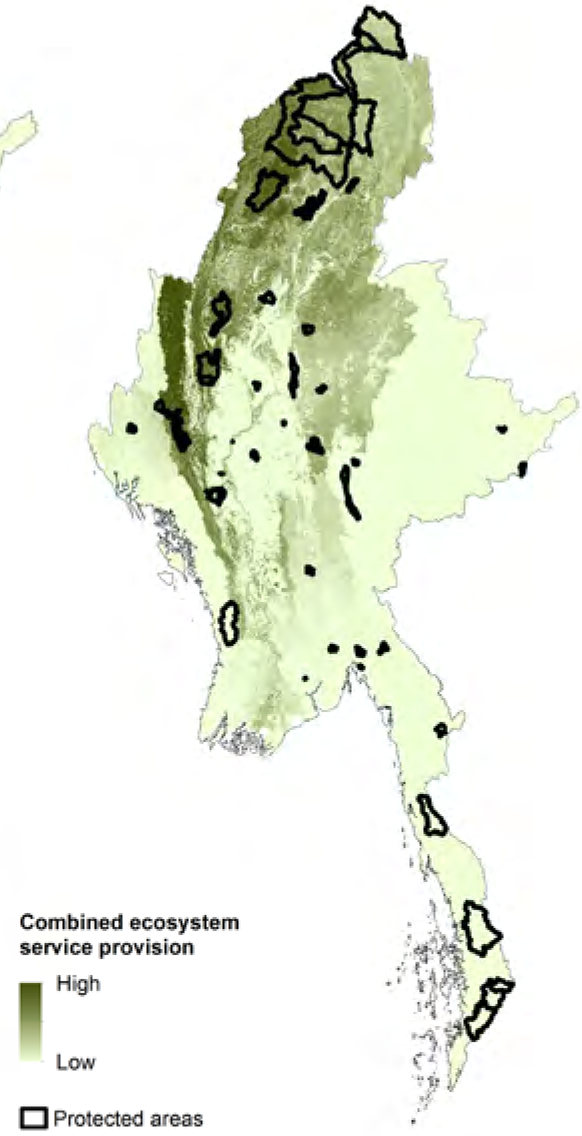
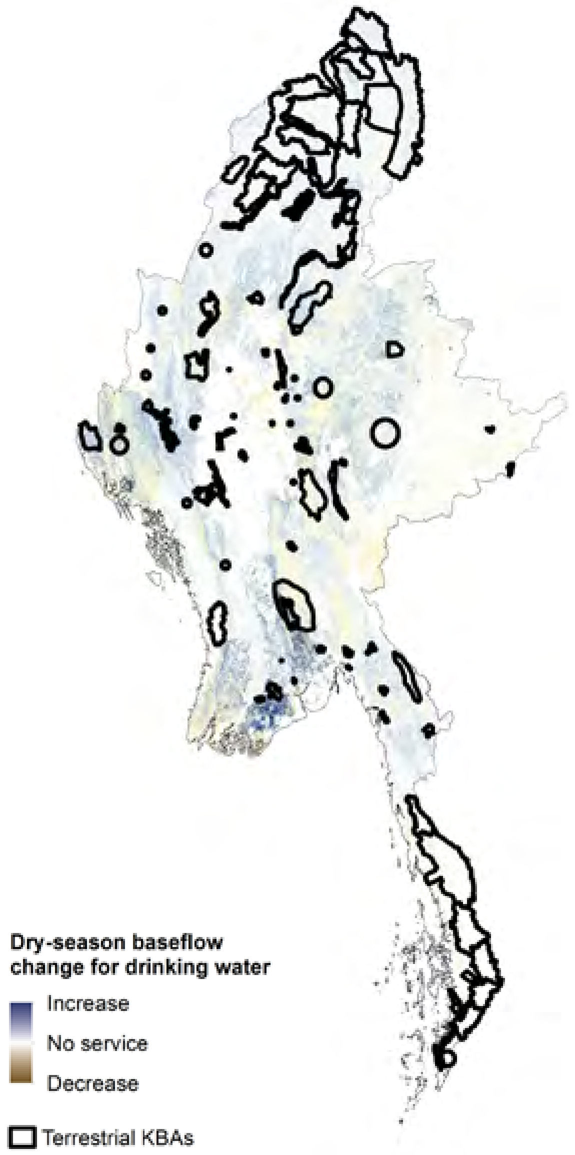


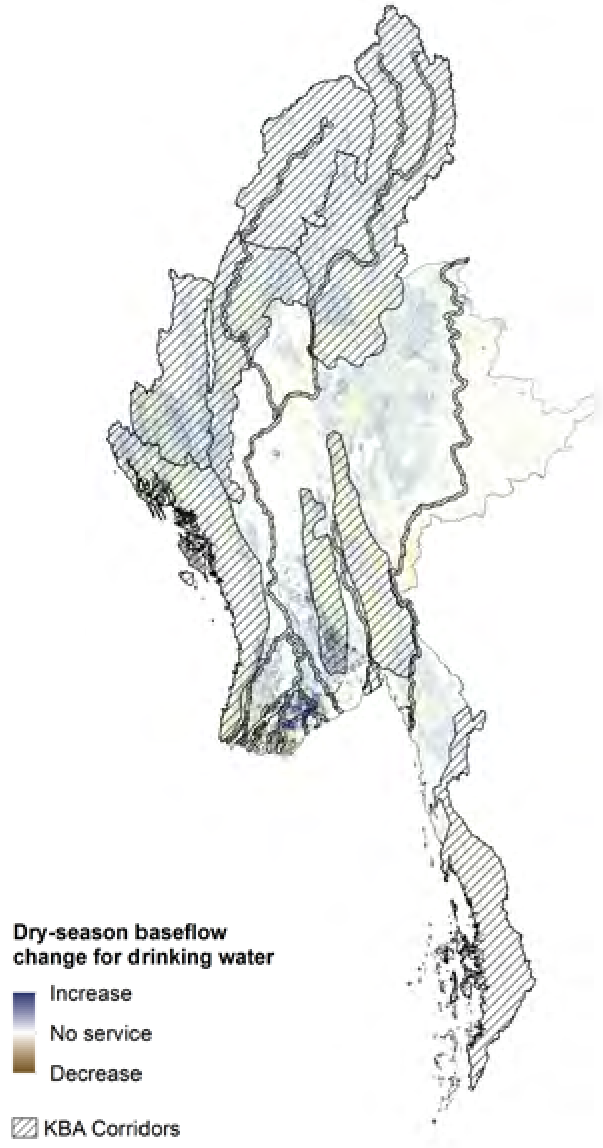
Map 6a.
Map showing where the highest ecosystem service provision occurs across all three terrestrial ecosystem service (sediment retention for drinking water, flood risk reduction for flood-prone villages and dry-season baseflow for drinking water), overlaid with Key Biodiversity Area corridors.



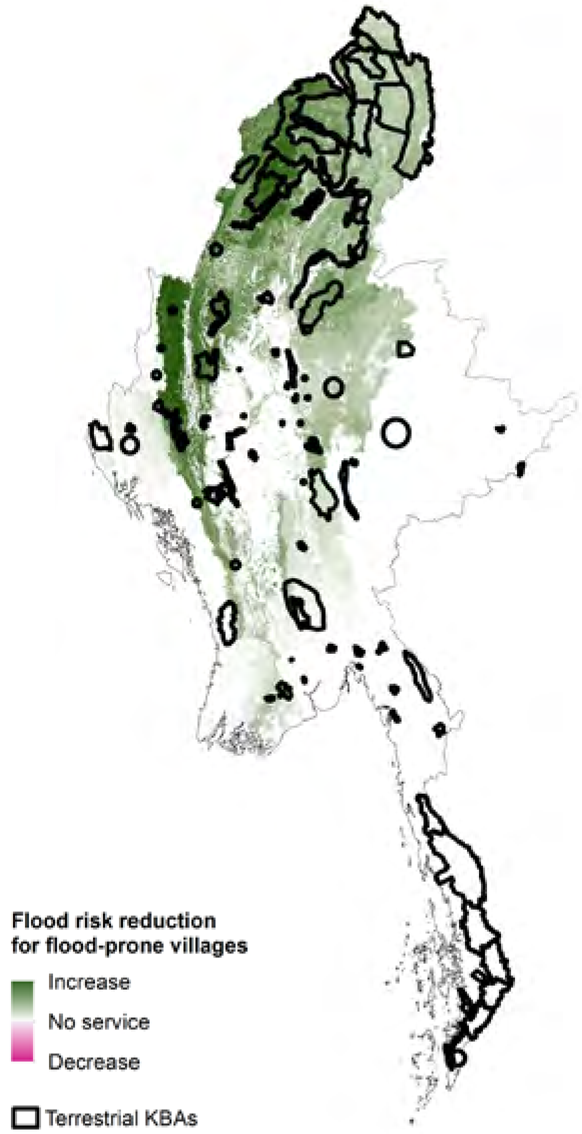
Map 6b.
Map showing where the highest ecosystem service provision occurs across all three terrestrial ES: sediment retention for drinking water, flood risk reduction for flood-prone villages and dry-season baseflow for drinking water, overlaid with currently protected area corridors in Myanmar (such as wildlife sanctuaries and national parks).



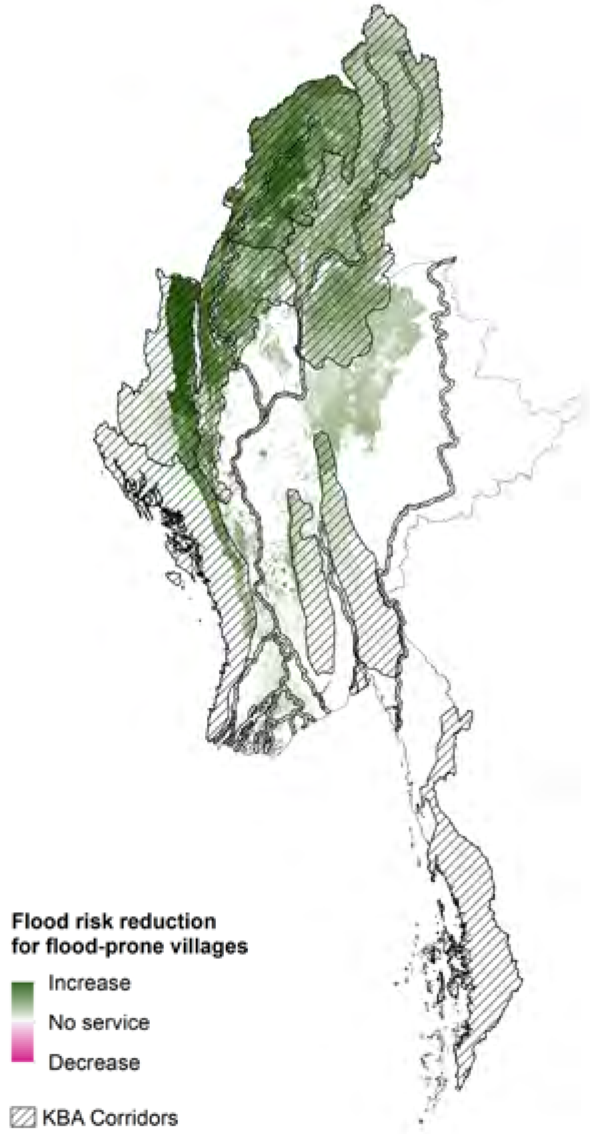
Map 6c.
Natural vegetation's role in providing baseflow to people who use surface water for drinking, overlaid with terrestrial and freshwater Key Biodiversity Areas. *This shows where there are synergies between places that provide services to people and habitat for other species under the current climate.*



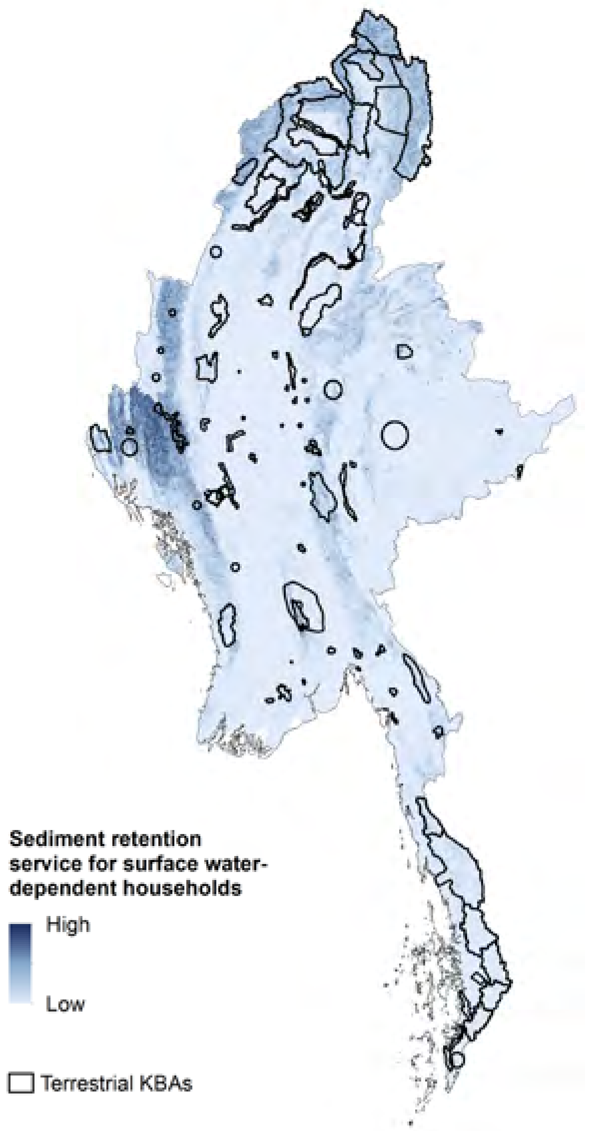
Map 6d.
Natural vegetation's role in providing baseflow to people who use surface water for drinking, overlaid with terrestrial and freshwater Key Biodiversity Area corridors. *This shows where there are synergies between places that provide services to people and habitat for other species under the current climate.*



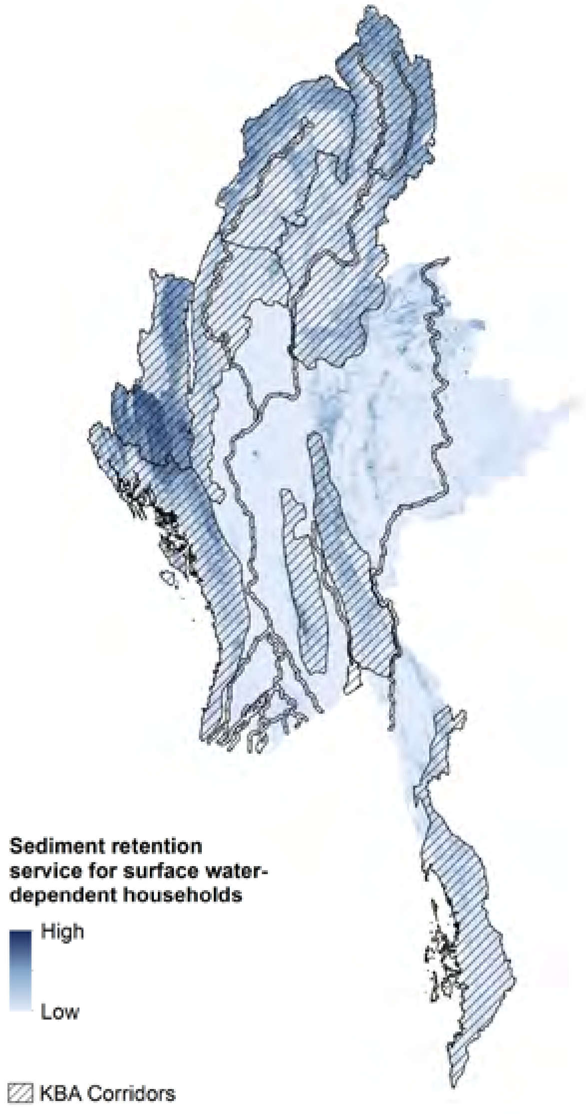
Map 6e.
Natural vegetation's role in reducing flood risk for people who use surface water for drinking, overlaid with terrestrial and freshwater Key Biodiversity Areas. *This shows where there are synergies between places that provide services to people and habitat for other species under the current climate.*



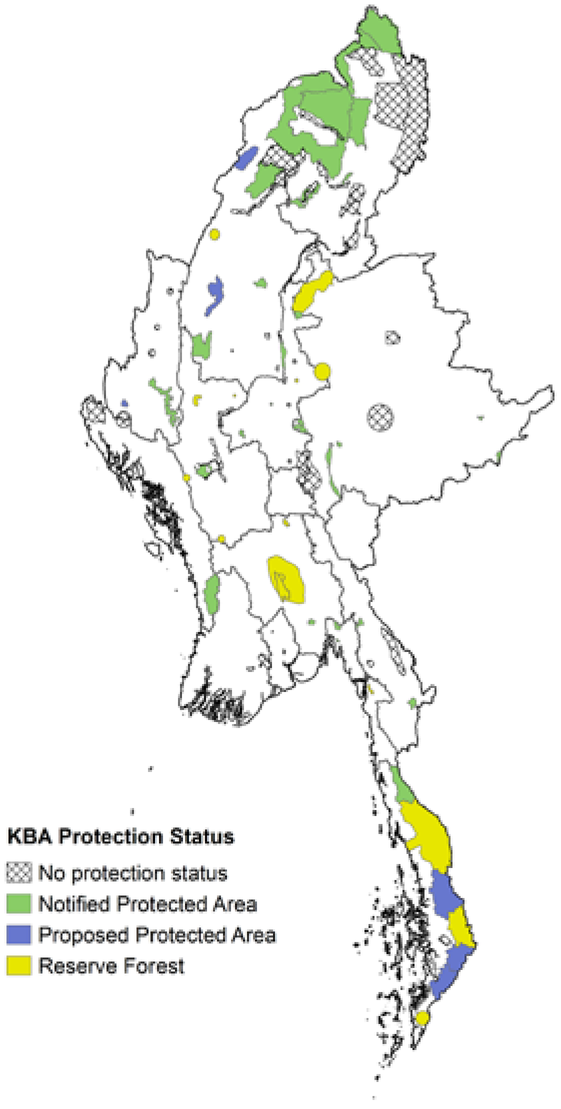
Map 6f.
Natural vegetation's role in reducing flood risk for people who use surface water for drinking, overlaid with terrestrial and freshwater Key Biodiversity Area corridors. *This shows where there are synergies between places that provide services to people and habitat for other species under the current climate.*



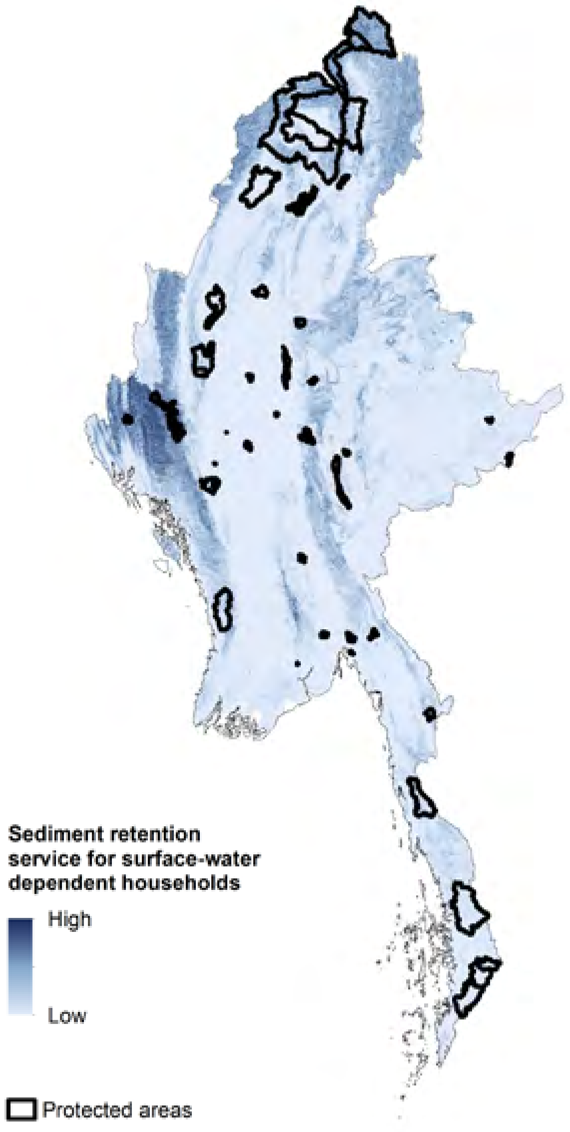
Map 6g.
Sediment retention service for households who use surface water for drinking, overlaid with terrestrial and freshwater Key Biodiversity Areas, under the current climate.



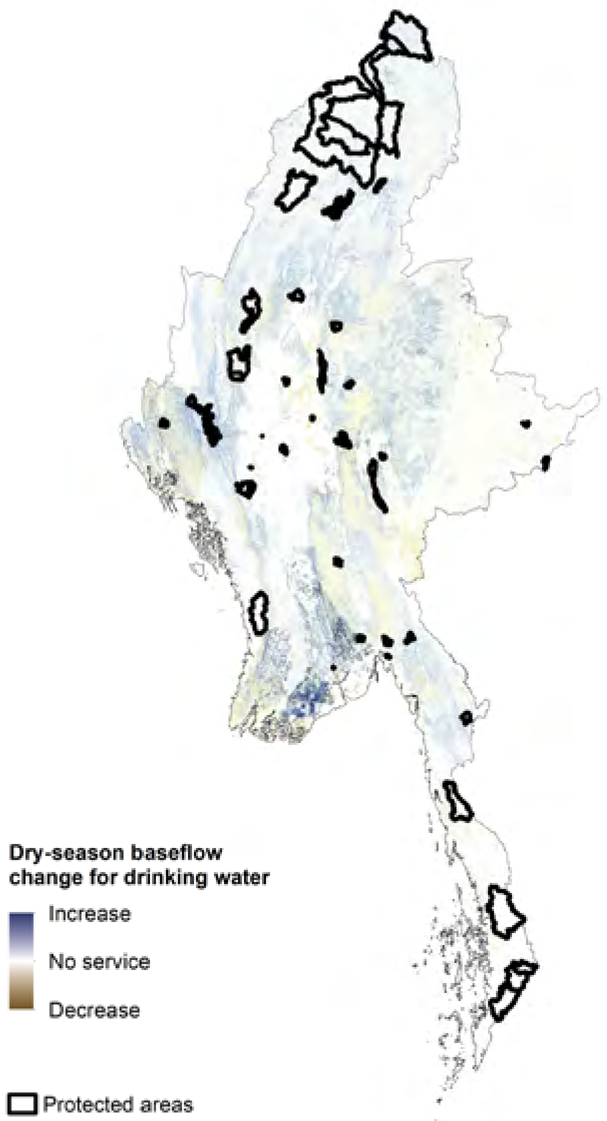
Map 6h.
Sediment retention service for households who use surface water for drinking, overlaid with terrestrial and freshwater Key Biodiversity Area corridors, under the current climate.



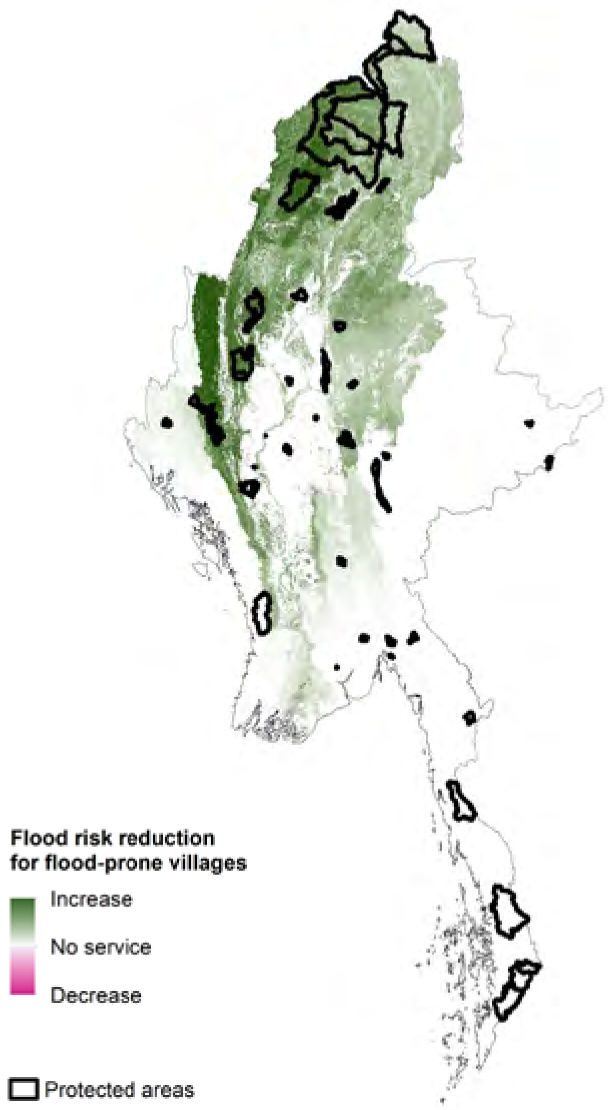
Map 6i.
Key Biodiversity Areas (KBAs) and their current protection status.



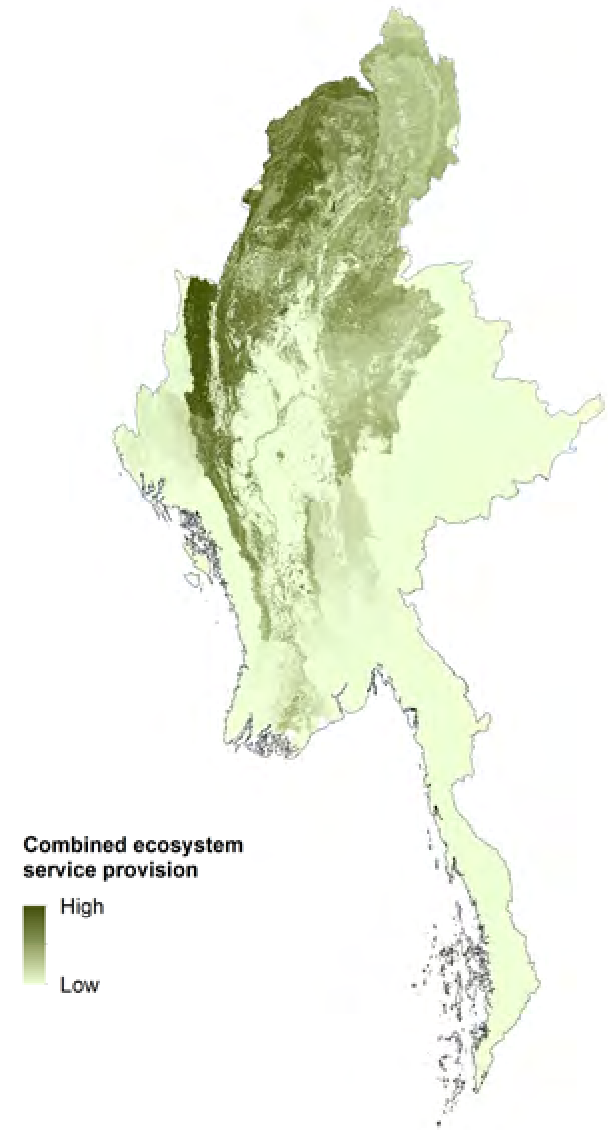
Map 6j.
Sediment retention service for households who use surface water for drinking, overlaid with currently protected areas in Myanmar (such as wildlife sanctuaries and national parks).



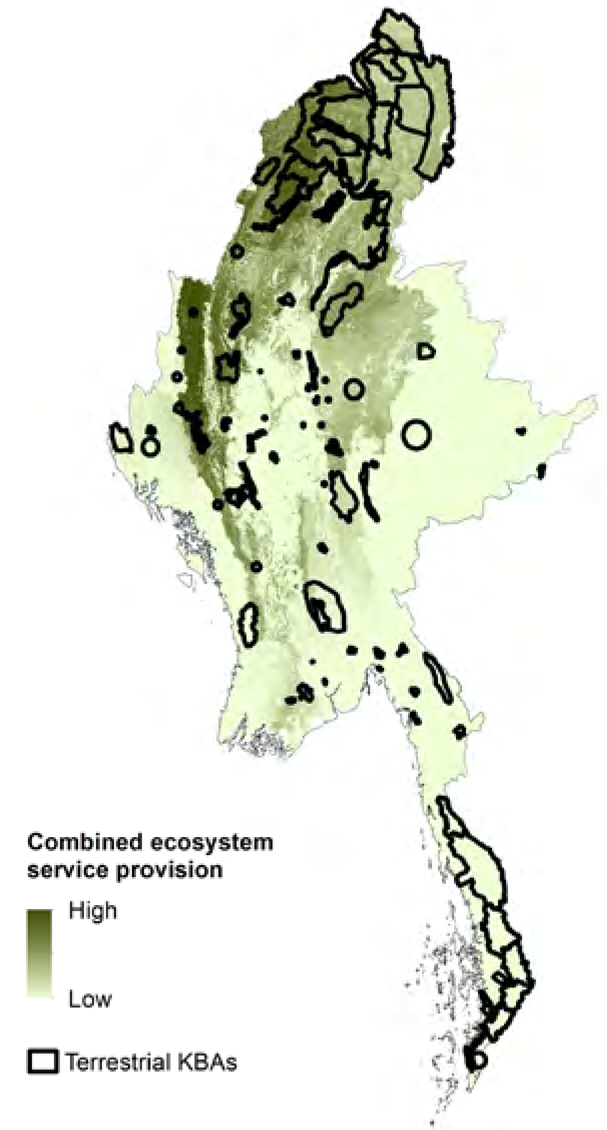
Map 6k.
Dry-season baseflow service for households who use surface water for drinking, overlaid with currently protected areas in Myanmar (such as wildlife sanctuaries and national parks).



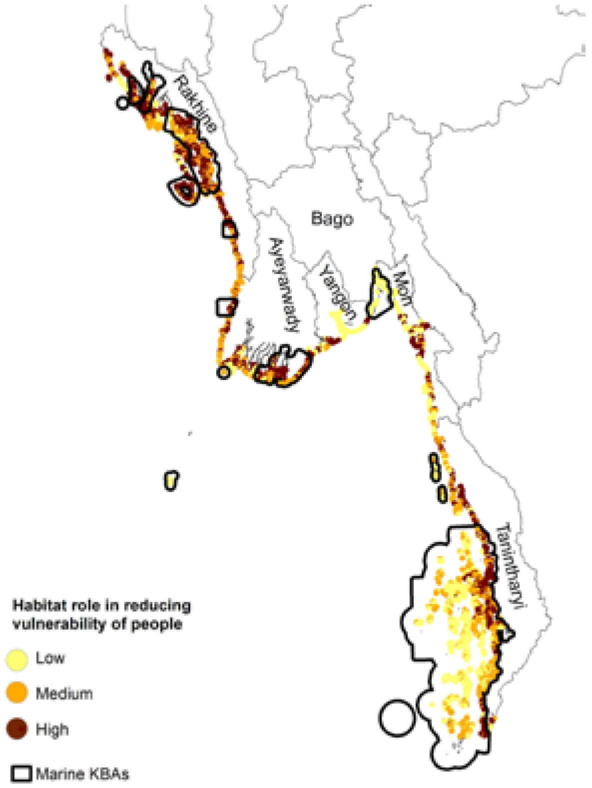
Map 6l.
Flood-risk reduction service for villages prone to flooding, overlaid with currently protected areas in ***Myanmar (such as wildlife sanctuaries and national parks).***

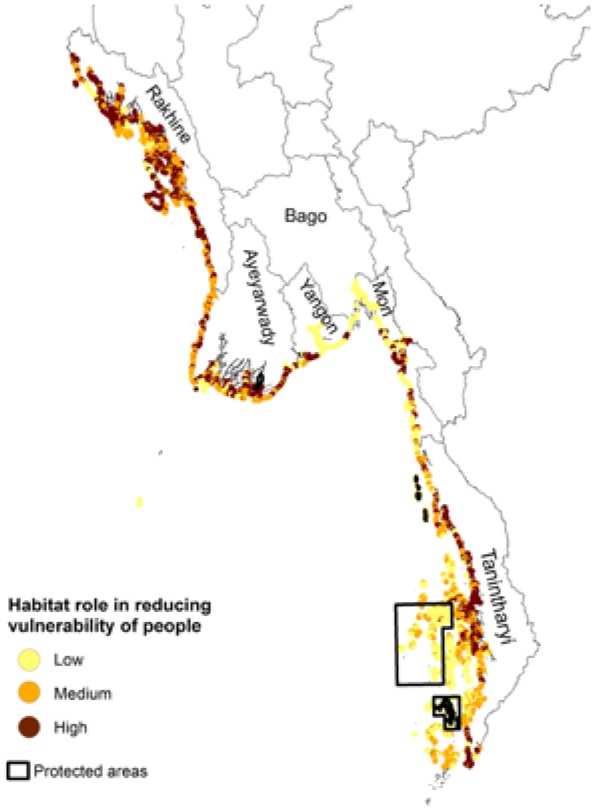


Map 6m.
Map showing where the highest ecosystem services provision occurs across all three terrestrial ecosystem services sediment retention for drinking water, flood risk reduction for flood-prone villages and dry-season baseflow for drinking water.



Map 6n.
Map showing where the highest ecosystem services provision occurs across all three terrestrial ES: sediment retention for drinking water, flood risk reduction for flood-prone villages and dry-season baseflow for drinking water. Overlaid with Key Biodiversity Areas.





Map 6o.
Coastal habitats' (mangroves, coral, sea grass) role in reducing vulnerability of coastal populations to storm surge and erosion overlaid with marine Key Biodiversity Areas. This shows where protection of coastal habitat can benefit both people and ecosystems.

Map 6p.
Coastal habitats' (mangroves, coral, sea grass) role in reducing vulnerability of coastal populations to storm surge and erosion overlaid with currently protected areas in Myanmar.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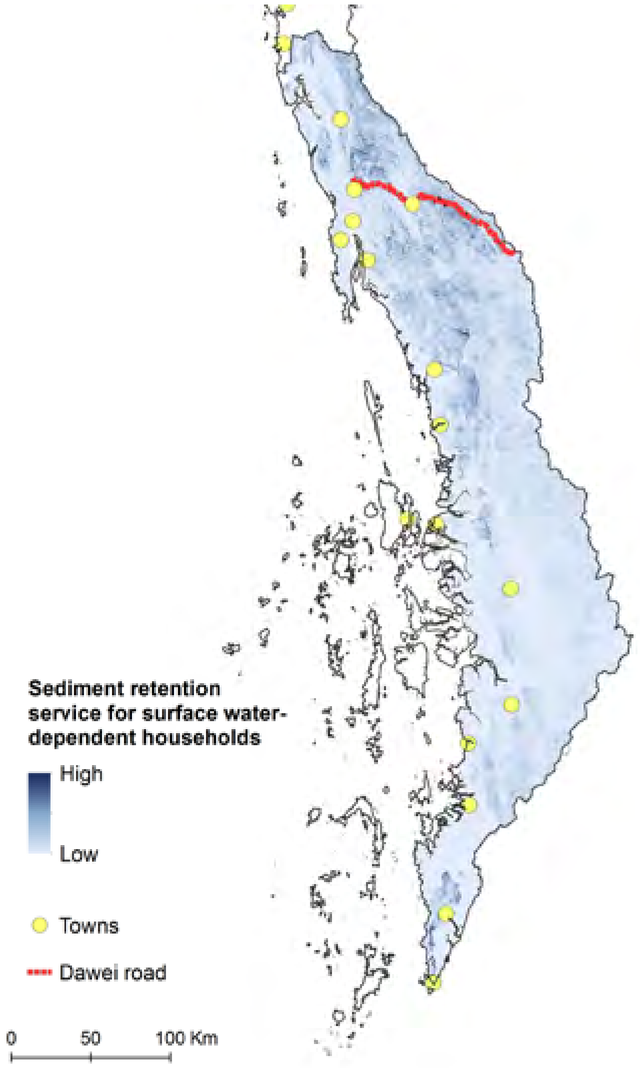
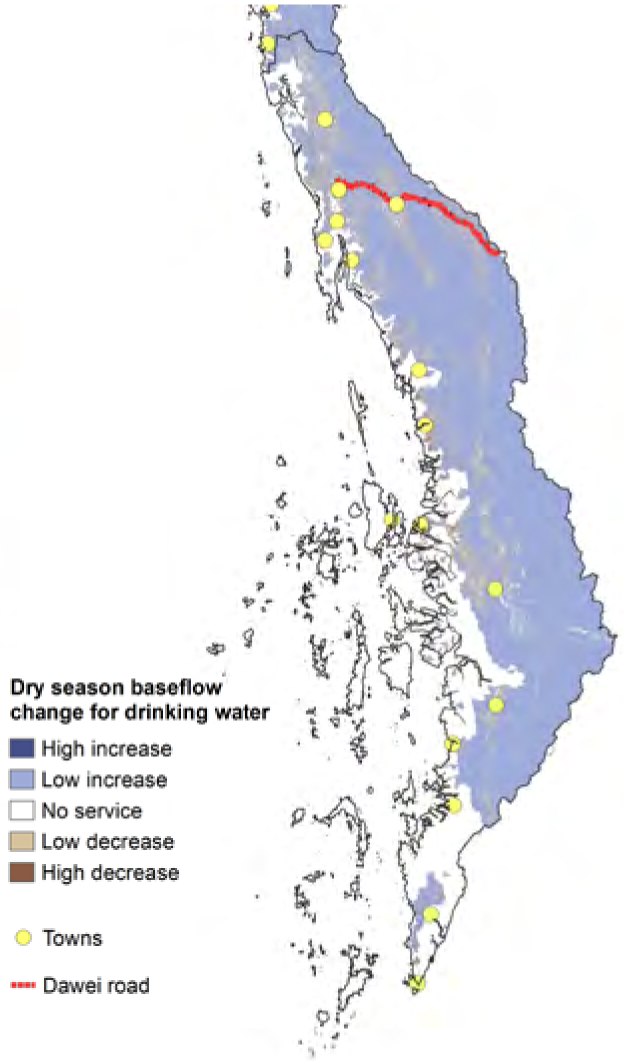
7. ACCOUNTING FOR NATURAL CAPITAL IN REGIONAL PLANNING

Natural capital assessments have value in guiding regional development planning, in addition to their role at the national level. These assessments guide regional resource management decisions, to protect those areas which provide ecosystem services to local communities, and to plan infrastructure and other investments to minimize losses of important natural capital and avoid risks from natural hazards. Due to the rich biodiversity of Tanintharyi and the various development and infrastructure projects planned, the region provides a good example of how natural capital can contribute to regional planning and management decisions. With the planned development of the Dawei Special Economic Zone on the coast and a road-link to Thailand, the region is likely to experience substantial land use change in the near future, with consequences for its natural capital and the ecosystem service benefits on which communities in the region depend.



Map 7a.
Sediment retention service in the Tanintharyi region, with towns and the Dawei road also shown.

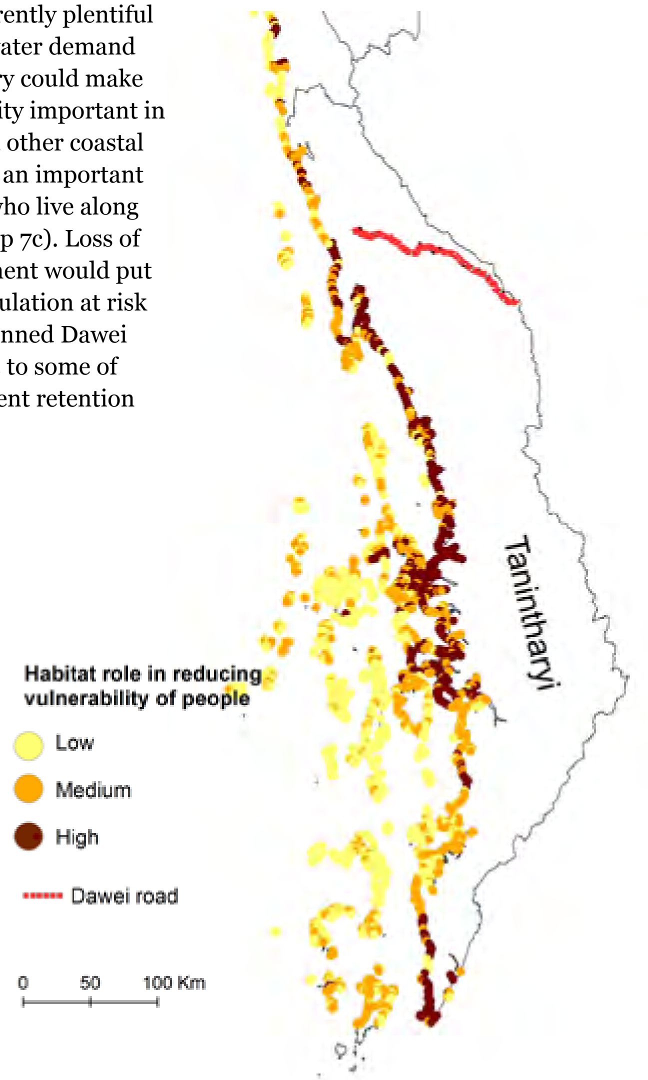


Map 7b.
Role of natural vegetation in providing dry-season baseflow for people using surface water for drinking in the Tanintharyi region, with towns and the Dawei road also shown.

TANINTHARYI'S FORESTS PROVIDE BENEFITS TO PEOPLE LIVING DOWNSTREAM

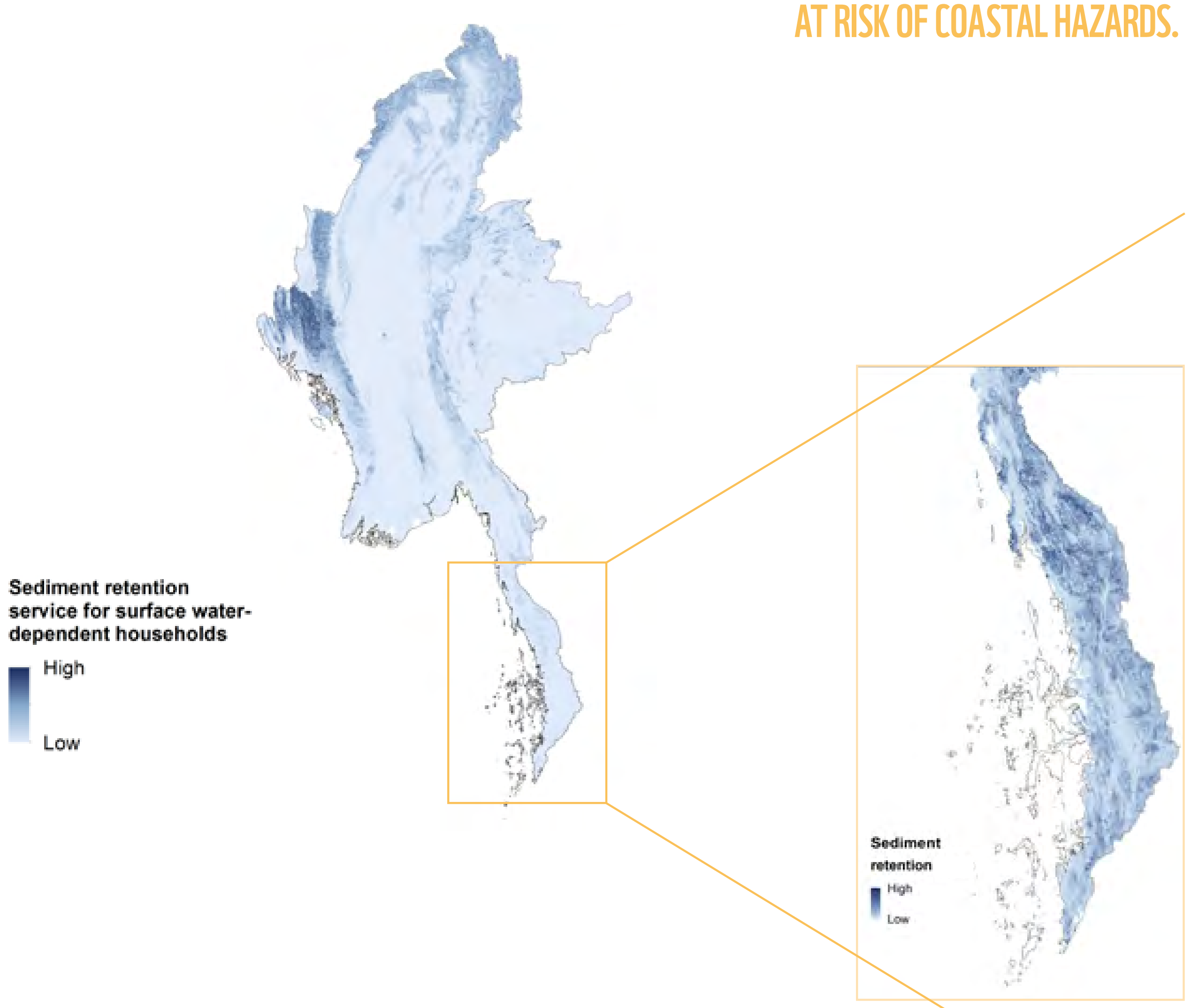
FORESTS IN THE MOUNTAINOUS AREAS OF THE TANINTHARYI PLAY AN IMPORTANT ROLE IN RETAINING SEDIMENT AND MAINTAINING CLEAN WATER FOR DOWNSTREAM POPULATION CENTRES THAT RELY ON RIVERS AND STREAMS FOR THEIR DRINKING WATER (MAP 7A, 7D)

Forests in the mountainous areas of the Tanintharyi play an important role in retaining sediment and maintaining clean water for downstream population centres that rely on rivers and streams for their drinking water (Map 7a, 7d). Much of the forests in the region are important to maintaining dry-season base flows (Map 7b). Although water is currently plentiful in the region, increasing water demand for agriculture and industry could make dry-season water availability important in the future. Mangroves and other coastal habitats in the region play an important role in protecting people who live along the coast from storms (Map 7c). Loss of these habitats to development would put a large segment of the population at risk of coastal hazards. The planned Dawei road runs through or close to some of the most important sediment retention areas in the region. If road development leads to increases in deforestation for mining and other activities in the surrounding area – a pattern observed frequently around roads – this could have substantial impacts on drinking water quality for people in the area.



Map 7c.
Habitat role in reducing vulnerability of coastal populations in the Tanintharyi region.

MANGROVES AND OTHER COASTAL HABITATS IN THE REGION PLAY AN IMPORTANT ROLE IN PROTECTING PEOPLE WHO LIVE ALONG THE COAST FROM STORMS (MAP 7C). LOSS OF THESE HABITATS TO DEVELOPMENT WOULD PUT A LARGE SEGMENT OF THE POPULATION AT RISK OF COASTAL HAZARDS.



Sediment retention weighted by downstream population

Sediment retention NOT weighted by downstream population

Map 7d.

At a national extent (left), the forests in the north and west stand out as areas providing clean drinking water to densely populated populated areas downstream such as Bago, the Ayeyarwady delta, and the Yangon area. Areas such as Tanintharyi are less densely populated compared to the above areas, and therefore the importance of the forests in these areas to local people is less visible in a national map. However, by zooming in (right), it becomes clear that the forests in Tanintharyi play a substantial role in retaining sediment, thereby potentially benefiting local communities.

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HOW TO USE THIS ASSESSMENT

Understanding how Myanmar's economy and people depend on its natural capital and how investments and climate change might threaten these services is important to ensuring that strategies and policies now under consideration pave the way for more sustainable, climate-resilient development. Natural capital assessments can facilitate coordinated planning across sectors, providing an understanding of how existing and planned investments both impact and depend on natural capital and the benefits it provides. These assessments can also support planning and development within key sectors, including agriculture and food security; environment and natural resources; energy, transport, and industry; urban, building and human settlements; education, awareness, science and technology; and disaster risk reduction, health and early-warning systems.

The information provided in this report could support the following processes:

POLICIES AND STRATEGIES

- Supporting the development and implementation of strategies and policies (existing or under development) including the green economy policy and strategic framework, the climate change strategy, and environmental policy;

LAND USE PLANNING

- Informing both national, regional and township level land use planning processes
- Understanding trade-offs and identifying alternative options for infrastructure development
- Optimizing social, economic and environmental benefits while avoiding the same associated costs

INVESTMENTS

- Providing input to Strategic Environmental Assessments and Environmental Impact Assessments, especially for assessing cumulative impacts;
- Developing sector-specific guidelines for investments and ensuring that impact on natural capital is avoided, minimized and mitigated;
- Serving as a basis for environmental management plans;
- Improved capacity to understand relationships between natural capital, climate change and economic development

CONSERVATION

- Identifying areas where conservation should be supported or enhanced and where investments in managing natural capital are needed;
- Guiding protected-area identification and management;

SUSTAINABLE FINANCING

- Supporting the development of payments for ecosystem services schemes;
- Providing input to natural capital accounting and including the value of nature in national accounting systems

POSSIBLE NEXT STEPS OF THIS WORK THAT COULD FURTHER THE ABOVE PROCESSES INCLUDE:

1. Using climate-informed development scenarios to evaluate outcome-specific development pathways or options being considered at the national, regional or local levels.
2. Expanding the set of ecosystem services included in the assessment, such as fisheries, agriculture, or other nature-based benefits important to livelihoods and the economy.
3. Incorporating improved data as they become available, such as updated land use or land cover maps, higher-resolution agricultural maps, more complete information on existing and planned infrastructure, and climate scenarios with higher temporal resolution and including extreme events.
4. Linking assessments to relevant economic and well-being indicators and to development plans for key sectors.
5. Increasing monitoring of ecosystem change coupled with weather, climate and sea level rise data to improve management of natural capital under changing climatic conditions.
6. Increasing weather monitoring efforts at daily and sub-daily scales for climate change and its impacts on development efforts and on Myanmar's natural capital can be tracked over time.

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CONCLUSIONS

Natural ecosystems such as mangroves, forests and wetlands provide important benefits to Myanmar's people and economy – supporting clean drinking water, reducing the risk of natural hazards, and helping to maintain the functioning of infrastructure investments such as reservoirs and dams. Planning the development of infrastructure, agriculture, and other sectors in Myanmar in ways that sustain this natural capital is vital to achieving inclusive and sustainable growth. The information provided by natural capital assessments can be used to avoid development in places that would cause the greatest losses, to understand how policies, plans and projects are likely both to impact and depend on natural capital, and to ensure that the necessary investments are made to sustain the benefits it provides.

Climate change will undoubtedly have consequences for natural capital and ecosystem services. Sea-level rise may inundate mangroves and other coastal ecosystems. Changing rainfall patterns may exacerbate erosion and flooding in some regions. In the face of increasing precipitation, forests are expected to keep even greater amounts of sediment out of waterways, making their protection increasingly important for water quality and reservoir and dam functioning. Loss of natural capital is likely to exacerbate the threats posed by climate change to other ecosystem services as well. Wise management of Myanmar's natural capital is especially important in the face of these challenges and a critical component of climate change adaptation. Notably, the areas providing the greatest sources of ecosystem service benefits are not likely to change over the next several decades, meaning that measures taken now to protect these areas will continue to provide benefits for decades to come.

Many parts of the country that provide ecosystem services have also been identified as being rich in biodiversity, or part of corridors that allow the movement of wildlife. This makes it all the more important to protect and manage these areas, which benefit people, infrastructure and biodiversity. Many are not now protected, leaving them open to encroachment, exploitative development and degradation. Prioritizing conservation in these areas would help ensure that their many benefits would continue to be at the service of the country and its people into the future.

By taking advantage of the findings of this report, Myanmar can secure its current wealth of natural capital assets and ecosystem service benefits for current and future generations, and promote a more sustainable and inclusive path to development.

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