Using spatial analysis to explore synergies between the Aichi Biodiversity Targets and REDD+ in the Philippines

A preliminary analysis

REDD pac

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Executive summary

- Action for REDD+ under the United Nations Framework Convention on Climate Change (UNFCCC) can contribute towards achieving the Aichi Biodiversity Targets, and vice versa. However, how National Biodiversity Strategy and Action Plans (NBSAPs) and REDD+ activities are ultimately planned and implemented is key to determining the extent of synergies and complementarities.

- The Philippines is presently in the process of revising its NBSAP under the Convention on Biological Diversity's (CBD), and has had a REDD+ Strategy in place since 2010. Spatial overlay maps, such as those presented in this report, can help identify locations where synergies can be achieved between actions which contribute to the Aichi Biodiversity Targets and REDD+.

- Information on past trends in forest cover, alongside an understanding of the drivers of deforestation and forest degradation, can support both NBSAP and REDD+ planning. Additionally, REDD+ requires information on existing carbon stocks in forests.

- Multiple drivers of deforestation exist and information on a range of factors that relate to these drivers can be useful in the context of addressing pressures on biodiversity and forests in the Philippines. These include those examined in this report: illegal logging hotspot areas, wildfires, and population density.

- Considering priority areas of biodiversity within REDD+ planning can potentially secure multiple benefits from REDD+ and help contribute to achieving the Aichi Biodiversity Targets. For example, this report explores how prioritising areas of importance for biodiversity under REDD+ could contribute to Aichi Biodiversity Target 5 (halving the rate of loss of all natural habitats, including forests and significantly reducing degradation and fragmentation) and Aichi Biodiversity Target 12 (preventing the extinction of known threatened species, and improving and sustaining their conservation status).

- Spatial analysis can support planning for ecosystem services such as soil erosion control. It allows exploring where existing forests play an important role in preventing soil erosion, and where forest restoration could potentially reduce soil erosion. The latter could potentially inform site selection under the National Greening Programme.

- The most useful analysis for supporting planning varies depending on which activities are being considered. Several examples are highlighted in this report, including analysis to support planning for the sustainable management of forests under REDD+ in line with the Aichi Biodiversity Target 7 (sustainably managing areas under agriculture, aquaculture and forestry, ensuring conservation of biodiversity), and analysis to support planning for reducing deforestation and forest degradation.

- Overall, joint planning for achieving the Aichi Biodiversity Targets and REDD+ that takes into account relevant spatial information, could help the Philippines develop complementary approaches, coordinate efforts between ministries, and build coherent biodiversity conservation, climate change mitigation, and land use policies.

Camp John Hay Forest Overlooking Baguio © Jun's World (CC-BY2.0) https://flic.kr/p/9XAJuS

1. Introduction

1.1 What are the Aichi Biodiversity Targets?

In October 2010, the Parties to the Convention on Biological Diversity (CBD) adopted a time-bound framework for action on biodiversity in the form of the Strategic Plan for Biodiversity for the period 2011-2020, and its 20 Aichi Biodiversity Targets. These targets include objectives such as conservation of marine and terrestrial ecosystems, access to genetic resources and benefits arising from their use, and ambitious targets for the conservation, sustainable use and restoration of forests. The targets are global, but actions to achieve them are primarily implemented at the national, sub-national and local level. The Strategic Plan is translated into national circumstances and implemented by countries through National Biodiversity Strategies and Action Plans (NBSAPs). Countries are supposed to ensure that their NBSAPs are mainstreamed into all sectors which have an impact (be it positive or negative) on biodiversity. At present, most countries, including the Philippines are in the process of submitting updated NBSAPs following the launch of the Strategic Plan.

1.2 What is REDD+?

According to the latest estimate from the Intergovernmental Panel on Climate Change (IPCC) (2013), land-use change, largely from deforestation, has accounted for an estimated net contribution of 10% of global anthropogenic emissions in the past decade. Maintaining, enhancing and managing forest carbon stocks can therefore make a significant contribution to global climate change mitigation. However, pressures that lead to the conversion and degradation of forests continue to be high, particularly in forest-rich developing nations. Under the United Nations Framework Convention on Climate Change (UNFCCC), countries are preparing to address this issue through REDD+: a proposed climate change mitigation mechanism aiming to significantly reduce greenhouse gas emissions from deforestation and forest degradation in developing countries, and increase carbon sequestration by forests, in a manner which also promotes the sustainable development of the countries involved (see Figure 1).

Figure 1: The five activities of REDD+, as described by the UNFCCC (Decision 1/CP.16)

REDD+

=

Reducing Emissions from
Deforestation and forest Degradation

\+

Conservation of forest carbon stocks
Sustainable management of forests
Enhancement of forest carbon stocks

The retention, restoration or better management of forests through REDD+ that would otherwise have been lost or degraded has the potential to deliver multiple benefits in addition to carbon. Social benefits potentially include job creation, clarification of land tenure or improved livelihoods due to carbon credit payments (CBD/GmbH, 2011; Duchelle et al., 2014; Knox et al., 2011). Potential environmental benefits include the conservation of forest biodiversity and ecosystem services[1], for example water regulation, soil conservation and the provision of timber, food and other non-timber forest products.

Depending on how it is planned and implemented, REDD+ could also pose social and environmental risks. For example, if forests are protected from conversion to agriculture, but the drivers of conversion are not addressed, other ecosystems are likely to become threatened as this pressure is displaced. In 2010, Parties to the UNFCCC recognised the social and environmental benefits and risks of REDD+, and agreed to promote and support a set of "Cancun safeguards" for REDD+ (Box 1). If these safeguards are appropriately addressed and respected, REDD+ should deliver multiple benefits with minimal risk.

[1] Ecosystem services are the benefits people obtain from ecosystems. These include provisioning services such as food, water, timber, and fibre; regulating services that affect climate, floods, disease, wastes, and water quality; cultural services that provide recreational, aesthetic, and spiritual benefits; and supporting services such as soil formation, photosynthesis, and nutrient cycling (MA, 2005).

1.3 Why explore synergies between the two?

As countries prepare to implement activities aimed at achieving the Aichi Biodiversity Targets, it may be helpful to consider how these activities relate to and complement actions which support REDD+ planning and implementation, and consequently, to promote synergies between them. If the REDD+ Cancun safeguards are respected and addressed, this will increase the ability of REDD+ to contribute towards achieving the Aichi Biodiversity Targets. The Cancun safeguards promote REDD+ actions consistent with the conservation of natural forests and biological diversity, and that effectively involve indigenous people and local communities.

While REDD+ holds promise for biodiversity conservation, it should be noted that REDD+ cannot contribute to the achievement of all the Aichi Biodiversity Targets, since these are broader than forest and its role in climate change mitigation. The achievement of the Aichi Biodiversity Targets could also sometimes be hindered under REDD+ if pressure on forest land were displaced across national boundaries or into other ecosystems. Still, joint planning for achievement of the Aichi Biodiversity Targets and REDD+ implementation could help countries to develop cost-effective and complementary approaches to biodiversity conservation and climate change mitigation.

Since responsibilities for CBD and REDD+ implementation are often held by different ministries (or departments within ministries), coordination of their efforts could help to enhance likely synergies, and minimise any conflicts. This is also applicable to wider cross-sectoral coordination with ministries responsible for agriculture, energy, infrastructure and extractive resources. Coordination may be particularly important during the policy development, information-sharing, and stake-holder consultation processes. Efforts to collect information, manage and share datasets on forests, biodiversity and other national priority areas could ensure coherent land use policies.

Joint planning for implementation of the Aichi Biodiversity Targets and REDD+ holds great relevance for a country such as the Philippines. Having ratified both the Convention on Biological Diversity (CBD) and the Kyoto Protocol under the UNFCCC, the Philippines is currently in the process of revising its NBSAP under the CBD, and has had a REDD+ Strategy in place since 2010. This report presents the outcomes of a national workshop conducted by United Nations Environment Programme World Conservation Monitoring Centre (UNEP-WCMC) in October 2013 with the Department for Environment and Natural Resources as part of the German government funded REDD-PAC project. The workshop aimed to demonstrate how spatial data can be used by national decision makers to inform where REDD+ could also help to meet a country's biodiversity conservation targets under the CBD.

Box 1: REDD+ safeguards identified in Appendix I of Decision 1/CP.16

When undertaking the activities referred to in paragraph 70 of this decision, the following safeguards should be promoted and supported:

a) That actions complement or are consistent with the objectives of national forest programmes and relevant international conventions and agreements;

b) Transparent and effective national forest governance structures, taking into account national legislation and sovereignty;

c) Respect for the knowledge and rights of indigenous peoples and members of local communities, by taking into account relevant international obligations, national circumstances and laws, and noting that the United Nations General Assembly has adopted the United Nations Declaration on the Rights of Indigenous Peoples;

d) The full and effective participation of relevant stakeholders, in particular indigenous peoples and local communities, in the actions referred to in paragraphs 70 and 72 of this decision;

e) That actions are consistent with the conservation of natural forests and biological diversity, ensuring that the actions referred to in paragraph 70 of this decision are not used for the conversion of natural forests, but are instead used to incentivize the protection and conservation of natural forests and their ecosystem services, and to enhance other social and environmental benefits;

f) Actions to address the risks of reversals;

g) Actions to reduce displacement of emissions.

2 The Philippines context

2.1 Forests and biodiversity in the Philippines

Map 1: Location of the Philippines

The Philippines is a 30 million ha archipelago in Southeast Asia consisting of more than 7,000 islands nestled between the South China, Philippine, Sulu and Celebes seas. Neighbouring countries include China to the North, Viet Nam to the West, Malaysia and Indonesia to the South, and Papua New Guinea to the Southeast (Map 1). The Philippines contains an estimated 7.7 million ha of forest, covering approximately 26% of the country's national territory (FAO, 2010). The 2003 land cover map (Map 2) developed by the Department of Environment and Natural Resources (DENR) and Philippines National Mapping and Resource Information Authority (NAMRIA) distinguishes between three main types of forest: open canopy forest, closed canopy forest, and mangroves. Brushland, another prominent land cover type consisting of areas dominated by a discontinuous cover of shrubby vegetation, covers more than 10.1 million ha and estimated at 34% of the country's land area. An updated 2010 land cover map was released by NAMRIA in late 2013, after the REDD-PAC working session had been completed. This map would give more accurate figures of land cover relative to the figures estimated from previous land-use studies used in the FAO study.

Deforestation rates in the Philippines have dropped significantly in the last decade. While the country was among the top ten countries contributing to greenhouse gas emissions from deforestation in the early to mid 2000s, according to the FAO it had positive forest growth (55,000 ha/year) between 2005 and 2010 (FAO, 2010; GIZ, 2012). However, recent national analysis by NAMRIA indicate that there has been deforestation between 2003 and 2010, at a rate of over 328, 000 ha or 4% (DENR FMB, 2014). Pressures on forests still exist, including from logging, fuelwood gathering and charcoal making, agricultural expansion (especially Kaingin making – the slashing and burning of the understorey and trees as part of shifting cultivation) and infrastructure expansion (e.g. due to expansion of the mining sector) (GIZ, 2012).

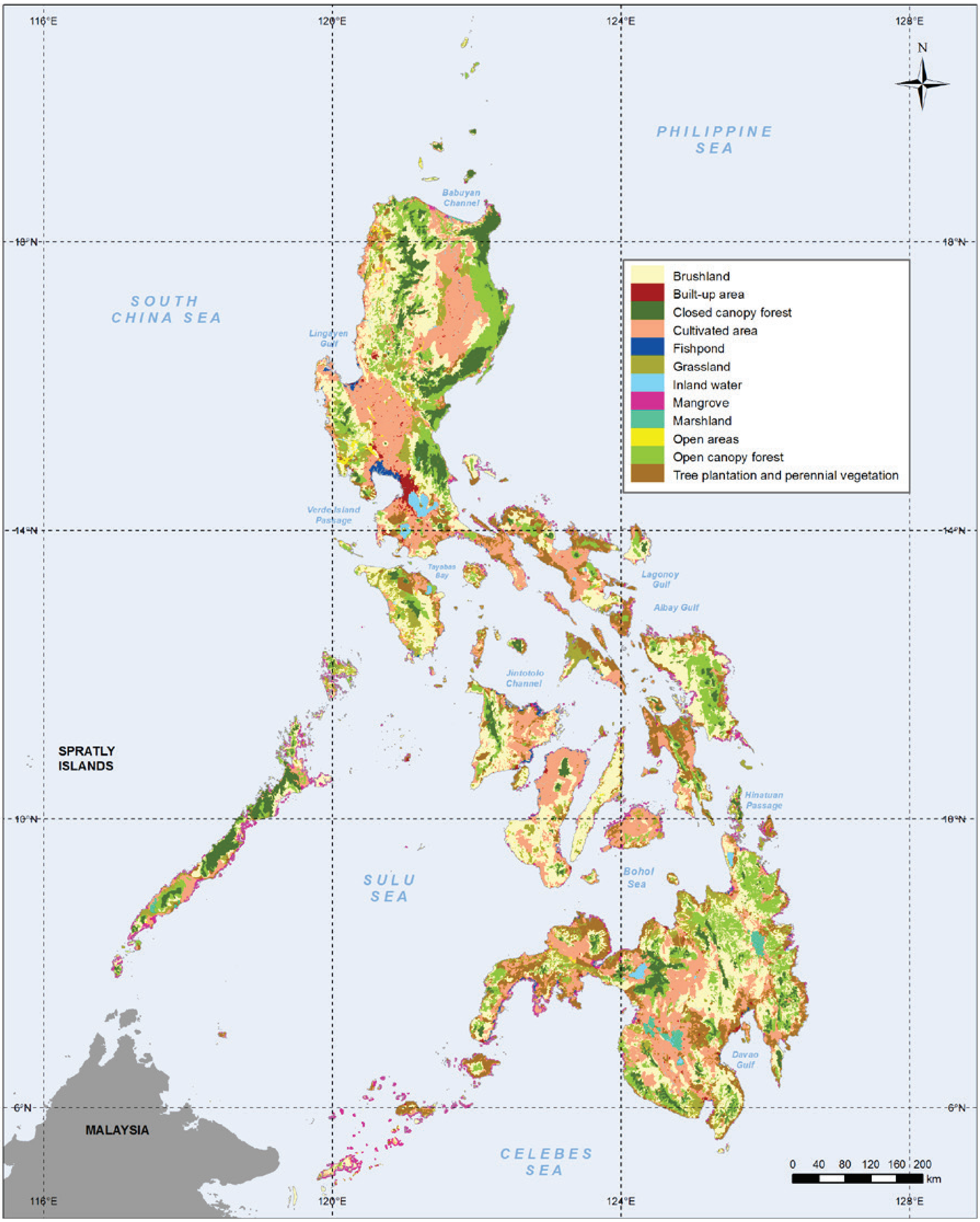
Ownership and management of the forest land falls under the Forest Management Bureau of DENR, while the Biodiversity Management Bureau is responsible for the conservation and management of the country's considerable network of 240 protected areas, covering 5.45 million ha (Biodiversity Management Bureau, 2013).

Many of these protected areas are a haven for the country's flora and fauna, which are among the most diverse in the world. Due to its geographical isolation, diversity of habitats and high rates of endemism, the Philippines is one of 17 megadiversity countries, which together hold two thirds of the earth's biodiversity, and approximately 70-80% of its animal and plant species (DENR, 2009; Mittermeier et al., 1999).

The Philippines is also a country with a high number (>700) of threatened species, including 38 species of mammals, 74 species of birds, 39 species of reptiles, 48 species of amphibians, and 229 species of plants classified as either critically endangered, endangered or vulnerable (IUCN, 2013).

Tigum-Aganan River in Iloilo Province © Engr. Eugenio O. Diaz, Jr, DENR River Basin Control Office

Map 2: Land Cover Map of the Republic of the Philippines 2003. The map distinguishes between three main types of forest: open canopy forests, closed canopy forest and mangroves.



Methods and data sources:
2003 Land Cover Map: Republic of the Philippines Department of Environment and Natural Resources (DENR), National Mapping and Resource Information Authority (NAMRIA) (2004).

All map analyses presented in this report have used the following projection: WGS84 / Lambert Azimuthal Equal Area (Central Meridian 123° E)

2.2 Aichi Biodiversity Targets and the Philippines

The Philippines ratified the CBD in 1993. Its NBSAP, the primary instrument for implementing the Convention at the national level, was first completed in 1997. Following the 10th Conference of the Parties to the CBD in 2010, the Philippines has been updating its NBSAP on an on-going basis to reflect the goals of the Strategic Plan and the Aichi Biodiversity Targets.

Although the details of the NBSAP are currently under development, it is expected that strengthening of the Protected Areas System, institutionalizing biodiversity conservation approaches (e.g. biodiversity corridors), and institutionalizing monitoring and evaluation systems will be priorities for the government in the updated iteration.

2.3 REDD+ in the Philippines

In 2010, the REDD-plus Strategy Team of the Philippine Government developed the Philippine National REDD-Plus Strategy (PNRPS), with the participation of civil society and non-governmental organizations. The strategy encompasses a 10 year timeframe (2010-2020), consisting of a Readiness Phase of three to five years, followed by a gradual scaling up to a five year Engagement Phase.

The PNRPS links to the country's National Climate Change Action Plan (2011-2028), as well as the Philippines Development Plan (2011-2016), and aims to build the adaptive capacity of communities and increase the resilience of natural ecosystems to climate change, thus optimising mitigation opportunities towards sustainable development.

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The PNRPS has adopted an inter-sectoral approach to REDD+ development, aiming to increase communication and coordination between key agencies and sectors which have links to deforestation and forest degradation. Environmental multiple-benefits considerations feature prominently throughout the Strategy, which "assumes watershed, natural ecosystem and landscape-level approaches to REDD-plus development in order to ensure multiple benefits", with the aim of targeting "projects on sites where emissions reductions can be achieved at a reasonable scale and cost, while also seeking to maximise co-benefits" (DENR & CoDe REDD-plus Philippines, 2010). The Strategy also targets areas of biodiversity conservation priority, stating that these are "often the last remaining forest blocks in the country" (DENR & CoDe REDD-plus Philippines, 2010).

In 2011, the Philippines undertook a multilateral process to prepare for REDD+ through the development of an Initial National Programme with the UN-REDD Programme. This focussed on strengthening REDD+ readiness in the country through effective, inclusive and participatory management processes, developing an approach to social and environmental safeguards, and building capacity to establish reference baselines (UN-REDD, 2010). The Initial National Programme also aimed to address national priorities of poverty alleviation, environmental protection and management, and adapting to climate change impacts while reducing greenhouse gas emissions.

Through the development of its various strategies and policies, the Philippines has made a clear effort to integrate its sectoral policies in recognition of the linkages between actions to conserve biodiversity, mitigate against climate change, and adapt to its impacts. A comprehensive framework for climate change action and sustainable development is important in a country such as the Philippines, which was ranked seventh most affected by extreme weather events between 1993 and 2012, and second most affected in 2012 alone, according to Germanwatch's Global Climate Risk Index (Kreft & Eckstein, 2013). Recent events, such as Typhoon Haiyan[2], which struck the Philippines in November 2013, causing unprecedented destruction to human lives and costing the Philippine economy billions of dollars' worth of damage, demonstrate the pertinence of climate change mitigation and adaptation for the country. Such events are predicted with medium confidence to become more intense in the future (IPCC, 2013).

[2] Although trends rather than events can be attributed to climate change, there is evidence that the intensity of typhoons such as Haiyan may have been exacerbated by climate change (IPCC, 2013).

Top: Chocolate Hills, Bohol, Philippines, April 1988 © Juha Riissanen (CC BY-NC-SA 2.0) https://flic.kr/p/e6ZrjJ
Bottom: Tarsier, Bohol, Central Visayas, Philippines © Lisa de Vreede (CC BY-NC-ND 2.0) https://flic.kr/p/89XSQW

3 Spatial analysis

3.1 Why create maps?

Maps can serve as useful tools in the decision-making process, as they can support spatial planning, are often rapidly produced, customizable and easily communicated.

Spatial analysis exercises can serve as a useful tool for exploring where actions for REDD+ may also complement or further promote a country's commitments under the CBD and help it realise the Aichi Biodiversity Targets. For example, Aichi Biodiversity Target 12 has the ambition to prevent the extinction of known threatened species, and improve and sustain their conservation status by 2020. If spatial information on threatened species is available, a spatial analysis exercise for REDD+ could look at where areas of importance for REDD+ actions are in relation to areas which contain high concentrations of threatened species, to see the extent of overlaps.

The mapping exercises that are undertaken in the following sections aim to explore areas in the Philippines where there are likely to be synergies between actions which contribute to the Aichi Biodiversity Targets and REDD+. Please see Table 1 for an overview of the sections of the report, and the Aichi Targets which are addressed under each section. It should be noted that it is not possible to address all Aichi Biodiversity Targets and REDD+ multiple benefits goals through mapping exercises alone. The examples in this report illustrate the types of analysis which are possible but are not exhaustive. How NBSAP and REDD+ activities are ultimately planned and implemented is key to determining to what extent synergies and complementarities will be achieved between the two Conventions.

Table 1: Overview of the Aichi targets addressed in different sections of the report

Section 3.1 Deforestation and forest degradation	**Section 3.2** Sustainable management of forest resources	**Section 3.3** Forest restoration	**The Aichi Target addressed**
X			Target 5: By 2020, the rate of loss of all natural habitats, including forests, is at least halved and where feasible brought close to zero, and degradation and fragmentation is significantly reduced.
	X		Target 7: By 2020 areas under agriculture, aquaculture and forestry are managed sustainably, ensuring conservation of biodiversity.
X			Target 12: By 2020 the extinction of known threatened species has been prevented and their conservation status, particularly of those most in decline, has been improved and sustained.
		X	Target 14: By 2020, ecosystems that provide essential services, including services related to water, and contribute to health, livelihoods and well-being, are restored and safeguarded, taking into account the needs of women, indigenous and local communities, and the poor and vulnerable.
X		X	Target 15: By 2020, ecosystem resilience and the contribution of biodiversity to carbon stocks has been enhanced, through conservation and restoration, including restoration of at least 15% of degraded ecosystems, thereby contributing to climate change mitigation and adaptation and to combating desertification.

3.2 Deforestation and forest degradation (Aichi Biodiversity Target 5)

Both the Aichi Biodiversity Targets and REDD+ include the aim to reduce deforestation and forest degradation. Aichi Biodiversity Target 5, states that by "2020, the rate of loss of all natural habitats, including forests, is at least halved and where feasible brought close to zero, and degradation and fragmentation is significantly reduced" and the first two REDD+ activities are reducing emissions from deforestation and forest degradation.

In order to plan for reducing deforestation and degradation it is important to understand where deforestation and degradation are currently occurring and may occur in the future. Information on past trends in forest extent can support identification of drivers of deforestation and so the identification of potential areas of future deforestation. Information on particular drivers such as fires and illegal logging can also support more specific planning (see sections 3.2.1 and 3.2.2).

The primary aim of REDD+ is overall emissions reductions through management and enhancement of carbon stocks. Therefore, planning for REDD+ also needs to take into account carbon stocks and their rate of loss, to inform decisions on which stocks will be maintained or enhanced in REDD+ implementation. In particular, emissions from forests depend on levels of deforestation and degradation, and the density of carbon in deforested and degraded areas.

Map 3 shows the distribution of biomass carbon across the country; the inset map shows the estimated percentage uncertainty (± %) associated with the values. According to this preliminary biomass carbon map, the Philippines contains approximately 3.50 Gt of carbon in above- and below-ground biomass. For methodological details of the biomass carbon map, please refer to Annex I of this report.

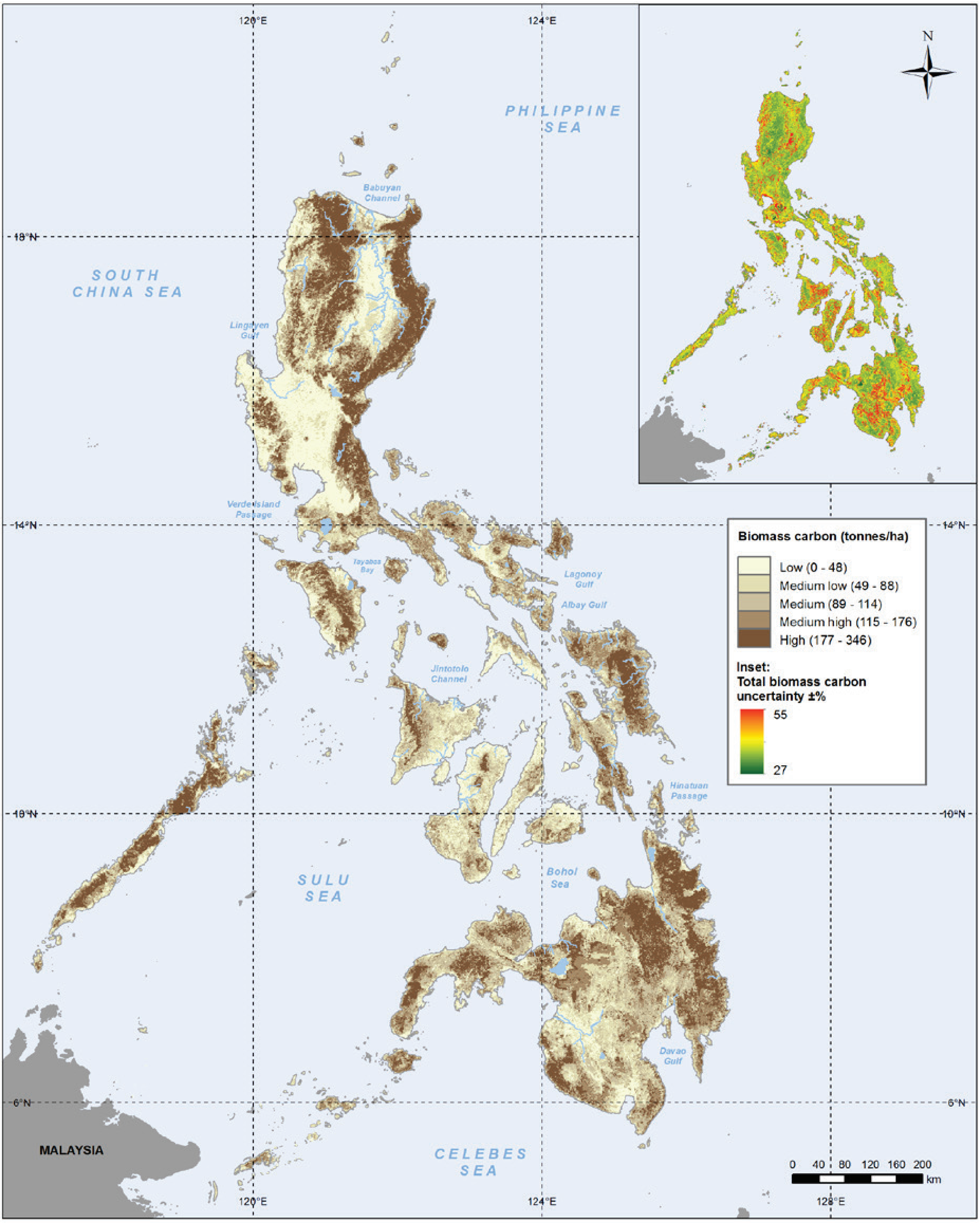
In addition to the carbon stored in the roots and shoots of live vegetation, there is a pool of carbon in the soil. Roughly two thirds of this is soil organic carbon, i.e. organic matter resulting from decomposition of leaves, wood and roots. The remainder is soil inorganic carbon, i.e. mineralised forms of carbon. Globally, the soil carbon pool is estimated to be 3.3 times the atmospheric carbon pool and 4.5 times the biotic carbon pool (Lal, 2004). Land use change, certain agricultural practices and erosion can lead to a loss of carbon from the soil. Managing soil for its carbon stocks may therefore be an important consideration for countries planning and implementing climate change mitigation measures.

However, robust data on soil carbon pools at national level is very limited at present. According to a global dataset on soil organic carbon (Scharlemann et al., 2014; see Annex II for further detail), the Philippines' soil organic carbon stock (see Map 5) amounts to 2.52 Gt. The maximum values for soil carbon density (292 tonnes/ha) are close to the maximum values for biomass carbon density (346 tonnes tonnes/ha), with many areas of high soil organic carbon density corresponding with areas of high biomass carbon density. These figures emphasise the importance of managing soil carbon for climate change mitigation, and of identifying potential losses, particularly when planning for avoided emissions. However, due to the coarseness of and uncertainties in the available data on soil carbon, the remainder of this report will focus solely on biomass carbon.

Map 4 highlights areas, where forest cover loss has occurred between 2000 and 2012, as identified by a global dataset developed by Hansen et al. (2013). The dataset showcases forest cover change from 2000 to 2012 (at medium resolution; 30m). The analysis used to generate the dataset, defines trees as vegetation taller than 5m, and forest cover loss as "a stand-replacement disturbance or the complete removal of tree cover canopy at the Landsat pixel scale".

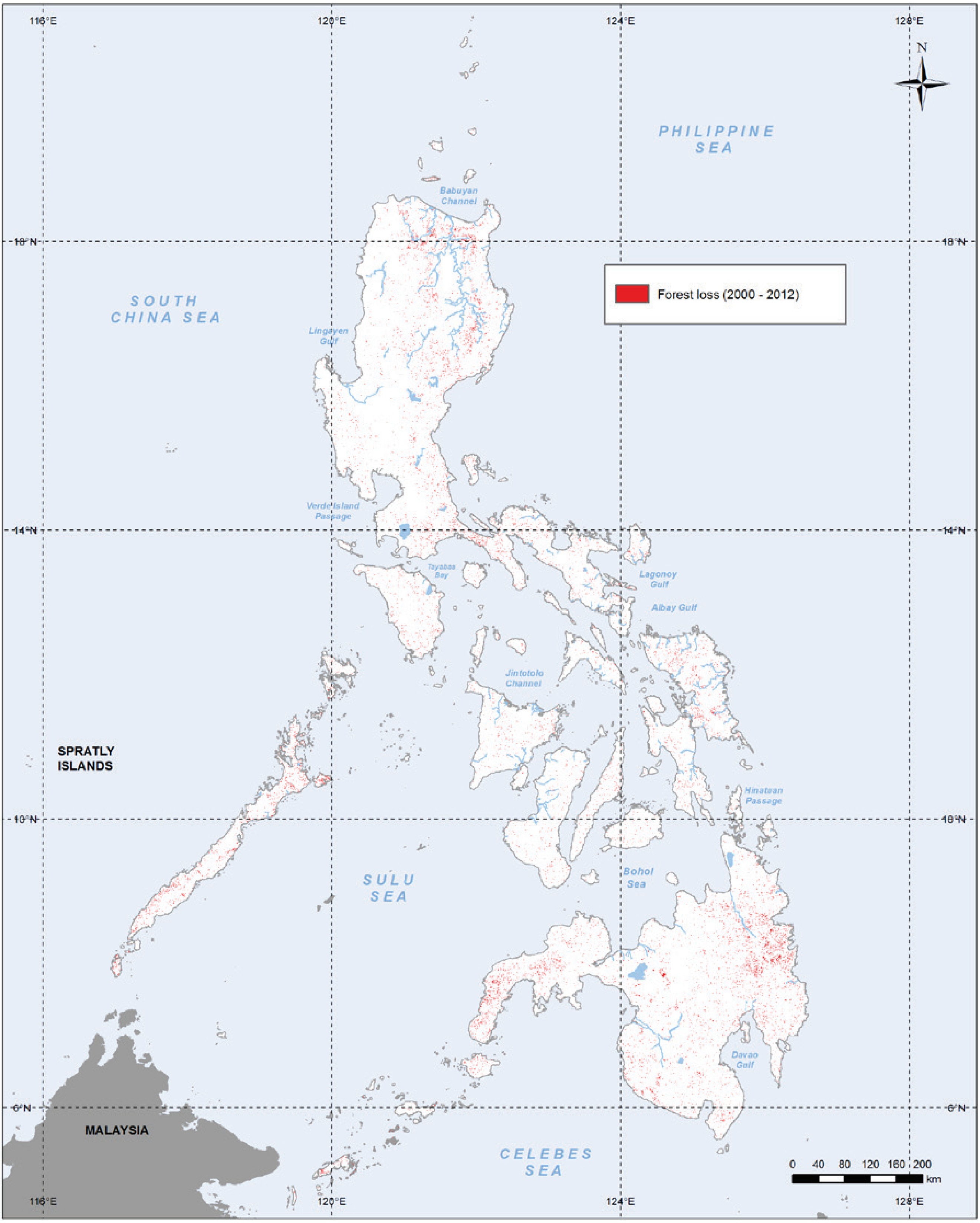
This tree definition employed by Hansen et al. is in line with the Philippines' national definition of forest, which is defined as "land with tree crown cover (or equivalent stocking level) of more than 10 percent and area of more than 0.5 hectares (ha). The trees should be able to reach a minimum height of 5 meters (m) at maturity in situ" (Government of Philippines, 2002).

Map 3: Above- and below-ground biomass carbon in the Philippines. Carbon stock varies according to land cover type and location (see Annex I for methodology). The inset map shows the uncertainty associated with the carbon values of Map 3 as a ± percentage



Methods and data sources:
Biomass carbon and uncertainty: Saatchi, S et al. "Benchmark map of forest carbon stocks in tropical regions across three continents", PNAS, 108. 24 (2011): 9899-904.

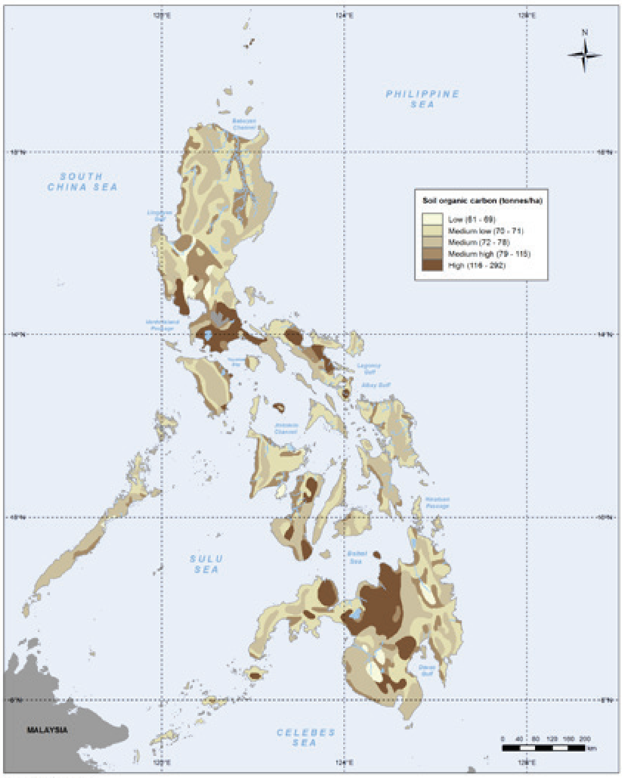
Map 4: Forest cover loss in the Philippines (2000-2012). Understanding the locations of past loss can help develop policies to reduce future loss.



Methods and data sources:
Forest cover loss 2000 – 2012:
Hansen, M. C., P. V. Potapov, R. Moore, M. Hancher, S. A. Turubanova, A. Tyukavina, D. Thau, S. V. Stehman, S. J. Goetz, T. R. Loveland, A. Kommareddy, A. Egorov, L. Chini, C. O. Justice, and J. R. G. Townshend. 2013. "High-Resolution Global Maps of 21st-Century Forest Cover Change." Science 342 (15 November): 850–53. Data available on-line from: http://earthenginepartners.appspot.com/science-2013-global-forest.

Forest loss during the period 2000–2012, defined as a stand-replacement disturbance, or a change from a forest to non-forest state.

Map 5: Soil organic carbon to 1m depth in the Philippines



Methods and data sources

Soil organic carbon: This map shows soil organic carbon to a depth of 1 metre at a 30 arc-second resolution.

Scharlemann, J.P.W., Hiederer, R., Tanner, E., Kapos, V. (2014) Global soil carbon: understanding and managing the largest terrestrial carbon pool. Carbon Management, February 2014, Vol. 5, No. 1, Pages 81-91

Forest degradation is harder to detect and map, despite also being an important driver of emissions and biodiversity loss. Nevertheless, mapping of past deforestation, degradation and carbon stocks are important for planning and implementing the Aichi Biodiversity Targets and REDD+. Neither the Aichi Biodiversity Targets which aim to reduce the rate of loss of habitats, nor REDD+, can be planned and implemented successfully without a proper understanding of the drivers of deforestation and forest degradation, along with a strategy to address and minimise these.

In the context of the Philippines, major drivers of deforestation include: logging (legal and illegal), fuelwood gathering and charcoal making, agricultural expansion (especially Kaingin making), infrastructure expansion (e.g. expansion of the mining sector), and biophysical factors such as climate change, typhoons, floods and landslides (GIZ, 2012). The following sections of the report examine the usefulness of maps of illegal logging hotspot areas, wildfires, and population density in the context of pressures on biodiversity and forests in the Philippines.

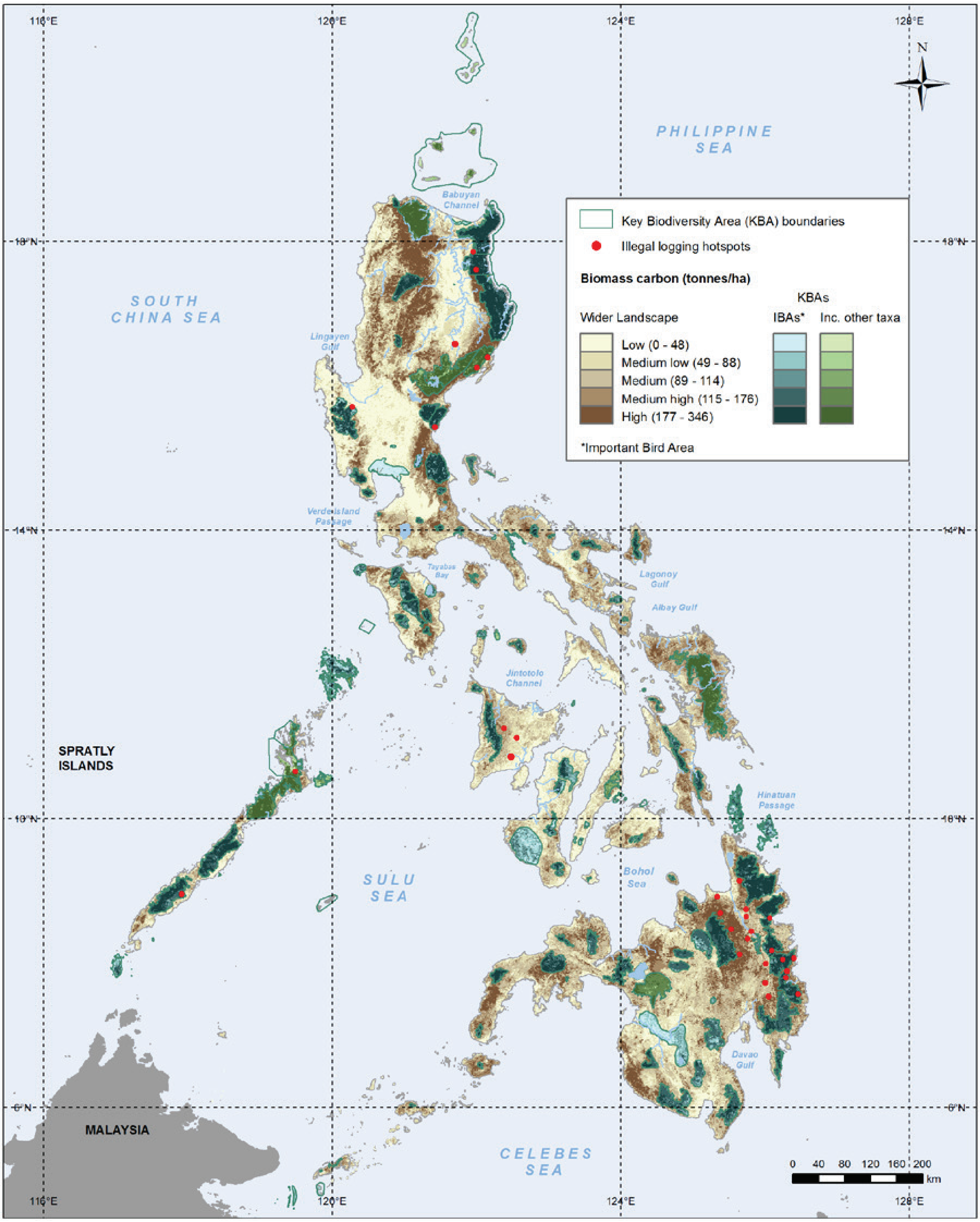
3.2.1 Forests, biodiversity and illegal logging hotspots

The Philippines was formerly one of the Southeast Asian countries most affected by illegal logging activity (Wertz-Kanounnikoff & Kongphan-Apirak, 2008). Despite a moratorium on logging in 2011, logging has been ranked as the principal driver of forest degradation throughout the Philippines (GIZ, 2012). In 2012, 41% of Filipino key informants identified logging as the critical driver of forest deforestation and degradation. Timber poaching (cutting of timber on a per tree basis) was ranked the third most important driver of deforestation in three of four regions. Logging and poaching activities have wider effects as they open up forests for other types of degradation activities (e.g. Kaingin making).

Understanding the locations of illegal logging in relation to carbon (Map 6) can therefore support planning for REDD+ and Aichi Biodiversity Target 5. Aichi Biodiversity Target 5 is specifically about natural habitats. The illegal logging hotspots indicate where there is pressure from forest degradation (FMB DENR, 2013). Map 6 also shows relation of biomass carbon and illegal logging hotspots to areas of importance for biodiversity which may therefore be particularly important natural habitat. Key Biodiversity Areas (KBAs) data include Important Bird Areas (IBAs) and areas important for other taxa, which are identified at a country level according to nationally agreed criteria. As can be seen, most illegal logging hotspots are located in the Southern Mindanao and Caraga regions of the Philippines, and either overlap with or are located in the vicinity of several KBAs.

Conserving forests against illegal logging is not just relevant to Aichi Biodiversity Target 5 but also Aichi Biodiversity Target 15 which states that "by 2020, ecosystem resilience and the contribution of biodiversity to carbon stocks has been enhanced, through conservation and restoration, including restoration of at least 15 per cent of degraded ecosystems, thereby contributing to climate change mitigation and adaptation and to combating desertification". Conserving forests can help in protecting carbon stocks and so climate change mitigation. Additionally, there is evidence that biodiversity can play a role in maintaining the resilience of carbon and ecosystems (including three literature reviews: Elmqvist et al., 2003; Miles, et al., 2010; and Thompson et al., 2012). Therefore, prioritising areas for REDD+ which are of importance for biodiversity and are located in areas where there is exposure to degradation, may contribute towards meeting Aichi Biodiversity Target 15 and decrease the risk of reversal of carbon emissions reductions achieved by REDD+.

Map 6: Above-and below-ground biomass carbon, Key Biodiversity Areas, and illegal logging hotspots. Combatting illegal logging in areas of high carbon density which are also important for biodiversity can provide large emission benefits and protect important natural habitats.



Methods and data sources:
Biomass Carbon: Saatchi, S et al. "Benchmark map of forest carbon stocks in tropical regions across three continents", PNAS, 108. 24 (2011): 9899-904.
Biodiversity: Key Biodiversity Areas (KBAs) of the world including Important Bird Areas (IBAs) and Alliance for Zero Extinction sites (AZEs) compiled by BirdLife International and Conservation International, October 2012. For further information, please contact mapping@birdlife.org.
The Philippines KBAs were identified by: Conservation International, Department of Environment and Natural Resources-Protected Areas and Wildlife Bureau, Haribon Foundation http://www.conservation.org/global/philippines/publications/Pages/Priority-Sites-for-Conservation-Key-Biodiversity-Areas.aspx
Illegal logging hotspots: Hotspots recorded after Executive Order 23 2011. Digitalised from data from the Forest Management Bureau, Department of Environment and Natural Resources (DENR), received December 2013.

3.2.2 Forests, biodiversity and wildfires

Wildfires pose a hazard in the Philippines, particularly in the summer. They originate from land being cleared for agriculture (for example, through kaingin making), accidental fires that spread through the forests, and human settlement next to forests which have increased (DENR, 2009; GIZ, 2012). The frequency and intensity of wildfires in the Philippines has also been linked to global warming and the El Niño phenomenon (DENR, 2009). Between 2000 and 2010, a total of 34,921 ha of land was damaged by forest fires, including 19,607 ha of natural forest land, and 15,314 ha of plantation areas.

Carbon losses from fires depend on the intensity of the fire, the vegetation type and speed of regeneration. In the Philippines, fire damaged forests can recover through time owing to the rainy season aiding vegetation growth; however, widespread forest fires continue to be a hazard as long as people are able to access forests without proper control (GIZ, 2012).

Reducing forest degradation, including through managing fires, can not only contribute to Aichi Biodiversity Target 5 and REDD+ but also to reducing the extinction of known threatened species exposed to pressures from forest degradation. Aichi Biodiversity Target 12, calls for the extinction of known threatened species to be prevented and their conservation status to be improved and sustained by 2020.

The government has made concerted efforts to address the issue, through investing in training programmes for its forestry workers and local communities to learn how to prevent and combat forest fires effectively (DENR, 2013). Priority areas for fire control and prevention have also been set in places where tree planting is occurring under the National Greening Programme, as well as protected areas where monitoring is taking place, in recognition of the role of these areas in providing valuable habitat for endangered species and ensuring water supplies for nearby communities (DENR, 2013).

Map 7 shows the distribution of areas of high threatened species richness in relation to fire occurrence between January and June 2013, which falls mostly in the dry season in the Philippines. The species richness layer is based on species ranges[3] of threatened mammals, amphibians and reptiles. The map also shows the boundaries of the Ancestral Domains (Philippines Constitution Article XII), recognising the role of Indigenous Peoples in the conservation of threatened biodiversity.

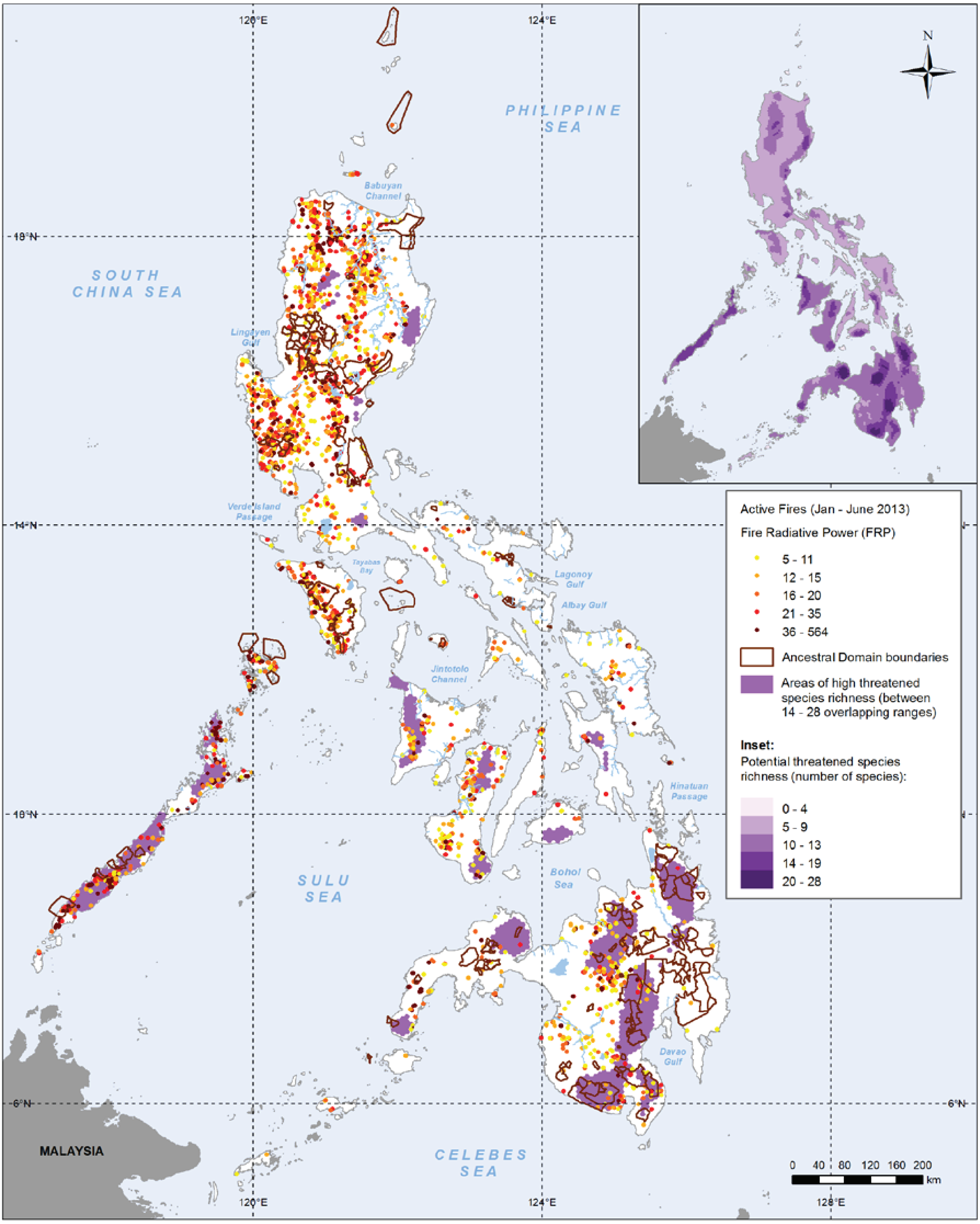
The map shows that fire occurrence between January and June 2013 was most acute in the Cordillera Administrative Region (CAR) and the Central Luzon region in the north of the country. This coincides with the DENR Forest Management Bureau's list of forest fire hotspots, which lists Cordillera Administrative Region (CAR) as the top hotspot, followed by Central Luzon (DENR, 2013).

Forest fires are an important consideration under any future national REDD+ mechanism. Strategies which aim to prevent forest fire under REDD+ will help guarantee the permanence of carbon stocks, reduce risks associated with forest regeneration and sustainable management of forest projects (Kapos et al., 2012), as well as help protect biodiversity and the livelihoods of forest-dependent people (Barlow et al., 2012).

Residual Forest, Cabicungan Watershed in Calanasan, Apayao Province © Engr. Eugenio O. Diaz, Jr, DENR River Basin Control Office

3 The species distribution maps, sometimes referred to as 'limits of distribution' or 'field guide' maps, aim to provide the current known distribution of the species within its native range. The limits of distribution can be determined by using known occurrences of the species, along with the knowledge of habitat preferences, remaining suitable habitat, elevation limits, and other expert knowledge of the species and its ranges (IUCN, 2013).

Map 7: Distribution of areas of high threatened species richness based on species ranges (mammals, amphibians and reptiles) and Ancestral Domains in relation to fire occurrence (January to June 2013). Managing fires in areas with many theatened species can support REDD+ and Aichi Biodiversity Target 12.



Methods and data sources:
Ranges of 132 species (not including birds) which are 'Critically Endangered', 'Endangered' and 'Vulnerable' (according to the IUCN Red List 2013) were loaded onto a 50km^2 hexagon grid covering the Philippines, where data was available. This analysis was undertaken in Quantum GIS, using the QMarxan plugin to generate the hexagon grid across the country and then count how many species ranges intersected with those hexagons (Trevor Wiens, 2013. QMarxan plugin for Quantum GIS. Apropos Information Systems Inc. http://aproposinfosystems.com).
Threatened species: IUCN 2013. IUCN Red List of Threatened Species. Version 2012.2. http://www.iucnredlist.org. Species information downloaded October 2013, spatial species range data April 2013. The top two classes from the inset map have been used to represent areas of high potential threatened species richness on the main map.
Ancestral domains: Ancestral Domains Office of the National Commission on Indigenous Peoples of the Philippines. October 2013.
Active Fires MODIS Active Fire Product, Fire Information for Resource Management System (FIRMS). Active fires January - June 2013. Fire Radiative Power depicts the pixel-integrated fire radiative power in MW (MegaWatts). FRP provides information on the measured radiant heat output of detected fires. We acknowledge the use of FIRMS data and imagery from the Land Atmosphere Near-real time Capability for EOS (LANCE) system operated by the NASA/GSFC/Earth Science Data and Information System (ESDIS) with funding provided by NASA/HQ. Downloaded December 2013. See: https://earthdata.nasa.gov/data/near-real-time-data/firms/active-fire-data

3.2.3 Forests and population density

The socio-economic context is an important factor in planning for reducing deforestation and forest degradation. For example, the most appropriate action is likely to vary depending on the population density and growth. Population growth is considered to be one of the primary underlying causes of forest loss in the Philippines, along with commercial exploitation of forests (DENR, 2009). However, it is also important to note that actions to achieve the Aichi Biodiversity Targets and/or REDD+ in areas with high population density could have an impact on large numbers of people. For example, in the Philippines, forest ecosystems support approximately 30% of the population, including 12-15 million forest-dependent indigenous peoples (DENR, 2009).

The 2010 national Census of Population and Housing shows that the population of the Philippines grew by more than 30% in the last two decades, from 61 million in 1990 to more than 92 million people in 2010 (Philippine Statistics Authority, 2010). Management choices may depend on increases in population density in different locations, coupled with changing demands for the use of the surrounding land and natural resources.

Map 8 shows the distribution of carbon stocks in relation to population density in the Philippines. Areas where high biomass carbon coincides with areas of high population density (shown in brown on the map) could be priority sites for projects which aim to both enhance livelihoods and reduce deforestation, for example through promoting fuel efficient stoves. On the other hand, areas where there is high biomass carbon and low population density (shown in orange on the map) may be priorities for conservation of forest carbon stocks. Areas of high population density which contain low carbon stocks are shown in blue. Overall, the map demonstrates that the majority of high biomass carbon areas in the Philippines do not coincide with areas of high population density.

3.3 Sustainable management of forest resources

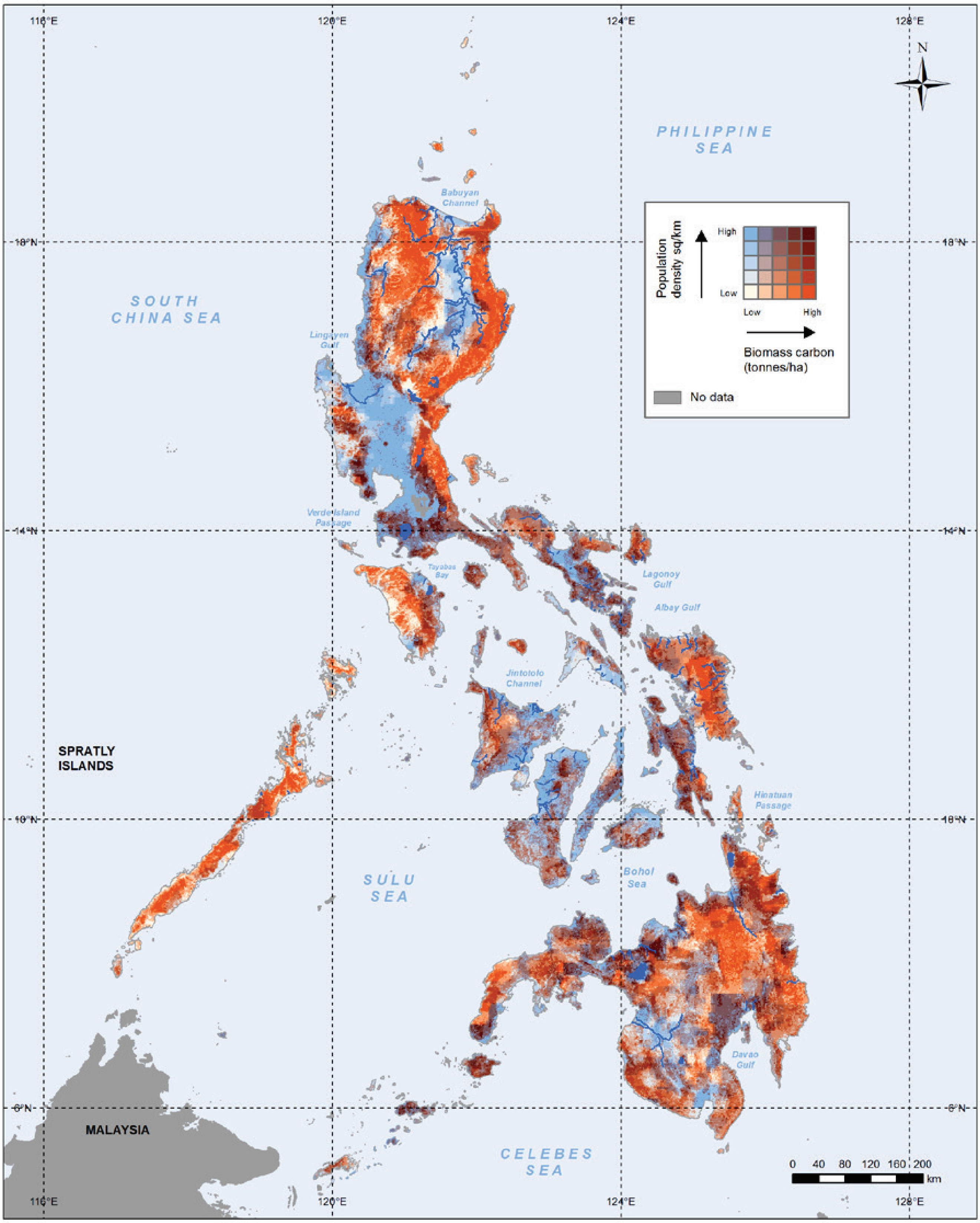
Actions relevant to REDD+ and the Aichi Biodiversity Targets do not just include reducing deforestation and forest degradation. The sustainable management of forests is also one of the five REDD+ activities and closely related to Aichi Biodiversity Target 7 that "By 2020 areas under agriculture, aquaculture and forestry are managed sustainably, ensuring conservation of biodiversity".

As of 2009, there were approximately 6 million ha of land in the Philippines that was under some form of community forest management (Lasco, Evangelista, Pulhin, & Lopez, 2009), including Ancestral Domains, Community-Based Forest Management Agreement (CBFMA) areas, and Protected Area Community Based Resource Management Agreements (REDD, 2010). The Philippine National REDD-Plus Strategy promotes community-based management of forest resources, and states that community-based forest management areas (along with other tenured areas such as ancestral domains and protected areas) represent the majority of remaining forests in the country, and present the greatest opportunities for delivering social and environmental benefits.

Map 9 provides an overview of the distribution of areas under the Community-Based Forest Management Agreement (CBFMA) in relation to Key Biodiversity Areas (KBAs). It shows where sustainable management of forests could be implemented as an activity under REDD+, in a way which also contributes to biodiversity conservation.

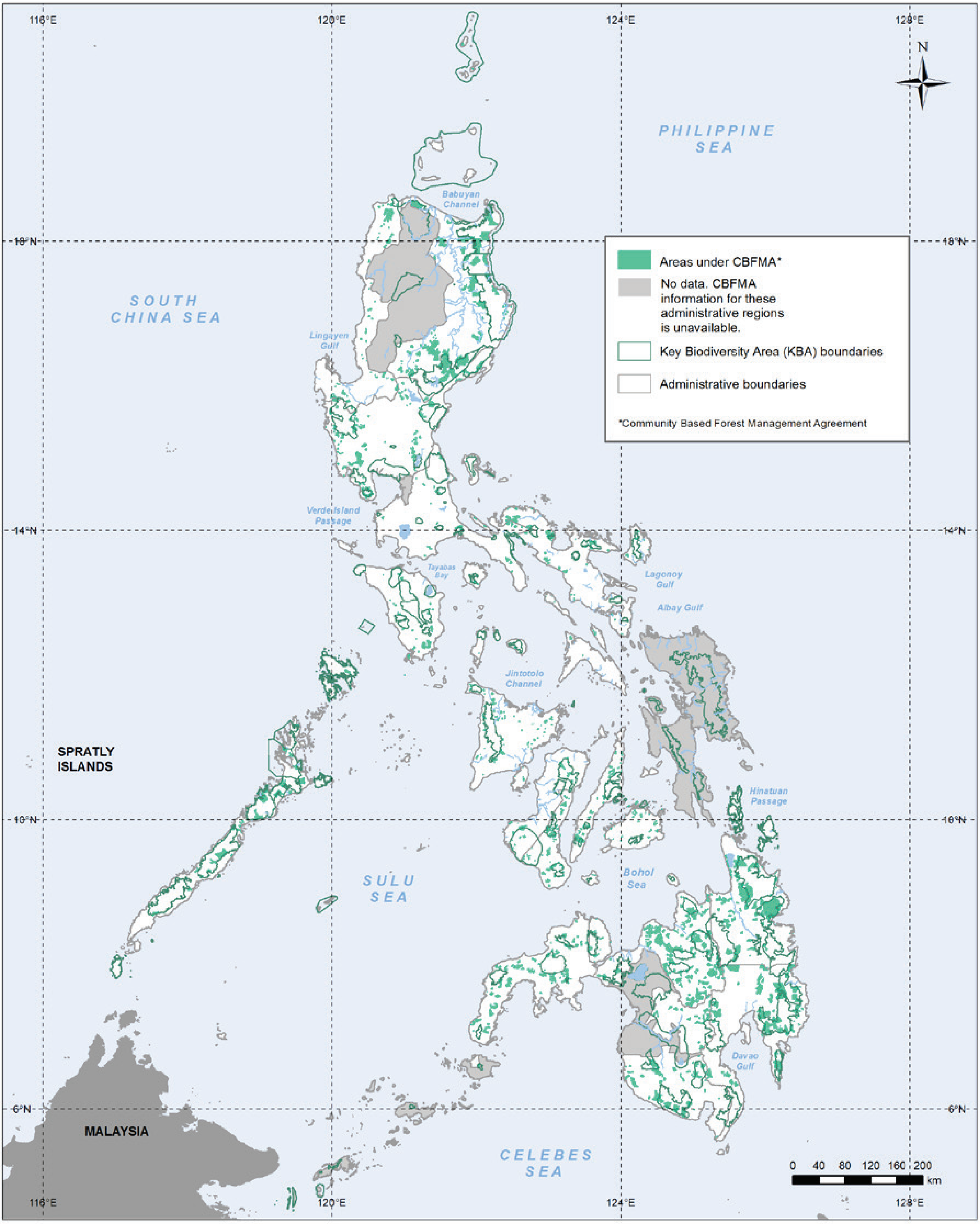
Panoramic view of portion of Cabicungan Watershed, Calanasan, Apayao © Engr. Eugenio O. Diaz, Jr, DENR River Basin Control Office

Map 8: Above-and below-ground biomass carbon in relation to population density. The most appropriate REDD+ action in a location will depend on the local context. Areas of high biomass carbon and high population (dark brown) could be priorities for projects aiming to reduce deforestation and enhance livelihoods (e.g. through fuel efficient stoves). Areas of high carbon and low population density (red) may be most relevant for conservation of forests.



Methods and data sources:
This map has combined biomass carbon data divided into 5 natural break classes and population density data divided into 5 quantile classes.
Biomass Carbon: Saatchi, S et al. "Benchmark map of forest carbon stocks in tropical regions across three continents", PNAS, 108. 24 (2011): 9899-904.
Population: Center for International Earth Science Information Network - CIESIN - Columbia University, and Centro Internacional de Agricultura Tropical - CIAT. 2005. Gridded Population of the World, Version 3 (GPWv3): Population Density Grid. Palisades, NY: NASA Socioeconomic Data and Applications Center (SEDAC). http://sedac.ciesin.columbia.edu/data/set/gpw-v3-population-density. Accessed October 2013.

Map 9: Community-Based Forest Management Agreement areas in relation to Key Biodiversity Areas (KBAs). Where CBFM and KMBAs overlap can highlight where actions to promote sustainable management of forests that takes into account biodiversity conservation could be implemented.



Methods and data sources:
CBFMA areas: Forest Management Bureau, Department of Environment and Natural Resources (DENR), data obtained December 2013. No data on CBFMA is currently available for the following administrative regions: 8, ARMM, CAR and Manila. These regions are displayed in grey on the map.
Key Biodiversity Areas: Key Biodiversity Areas (KBAs) of the world including Important Bird Areas (IBAs) and Alliance for Zero Extinction sites (AZEs) compiled by BirdLife International and Conservation International, October 2012. For further information, please contact mapping@birdlife.org.
The Philippines KBAs were identified by: Conservation International, Department of Environment and Natural Resources-Protected Areas and Wildlife Bureau, Haribon Foundation
http://www.conservation.org/global/philippines/publications/Pages/Priority-Sites-for-Conservation-Key-Biodiversity-Areas.aspx

3.4 Forest restoration

Restoration is a key part of Aichi Biodiversity Target 15. It specifically refers to the role of restoration in contributing to forest carbon stocks and climate change mitigation. Restoration of forests can also be undertaken as part of the REDD+ activity of enhancing forest carbon stocks.

Restoration of forests can also contribute to Aichi Biodiversity Target 14 ("by 2020, ecosystems that provide essential services are restored and safeguarded, taking into account the needs of women, indigenous and local communities, and the poor and vulnerable").

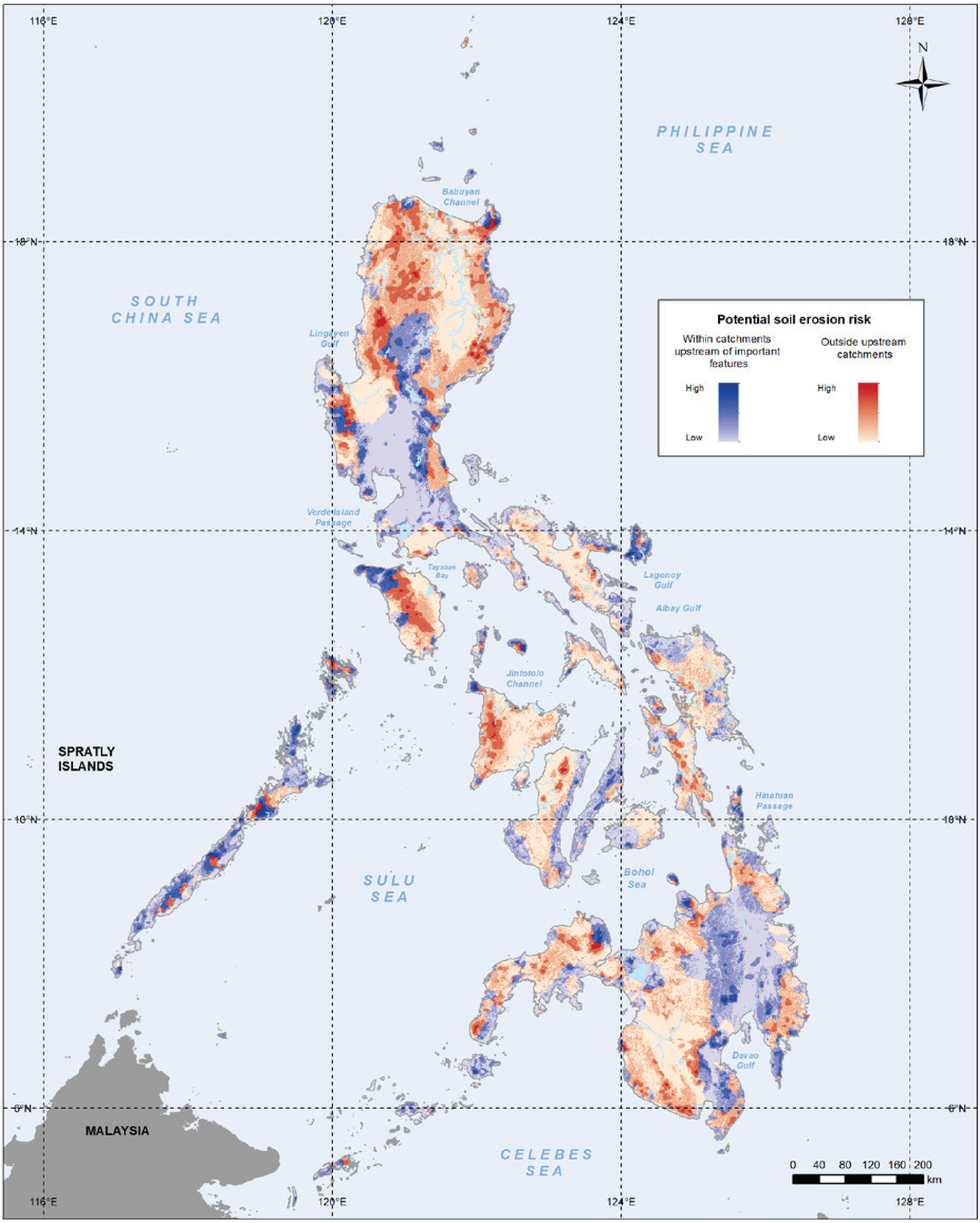
Forests, especially those on slopes, can stabilize soils and prevent soil erosion. The tree canopy, saplings, litter layer and woody debris protect the soil surface from the erosive power of raindrops, and control runoff; thereby preventing soil detachment. On high slopes, deforestation or forest degradation can lead to several detrimental effects. Degraded landscapes lack the retention and absorption capacities that prevent rapid runoff after heavy rains (Watkins & Imbumi, 2007), thus increasing the risk for flooding downstream. Removal of forests can also result in erosion of topsoil. When the soil particles are carried by runoff into rivers and streams, they contribute to higher sediment loads which can have negative effects, for example for downstream infrastructure such as dams and coastal ecosystems, such as coral reefs and seagrasses. Soil erosion control is therefore an important ecosystem service for communities in areas where the terrain is steep and precipitation levels are high. Soil erosion control can also be important for communities which rely on services which may be impacted by erosion, such as hydroelectric power plants, or coastal tourism and fisheries. Reforestation in areas where there is a risk of soil erosion may therefore help to restore and maintain these ecosystem services.

Map 10 provides an overview of areas of potential importance for soil erosion control inside and outside watersheds upstream from dams, marine protected areas, and coral reef and sea grass ecosystems. This has been evaluated by developing a soil erosion risk layer, which is a function of slope and rainfall (see Map 11 for individual data layers; for details on the methodology employed please refer to Annex II). The premise is that the higher the potential soil erosion risk of an area, the higher the importance of the area for soil erosion control. The important catchment areas layer has been developed by identifiying watersheds which are upstream from dams and coastal features within the near shore zone (2.5km of the coast; see Map 12).

Comparing this map to potential areas for restoration (such as where there has been deforestation but the area is not currently needed for agriculture) can support understanding of where restoration could support erosion control. Additionally, comparing this map with areas of current forest can support understanding of where existing forest plays an important role in maintaining soil erosion control services. In 2011, the Philippine Government launched the National Greening Program, a large-scale forest rehabilitation initiative which aims to plant 1.5 billion trees covering 1.5 million ha over a period of six years. The National Greening Program may be an early action REDD+ demonstration activity, which could contribute to soil stabilisation and soil loss prevention in areas identified as potentially at risk by this analysis. Map 13 shows the proposed future location of National Greening Programme sites.

Comparing Map 10 to the proposed National Greening Site areas map (Map 13) of the National Greening Programme, illustrates that half of the proposed future National Greening Programme sites fall within the top 3 categories of potential risk out of 5, with 11% falling within the top 2 categories.

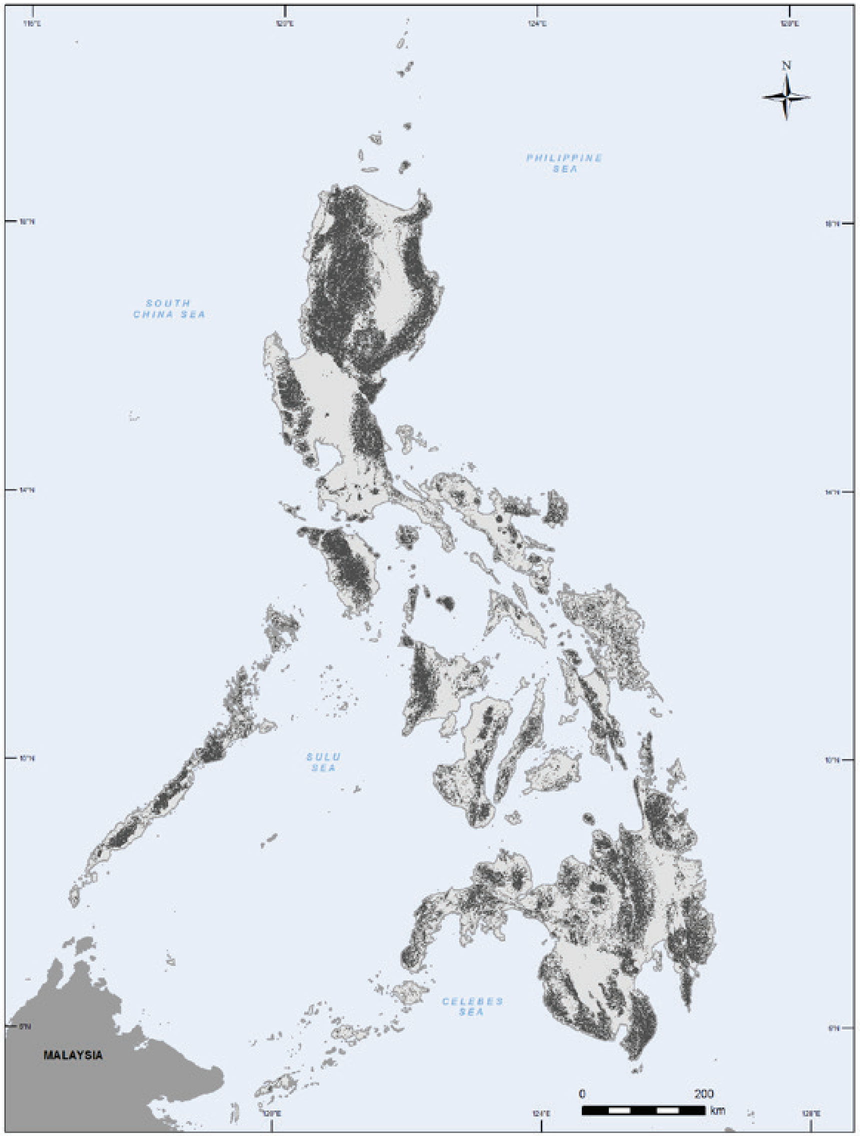
Map 10: Areas of potential importance for soil erosion control. Comparing this map to potential areas for restoration can support understanding of where restoration could support erosion control. Additionally, comparing this map with areas of current forest can support understanding of where existing forest plays an important role in maintaining soil erosion control services.



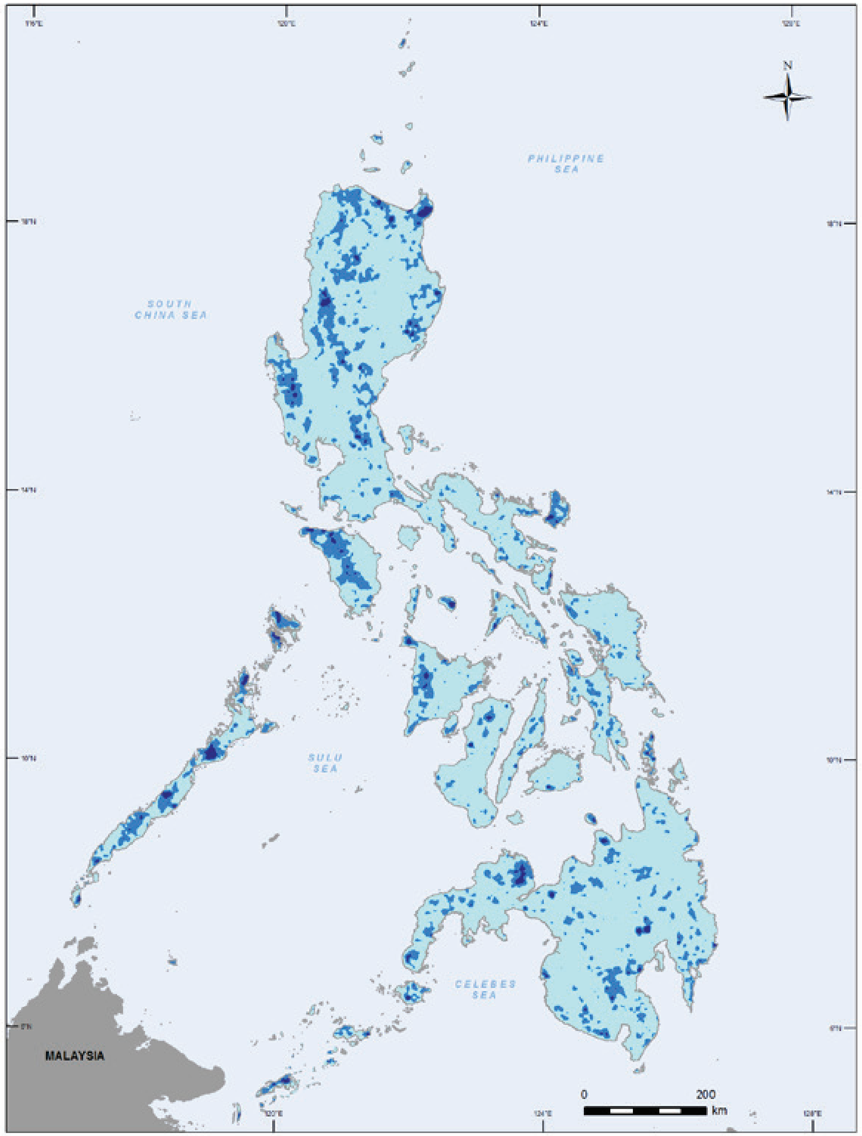
Methods and data sources:
The relative importance of an area has been evaluated as a function of slope and rainfall. This method uses an overlay approach, where data on precipitation is combined with data generated for slope.
Elevation: Lehner, B., Verdin, K., Jarvis, A. (2008): New global hydrography derived from spaceborne elevation data. Eos, Transactions, AGU, 89(10): 93-94. See http://hydrosheds.cr.usgs.gov/. Slope classes determined using the threshold values defined legally as forest land (land with greater than18% slope) by the Philippines Department of Environment and Natural Resources (DENR).
Precipitation: June - October mean monthly rainfall intensity (mm per rain hour). Mulligan, M (2006) Global Gridded 1km TRMM Rainfall Climatology and Derivatives.Version 1.0. Database: http://geodata.policysupport.org/2b31climatology. Data was split into three classes based on the national daily critical threshold rainfall intensity values that would induce landslides and flashflooding estimated by Philippine Council for Industry and Energy Research and Development (PCIERD) (150 to 200 millimeters of rainfall per day). An upper threshold of > 8mm/rainfall per rain hour for precipitation was used in this analysis, with 4mm/rainfall per rain hour chosen as an intermediate value.

Catchments upstream of features of importance have been generated using dam data and selected coastal and marine features (coral reefs, seagrasses, marine and coastal protected areas). Marine features were clipped to a 2.5km nearshore buffer around the Philippines coastline. Using these features and a stream order network for the Philippines, catchments upstream of dams and these coastal areas were generated and have been highlighted as potential priorities for soil erosion and sediment load control. For data sources please see soil erosion methodology input maps 11 and 12.

Map 11: Areas of potential importance for soil erosion control. Areas of high slope and high rainfall are under higher risk of erosion (therefore these layers served as inputs into Map 10, please see Annex II for further detail).



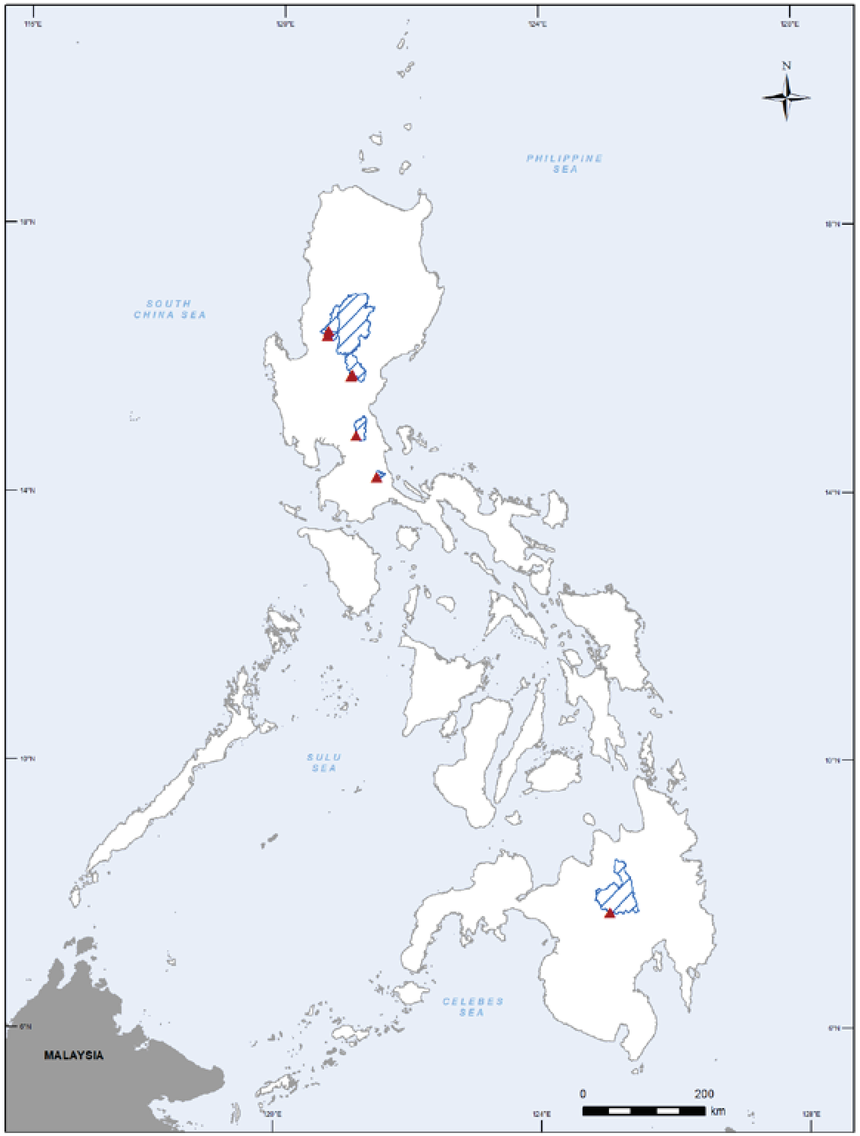
2 slope classes (%) 0 - 18 > 18

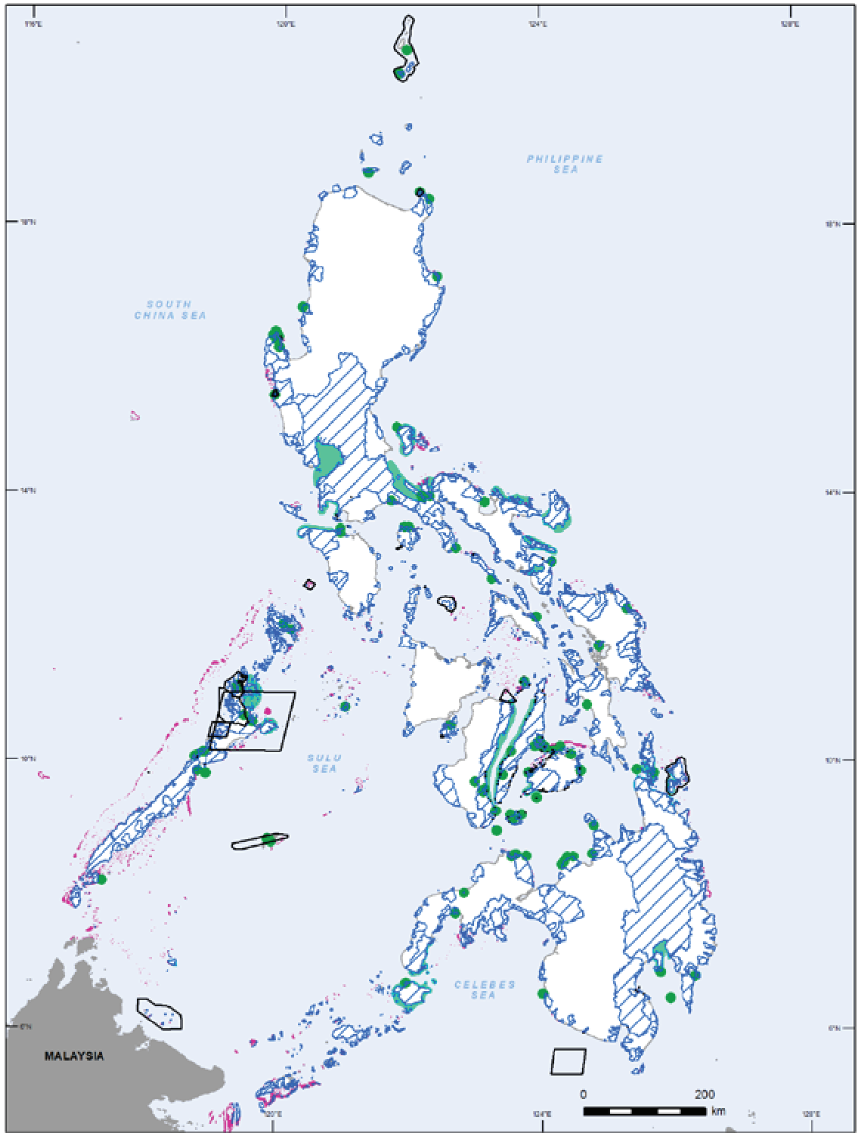


3 precipitation intensity classes: June - October (mm/per rain hour) 0 - 4 4 - 8 > 8

Methods and data sources:
The relative importance of an area has been evaluated as a function of slope and rainfall. This method uses an overlay approach, where data on precipitation is combined with data generated for slope.
Elevation: Lehner, B., Verdin, K., Jarvis, A. (2008): New global hydrography derived from spaceborne elevation data. Eos, Transactions, AGU, 89(10): 93-94. See http://hydrosheds.cr.usgs.gov/. Slope classes determined using the threshold values defined legally as forest land (land with greater than 18% slope) by the Philippines Department of Environment and Natural Resources (DENR). **Precipitation:** June - August mean monthly rainfall intensity (rainfall mm per rain hour) Mulligan, M (2006) Global Gridded 1km TRMM Rainfall Climatology and Derivatives Version 1.0. Database: http://geodata.policysupport.org/2b31climatology. Data was split into three classes, based on the national daily critical threshold rainfall intensity values that would induce landslides and flashflooding as estimated by Philippine Council for Industry and Energy Research and Development (PCIERD) (150 to 200 millimeters of rainfall per day). An upper threshold of > 8mm/rainfall per rain hour for precipitation was used in this analysis, with 4mm/rainfall per rain hour chosen as an intermediate value.

Map 12: Importance of soil erosion control. Preventing erosion can be most important in catchments upstream of dams and marine features such as coral reefs and seagrasses which can be regularly affected by sedimentation of eroded material (therefore these layers served as inputs into Map 10) .



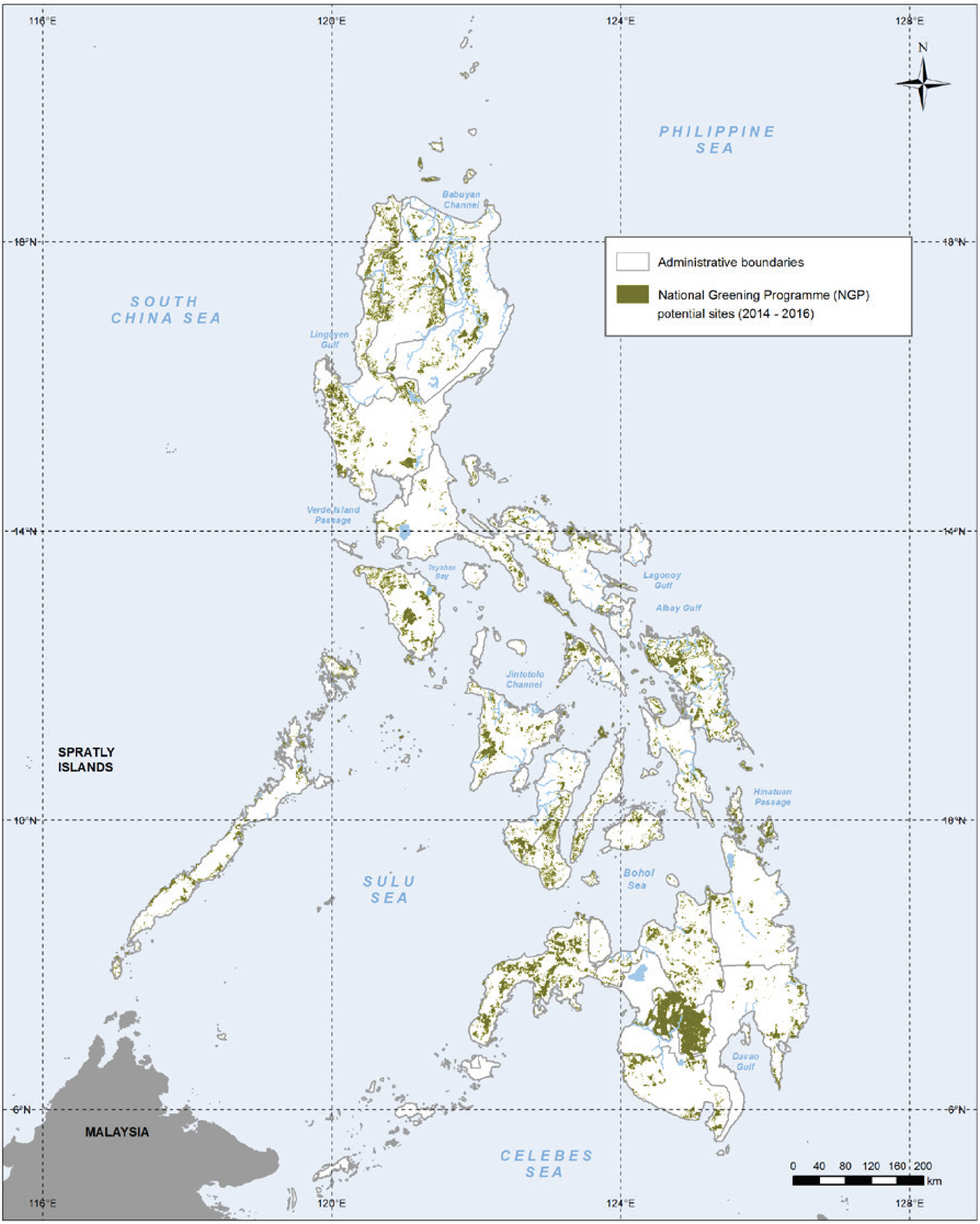


Dams Upstream catchments

Marine and coastal protected areas Seagrass Upstream catchments
Coral reefs Seagrass

Methods and data sources:
Catchments upstream of features of importance have been generated using dam data and selected coastal and marine features (coral reefs, seagrasses, marine and coastal protected areas). Marine features were clipped to a 2.5km nearshore buffer around the Philippines coastline. Using these features and a stream order network for the Philippines, catchments upstream of dams and these coastal areas were generated and have been highlighted as potential priorities for soil erosion and sediment load control.
Dams: Lehner, B., R-Liermann, C., Revenga, C., Vörösmarty, C., Fekete, B., Crouzet, P., Döll, P. et al.: High resolution mapping of the world's reservoirs and dams for sustainable river flow management. Frontiers in Ecology and the Environment. Source: GWSP Digital Water Atlas (2008). Map 81: GRanD Database (V1.0). Available online at http://atlas.gwsp.org. **Protected Areas:** Philippines Protected Areas and Wildlife Bureau (PAWB) data obtained October 2013 **Coral reefs:**IMaRS-USF (Institute for Marine Remote Sensing-University of South Florida) (2005). Millennium Coral Reef Mapping Project. Unvalidated maps. These maps are unendorsed by IRD, but were further interpreted by UNEP World Conservation Monitoring Centre. Cambridge (UK): UNEP World Conservation Monitoring Centre. IMaRS-USF, IRD (Institut de Recherche pour le Developpement) (2005). Millennium Coral Reef Mapping Project. Validated maps. Cambridge (UK): UNEP World Conservation Monitoring Centre. Spalding MD, Ravilious C, Green EP (2001). World Atlas of Coral Reefs. Berkeley (California, USA): The University of California Press. 436 pp. UNEP-WCMC, WorldFish Centre, WRI, TNC (2010). Global distribution of warm-water coral reefs, compiled from multiple sources (listed in "Coral_Source.mdb"), and including IMaRS-USF and IRD (2005), IMaRS-USF (2005) and Spalding et al. (2001). Cambridge (UK): UNEP World Conservation Monitoring Centre. data.unep-wcmc.org/datasets/13 **Seagrasses:**UNEP-WCMC, Short FT (2005). Global distribution of seagrasses (version 2). Updated version of the data layer used in Green and Short (2003). Cambridge (UK): UNEP World Conservation Monitoring Centre. data.unep-wcmc.org/datasets/10 (polygons) and data.unep-wcmc.org/datasets/9 (points)

Map 13: Potential sites for the National Greening Programme (NGP) 2014-2016 in the Philippines



Methods and data sources:
National Greening Programme (NGP) potential sites 2014 - 2016: Forest Management Bureau, Department of Environment and Natural Resources (DENR), data obtained December 2013.

Panoramic view of middle portion of Abra River Basin, bagued, Abra © Engr. Eugenio O. Diaz, Jr DENR River Basin Control Office

3.5 Forests, protected areas and nationally threatened species

Increasing the effective management and extent of protected areas is the focus of Aichi Biodiversity Target 11; that "by 2020, at least 17 per cent of terrestrial and inland water, and 10 per cent of coastal and marine areas, especially areas of particular importance for biodiversity and ecosystem services, are conserved through effectively and equitably managed, ecologically representative and well connected systems of protected areas and other effective area-based conservation measures, and integrated into the wider landscapes and seascapes". The potential role that protected areas can play within REDD+ is also recognised within the Philippines REDD+ strategy. Protected areas can be important for the REDD+ activity of conservation of forest carbon stocks as well as reducing deforestation and degradation.

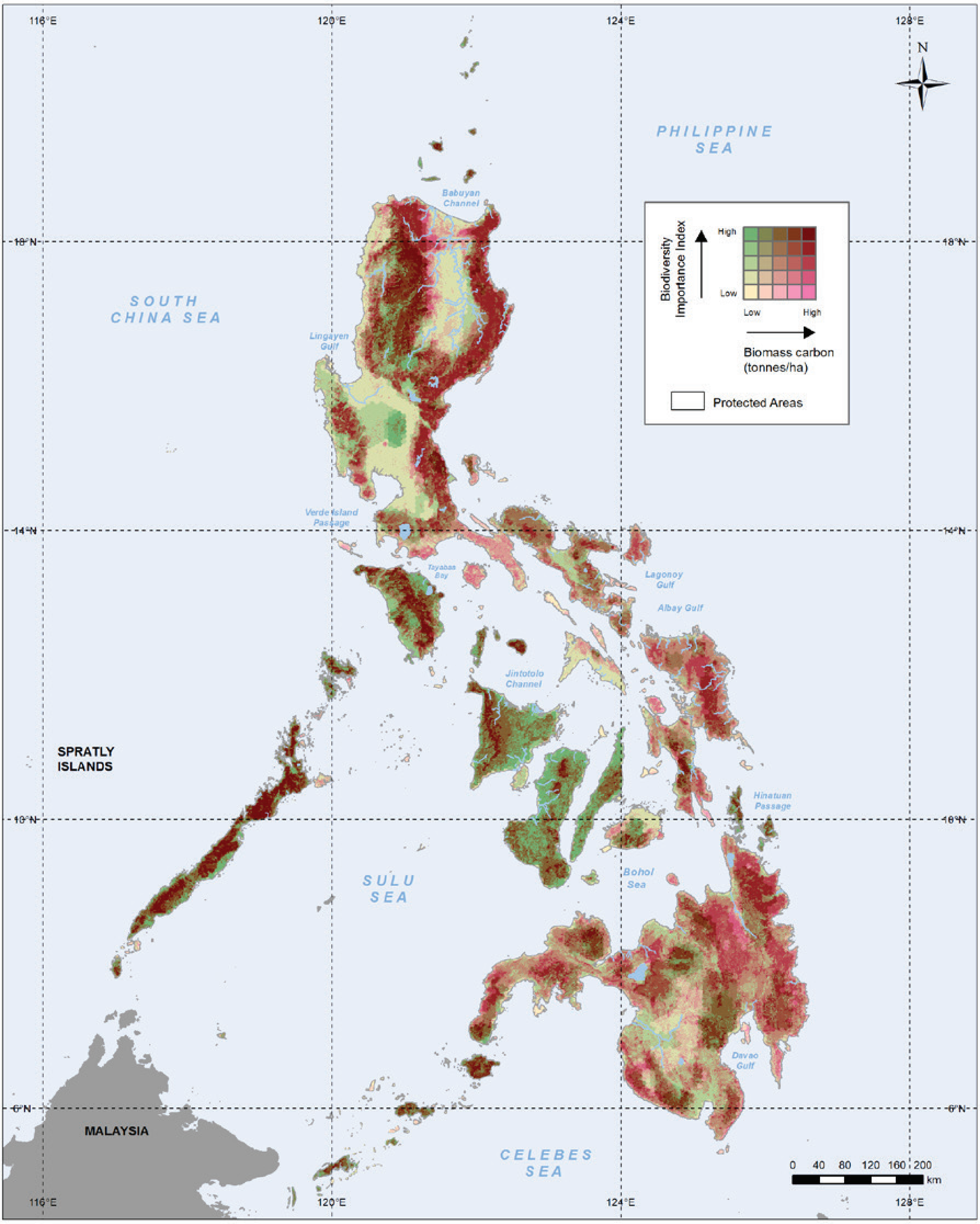
Map 14 shows the locations of areas which are high in carbon, important for threatened species and the location of protected areas. REDD+ actions, including increasing the effectiveness and extent of protected areas, in areas important for threatened species and which are high in carbon, have the potential to contribute towards emissions reduction and Aichi Biodiversity Target 12, which aims to prevent the extinction of known threatened species, and improve and sustain their conservation status by 2020.

Map 14 contains an indicator of biodiversity importance based on a species range size rarity index for nationally threatened species listed in the DENR Administrative Order No. 2004-15[4], for which IUCN data Red List data was available (Map 15). In contrast to the potential species richness presented in Map 7, the biodiversity importance index presented in Map 15 has been calculated[5] to take account of both the extent to which species ranges overlap, and the size of those species' ranges in the Philippines. The index is highest for cells with many species of restricted range, and lowest for cells where the few species that are present are also widely-distributed. As a range of potential biodiversity indicators exist, which take into account different aspects of biodiversity, it is important to consider what aspects of biodiversity are of greatest interest when developing maps. Map 15 shows that Palawan, Mindoro, the Central and Western Visayas, and parts of Mindanao, Bicol, Cagayan Valley and Ilocos regions have many restricted-range species. Implementing REDD+ in these areas in a manner which is consistent with the conservation of natural forests and biodiversity could contribute to the objectives of Aichi Biodiversity Target 12.

[4] DENR Administrative Order No. 2004 – 15 "Establishing the list of terrestrial threatened species and their categories, and the list of other wildlife species pursuant to republic act no. 9147, otherwise known as the wildlife resources conservation and protection act of 2001."

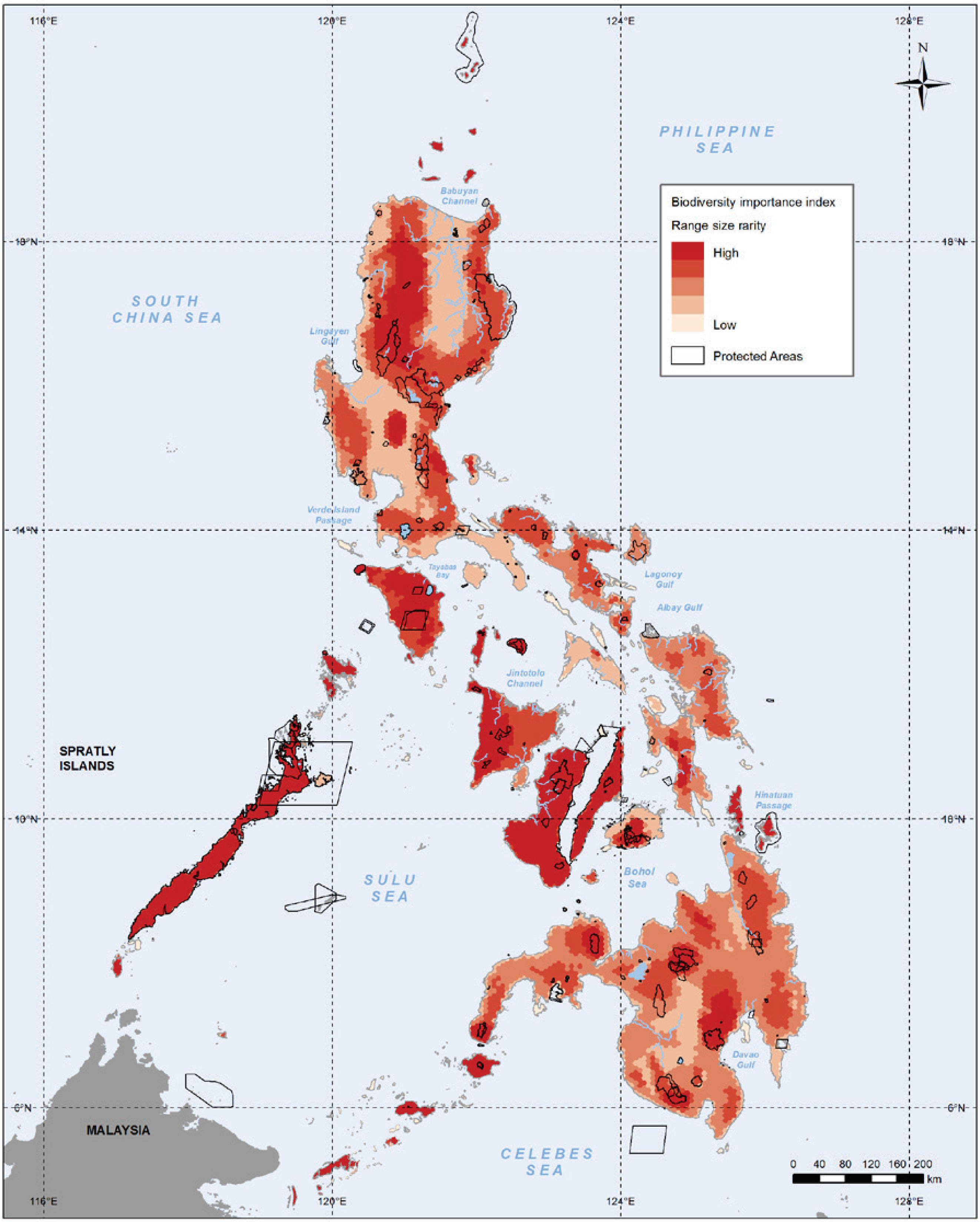
[5] Please refer to the map caption for a detailed account of the methodology used to generate the biodiversity importance index map.

Map 14: Biomass carbon in relation to areas of importance for threatened species. Protecting areas high in biodiversity and carbon (brown) which are also under threat can have large benefits for both REDD+ and NBSAP objectives.



Methods and data sources:
This map has combined biomass carbon data divided into 5 natural break classes and a biodiversity importance index divided into 5 quantile classes.
Biomass Carbon: Saatchi, S et al. "Benchmark map of forest carbon stocks in tropical regions across three continents", PNAS, 108. 24 (2011): 9899-904.
Biodiversity Importance Index: For methodology description see Map 15. **Species data:** IUCN 2013. IUCN Red List of Threatened Species. Version 2013.1 http://www.iucnredlist.org. Species range data downloaded February 2014.
Protected Areas: Philippines Protected Areas and Wildlife Bureau (PAWB) data obtained October 2013

Map 15: Biodiversity importance index: Range size rarity of species listed in Philippines' DENR Administrative Order No. 20014-15. This serves as an input into Map 14.



Methods and data sources:
Ranges of species listed in DENR Administrative Order No. 2004 – 15 "Establishing the list of terrestrial threatened species and their categories, and the list of other wildlife species pursuant to republic act no. 9147, otherwise known as the wildlife resources conservation and protection act of 2001" for which IUCN Red List data was available were loaded onto a 50km^2 hexagon grid covering the Philippines. This analysis was undertaken in Quantum GIS, using the QMarxan plugin to generate the hexagon grid across the country. (Trevor Wiens, 2013. QMarxan plugin for Quantum GIS. Apropos Information Systems Inc. http://aproposinfosystems.com).
A biodiversity importance index representing the species listed in DAO 2004-15 was calculated to take account of both the extent to which species ranges overlap, and the size of those species' ranges in the Philippines. The index is highest for cells with many species of restricted range, and lowest for cells where the few species that are present are also widely-distributed. First, for every species, and every 50km^2 hexagon, the area of the hexagon covered by that species' range, divided by the total Philippines range area for that species was calculated. This gives a proportion of the species' national range that falls within that hexagon. The biodiversity index was calculated by summing these values together for all species for that hexagon, to give an index that represents both how restricted the species are to that hexagon and how many species ranges occur in that hexagon. This methodology is derived from WorldMap (Williams 1988) http://www.nhm.ac.uk/research-curation/research/projects/worldmap/worldmap/info.htm#credits, the MacArthur project and the REDD-PAC project http://www.redd-pac.org
Species data: IUCN 2013. IUCN Red List of Threatened Species. Version 2013.1 http://www.iucnredlist.org. Species range data downloaded February 2014.

4 Conclusions and outlook

The maps presented in this report demonstrate that there are concrete opportunities in the Philippines for linking actions to support REDD+ and those which aim to achieve the Aichi Biodiversity Targets. However, it should also be noted that REDD+ cannot contribute to the achievement of all the Aichi Biodiversity Targets, since these are broader than forests and its role in climate change mitigation.

Joint planning for achieving the Aichi Biodiversity Targets and REDD+ could help the Philippines develop complementary approaches, coordinate efforts between ministries, and build coherent biodiversity conservation, climate change mitigation and land use policies. Spatial analysis as presented in this report can support such planning. For example, both NBSAP and REDD+ planning require information on past trends in forest cover and the drivers of forest loss (such as illegal logging hotspot areas, wildfires).

Using spatial analysis for prioritising areas under REDD+ to secure multiple benefits could help contribute to more than one Aichi Biodiversity Target. For example, as this report illustrates, prioritising areas of importance for biodiversity under REDD+ could contribute to Target 5 on reducing the rate of loss of all natural habitats and Target 12 on preventing the extinction of known threatened species.

The specific analysis needed for supporting planning varies between the different REDD+ activities. For example, this report illustrates how maps can support both planning for reducing deforestation and planning for the sustainable management of forests under REDD+ and Aichi Biodiversity Target 7 (sustainably managing areas under agriculture, aquaculture and forestry, ensuring conservation of biodiversity).

Spatial analysis can also support planning for the conservation or enhancement of ecosystem services such as soil erosion. It allows exploration of where existing forest plays an important role in preventing soil erosion, and where forest restoration could potentially reduce soil erosion. This could potentially inform the selection of sites under the National Greening Programme.

As planning for REDD+ and the Aichi Biodiversity Targets moves forward, the implementation of NBSAP and REDD+ activities will ultimately determine the extent to which synergies are achieved.

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Annex I: Generation of the above- and below-ground biomass carbon map for the Philippines

An estimate of the above-ground biomass carbon contained within the Philippines was developed using a 1 km resolution pan-tropical map of biomass carbon produced by Saatchi et al. (2011). According to this data, approximately 2.06 - 4.45 Gigatonnes (GtC) of above- and below-ground biomass carbon is stored in the Philippines, with a mean value of 3.50 GtC. Map 2 shows the distribution of biomass carbon across the Philippines, with the inset map showing the estimated percentage uncertainty (±%) associated with the values.

The biomass carbon map was produced in several stages by the NASA Jet Propulsion Laboratory, California Institute of Technology research group. Forest plots were sampled and a relationship was derived between these forest measurements and GLAS Lidar derived Lorey's height to give above ground and below ground biomass values for several hundred Lidar footprints. These Lidar footprints were then used as calibration plots for a MaxEnt spatial model to predict carbon values, where the 14 variables for the model were derived from remote sensing quick scatterometer (QSCAT) data, moderate resolution imaging spectroradiometer (MODIS) and the SRTM digital elevation data, 5 NDVI (Normalized Difference Vegetation Index), 3 LAI (Leaf Area Index), 4 QSCAT (Quick Scatterometer), and 2 SRTM (Shuttle Radar Topography Mission) metrics. Finally, a spatially explicit uncertainty estimate was produced from the model, which can be used to evaluate the uncertainty of the map at a national scale.

Annex II: Generation of the potential soil erosion risk map for the Philippines

To evaluate the potential importance of an area for soil erosion control, the analysis presented here uses a simple quantitative approach. Relative importance has been evaluated as a function of slope and rainfall. Precipitation intensity data for June – October for the Philippines (mean monthly rainfall intensity, mm per rain hour) (Mulligan, 2006) was combined and split into three classes, based on the national daily critical threshold rainfall intensity values that would induce landslides and flash flooding as estimated by Philippine Council for Industry and Energy Research and Development (PCIERD) (150 to 200mm of rainfall per day). An upper threshold of >8mm/rainfall per rain hour for precipitation was used in this analysis, with 4mm/rainfall per rain hour chosen as an intermediate value.

Digital Elevation Model (DEM) data (Lehner et al., 2008a) was used to generate slope, which was then reclassed into two classes, in accordance with the threshold used by the Department of Environment and Natural Resources of the Philippines (DENR). Upland areas, defined as those with >18% slope.

These two elements were then combined additively. Since there are 2 classes for slope (1-2) and 3 classes for mean precipitation (1-3) the resulting output has a maximum value of 5, and a minimum value of 2, and therefore 4 classes. These classes represent a low to high potential importance of an area for soil erosion control. Highest values represent higher erosion risk. No weighting is used in this approach; the relative importance of high precipitation is the same as that for steep slopes.

Catchments upstream of features of importance were generated using dam data and selected coastal and marine features (coral reefs, seagrasses, marine and coastal protected areas). Marine features were clipped to a 2.5 km nearshore buffer around the Philippines coastline (Davidson-Arnott & Greenwood, 2009). Using these features and a stream order network for the Philippines, catchments upstream of dams and coastal areas were generated and have been highlighted as potential priorities for soil erosion and sediment load control. Proposed future locations of National Greening Programme sites in areas identified as potentially at risk could also effectively contribute to soil stabilisation and the reduction of erosion.

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REDD+ aims to incentivise Reducing Emissions from Deforestation and forest Degradation, as well as the conservation of forest carbon stocks, sustainable management of forests and the enhancement of forest carbon stocks. Action for REDD+ under the United Nations Framework Convention on Climate Change (UNFCCC) can contribute towards achieving the Aichi Biodiversity Targets, and vice versa. Having ratified both the Convention on Biological Diversity (CBD) and the UNFCCC, joint planning for implementation of the Aichi Biodiversity Targets and REDD+ holds great relevance for a country such as the Philippines.

Spatial analysis exercises can serve as a useful tool for exploring where actions for REDD+ may also complement or further promote a country's commitments under the CBD and help it realise its Aichi Biodiversity Targets. This report presents selected results of spatial analysis to explore how spatial data can be used to inform where REDD+ could also help to meet the Philippines' biodiversity conservation targets under the CBD.

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