The role of spatial analysis in supporting REDD+ planning

REDD+ Academy

Expected Learning Outcomes

This module will provide an overview of the role of spatial analysis in supporting REDD+ planning. In particular, we will discuss:

- The importance of land-use planning in the context of REDD+, and the use of maps as decision-support tools for REDD+
- How information on spatial distribution of social and environmental benefits and potential risks, as well as costs, can be used for REDD+ planning
- How spatial information can be used to identify priority areas for REDD+ actions

Overview

- Part 1: Introduction: the role of spatial analysis in supporting REDD+ planning
- Part 2: Importance of stakeholder engagement
- Part 3: Multiple benefits, risks and costs of REDD+
- Part 3: Identifying priority areas for REDD+ actions

PART 1

INTRODUCTION: THE ROLE OF SPATIAL ANALYSIS IN SUPPORTING REDD+ PLANNING

Competing land uses

- Land subject to competing uses – including urban areas and infrastructure, agriculture, forests and other ecosystems
- Land-use planning for REDD+ helps to assess alternative uses for land (within limited resources) and identify priority locations for implementation of REDD+ actions, while enhancing potential benefits and avoiding potentials risks

The Cancun Agreements (COP16, 2010)

Land-use planning is an important input for the development of a national REDD+ strategy:

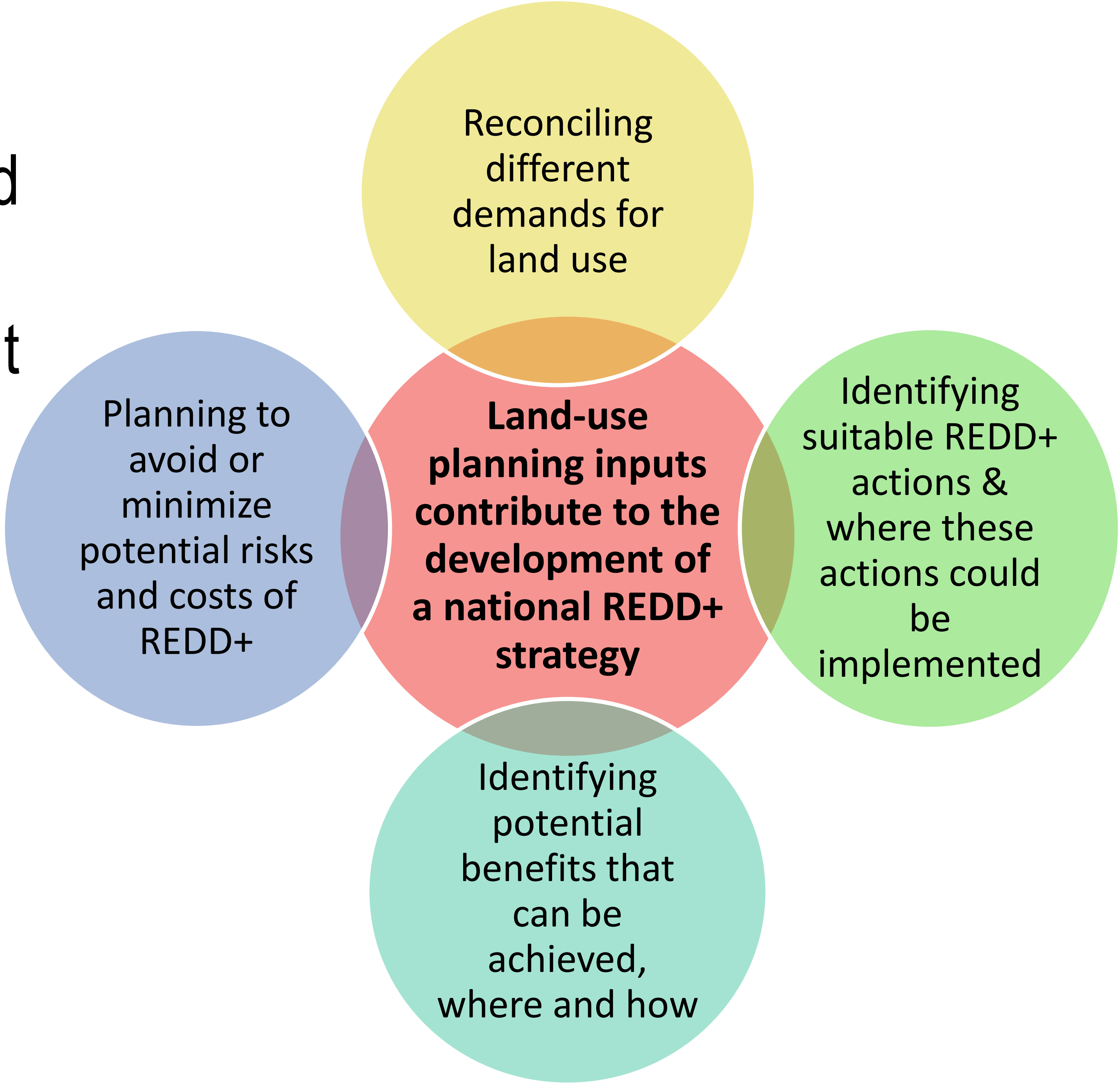
1. National REDD+ strategy or action plan

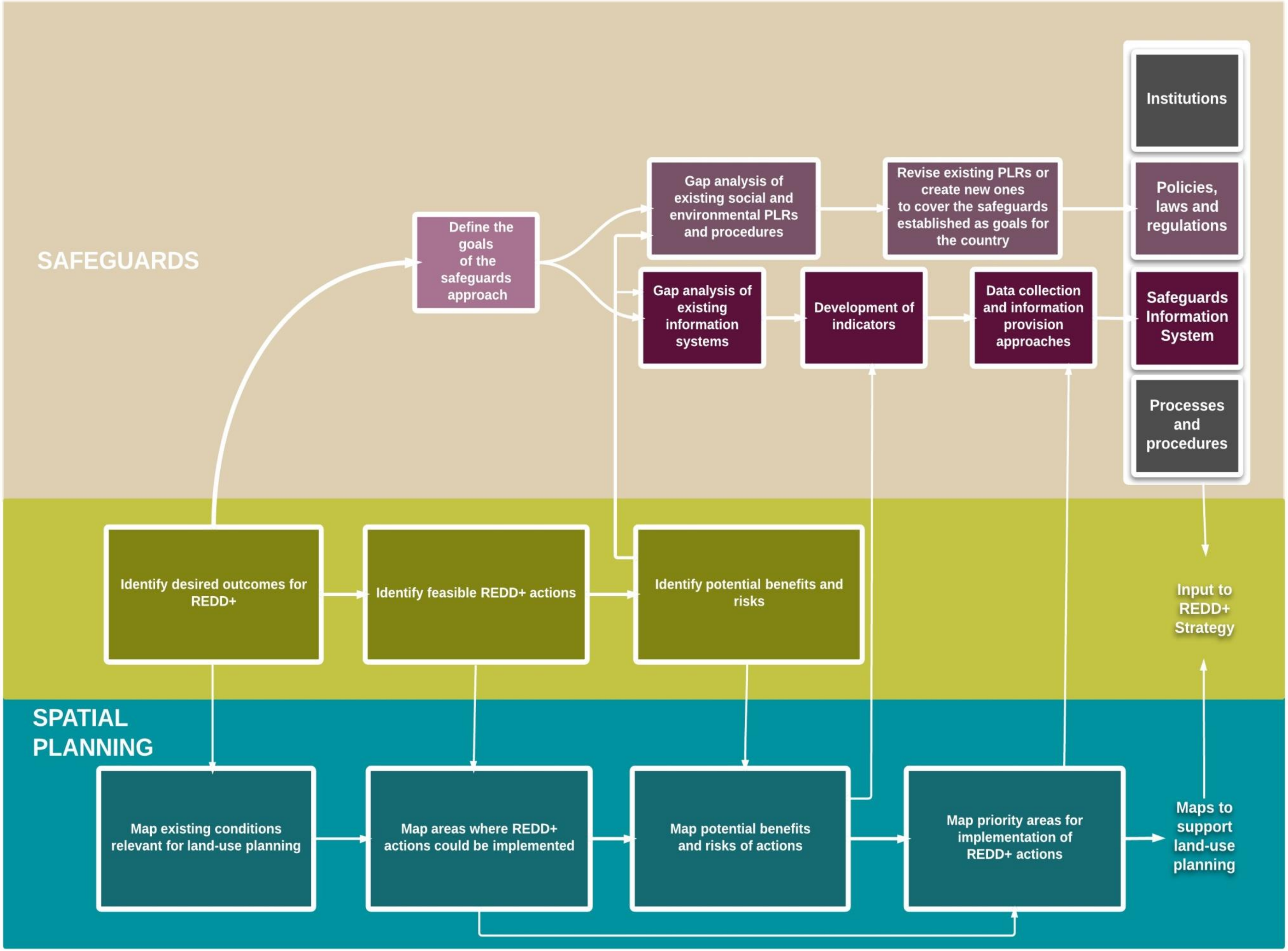
3. National forest monitoring system

2. National forest reference emission level and/or reference level

4. SIS: System for providing information on how the REDD+ safeguards are being addressed and respected throughout the implementation of the activities

Land-use planning and the development of a national REDD+ strategy





SAFEGUARDS
Define the goals of the safeguards approach
Gap analysis of existing social and environmental PLRs and procedures
Revise existing PLRs or create new ones to cover the safeguards established as goals for the country
Gap analysis of existing information systems
Development of indicators
Data collection and information provision approaches
Institutions
Policies, laws and regulations
Safeguards Information System
Processes and procedures
Identify desired outcomes for REDD+
Identify feasible REDD+ actions
Identify potential benefits and risks
Input to REDD+ Strategy
SPATIAL PLANNING
Map existing conditions relevant for land-use planning
Map areas where REDD+ actions could be implemented
Map potential benefits and risks of actions
Map priority areas for implementation of REDD+ actions
Maps to support land-use planning

Developing maps to support land-use planning for REDD+

- Spatial planning can help to:
  - Map existing conditions relevant for land-use planning
  - Map areas where REDD+ actions could be implemented
  - Map potential benefits and risks of actions
  - Map priority areas for implementation of REDD+ actions
- Spatial analyses can support land-use planning for REDD+ that **enhances benefits**, **reduces risks** and **minimizes costs**

Maps as decision-support tools

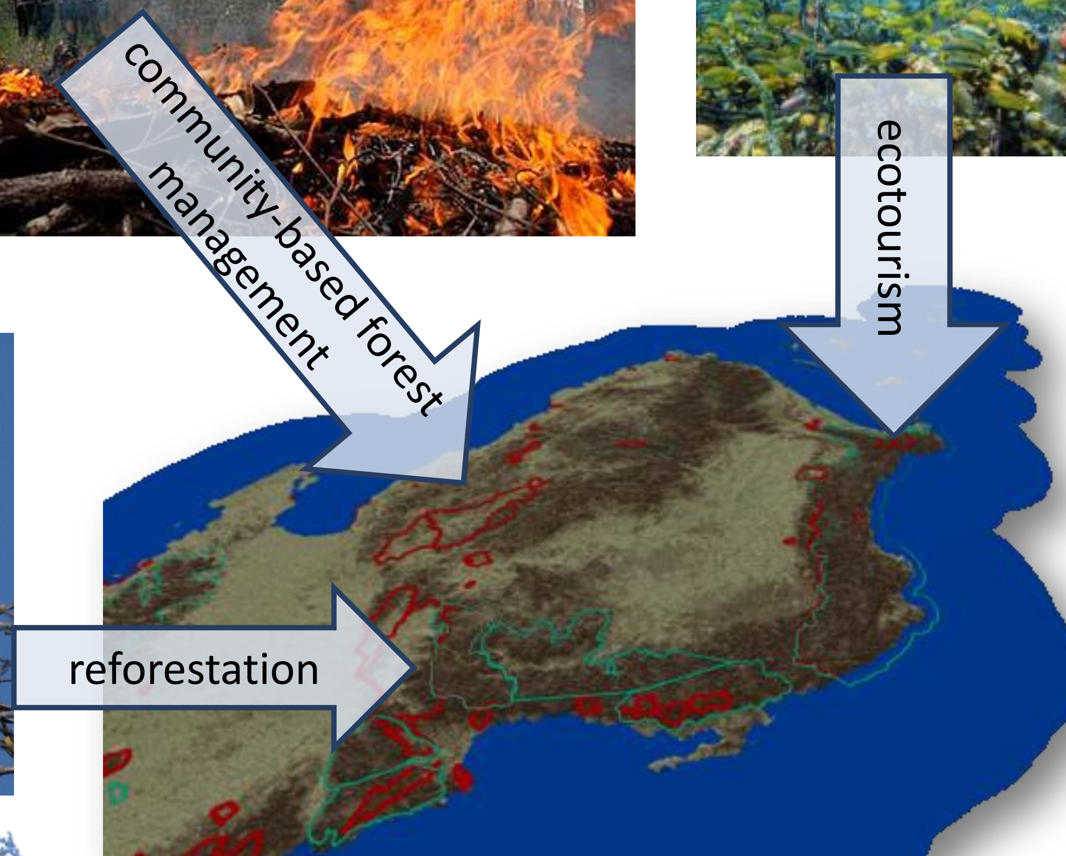
- Maps can be used as **decision-support tools** for REDD+, helping planners and stakeholders to:
  - understand context for REDD+ planning, with e.g., maps of forest cover; land use; current/planned infrastructure development; population distribution
  - analyze suitability of locations for different land uses, and priority areas for REDD+ actions
  - provide inputs for further sub-national planning

Important considerations in using spatial analysis for REDD+ planning

- Be clear what question each map is intended to address
- Consult thoroughly with the users of the maps
- Validate the results and explore with stakeholders how they can best be presented
- Consider availability, resolution, scale, copyright and quality of spatial information, as all will affect mapping work for REDD+
  - There are numerous types of data of interest for REDD+ planning, but not all are relevant, not all can be presented spatially, and not all are available, accurate, recent or of high enough resolution

Different REDD+ actions may be implemented in different areas

Potential **benefits, risks and costs** of REDD+ depend on where and how actions are implemented

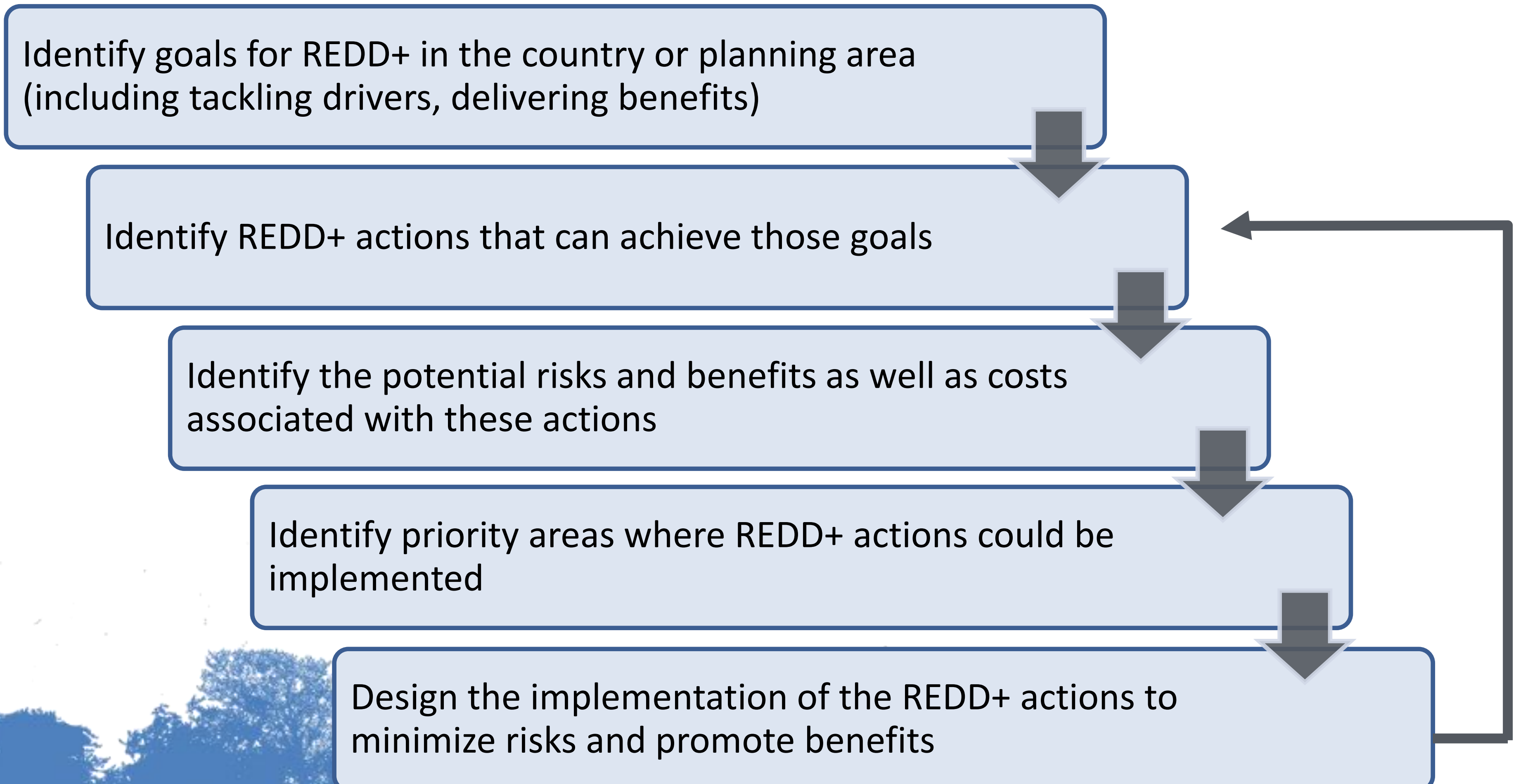


Identification of benefits and risks, in consultation with stakeholders at different levels

Evaluation of costs

Help decision-makers plan for REDD+ actions that enhance benefits, reduce or address risks and minimize costs

Addressing REDD+ benefits, risks and costs in land-use planning



PART 2

IMPORTANCE OF STAKEHOLDER ENGAGEMENT

Importance of stakeholder engagement

Stakeholder priorities

- Different stakeholder groups place different values on forest; for example:
  - farmers may see soil protection and hydrological regulation as key services to be secured by maintaining forests
  - tourism workers may prioritize protection of forest in key tourism sites
  - indigenous peoples/local communities may value forests for spiritual importance
  - forest-dependent households may value subsistence and income opportunities forests provide through NTFPs such as medicinal plants, forest food, firewood and charcoal

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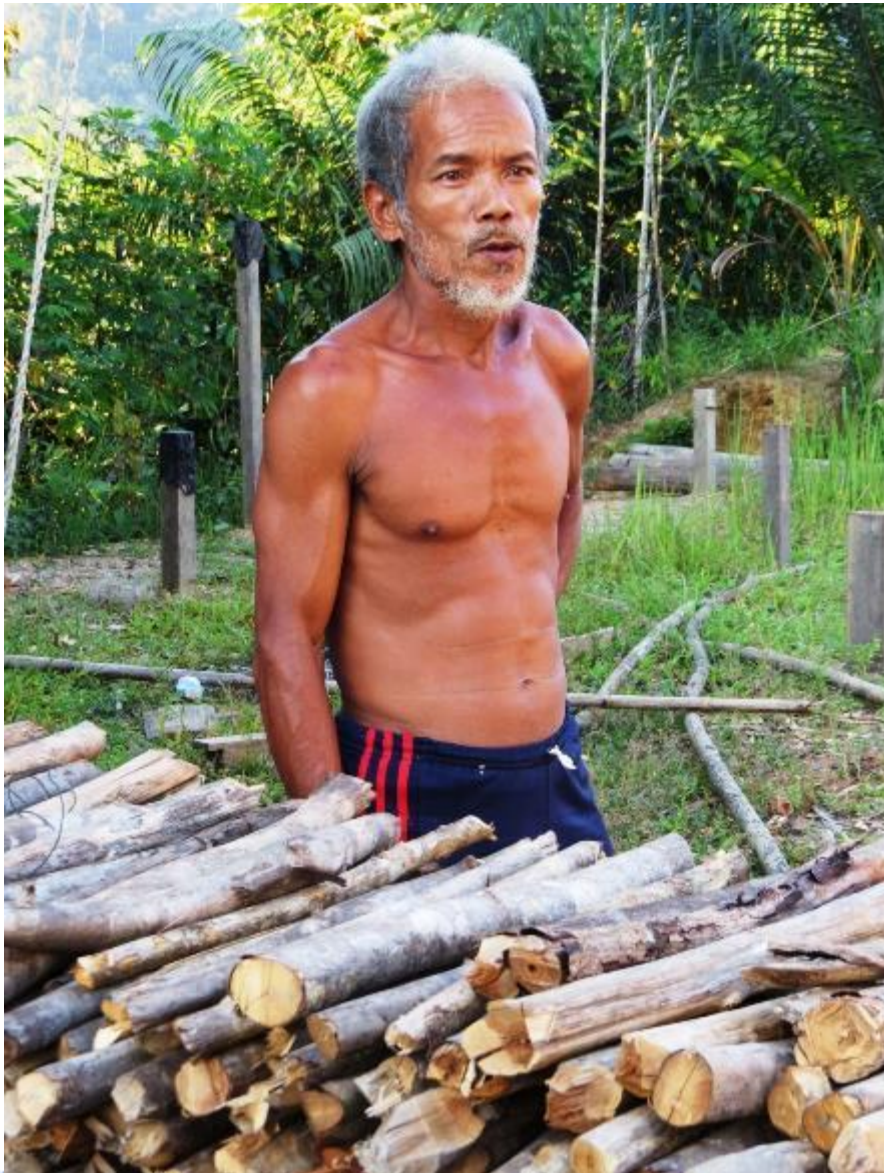

A villager drying firewood used for cooking
Manuel Boissière, CIFOR-PMRV, 2013

A villager weaving a 'ronjong' basket using 'perupuk' leaves (a type of pandan) collected from the forest. They use the basket to carry harvested paddy.
Indah WB, CIFOR-PMRV, 2013

Forests: Safe drinking water for Jakarta

PART 3

MULTIPLE BENEFITS, RISKS AND COSTS OF REDD+

Forests, carbon and REDD+

REDD+

= Reducing emissions from Deforestation and forest Degradation

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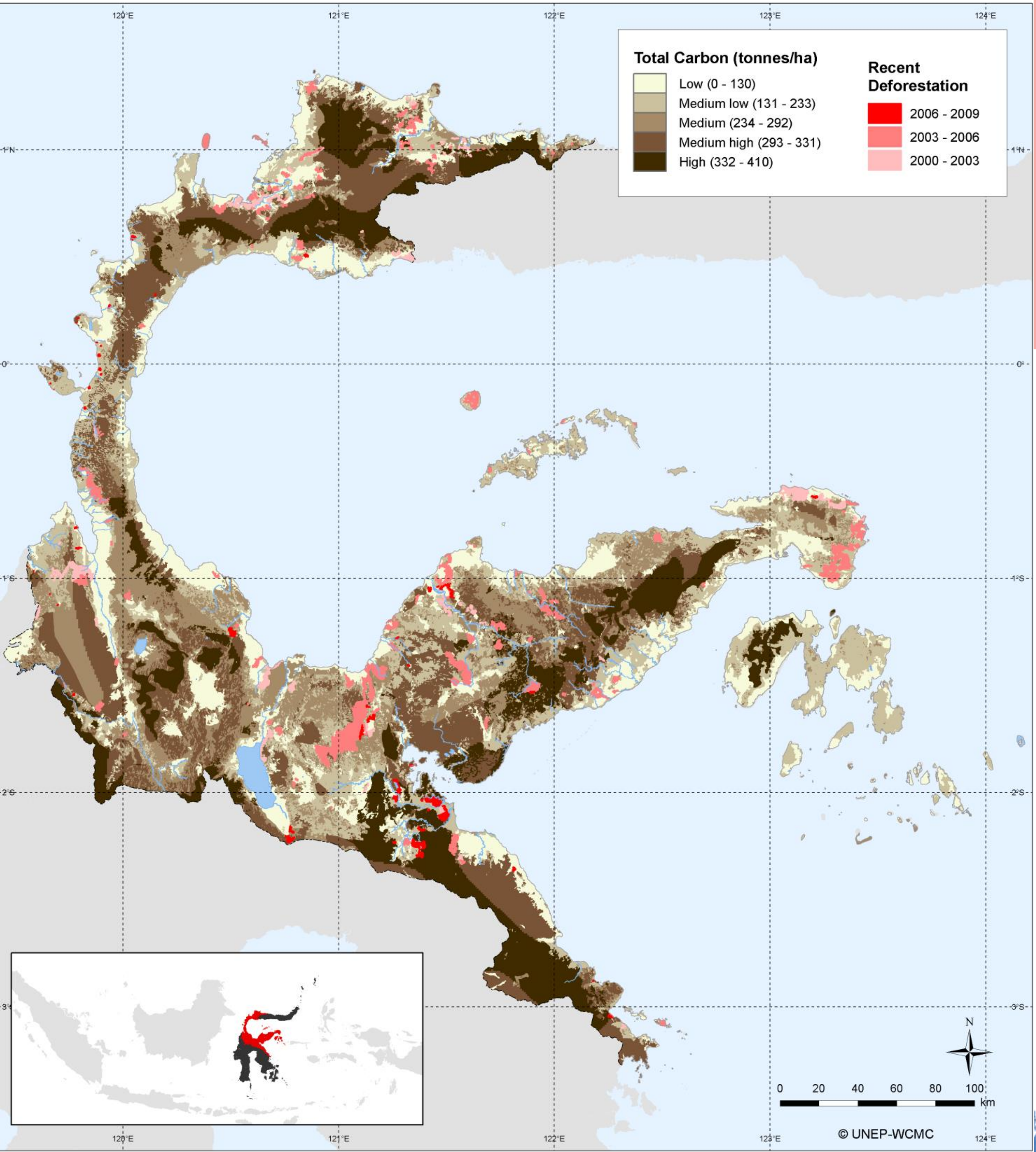
Conservation of forest carbon stocks
Sustainable management of forests
Enhancement of forest carbon stocks

- Central value REDD+ intended to protect and enhance is forest carbon
    - Maintenance and enhancement of forest carbon stocks important contribution to global climate change mitigation
- Information on location of **forests** and **carbon stocks**, as well as land cover change **pressures**, essential for REDD+ planning

For example: Carbon stocks and areas of recent deforestation (2000-2009) in Central Sulawesi



Information can be used to **assess land-cover change (including forest cover loss) quantitatively** and identify possible priority areas for REDD+ actions to reduce deforestation

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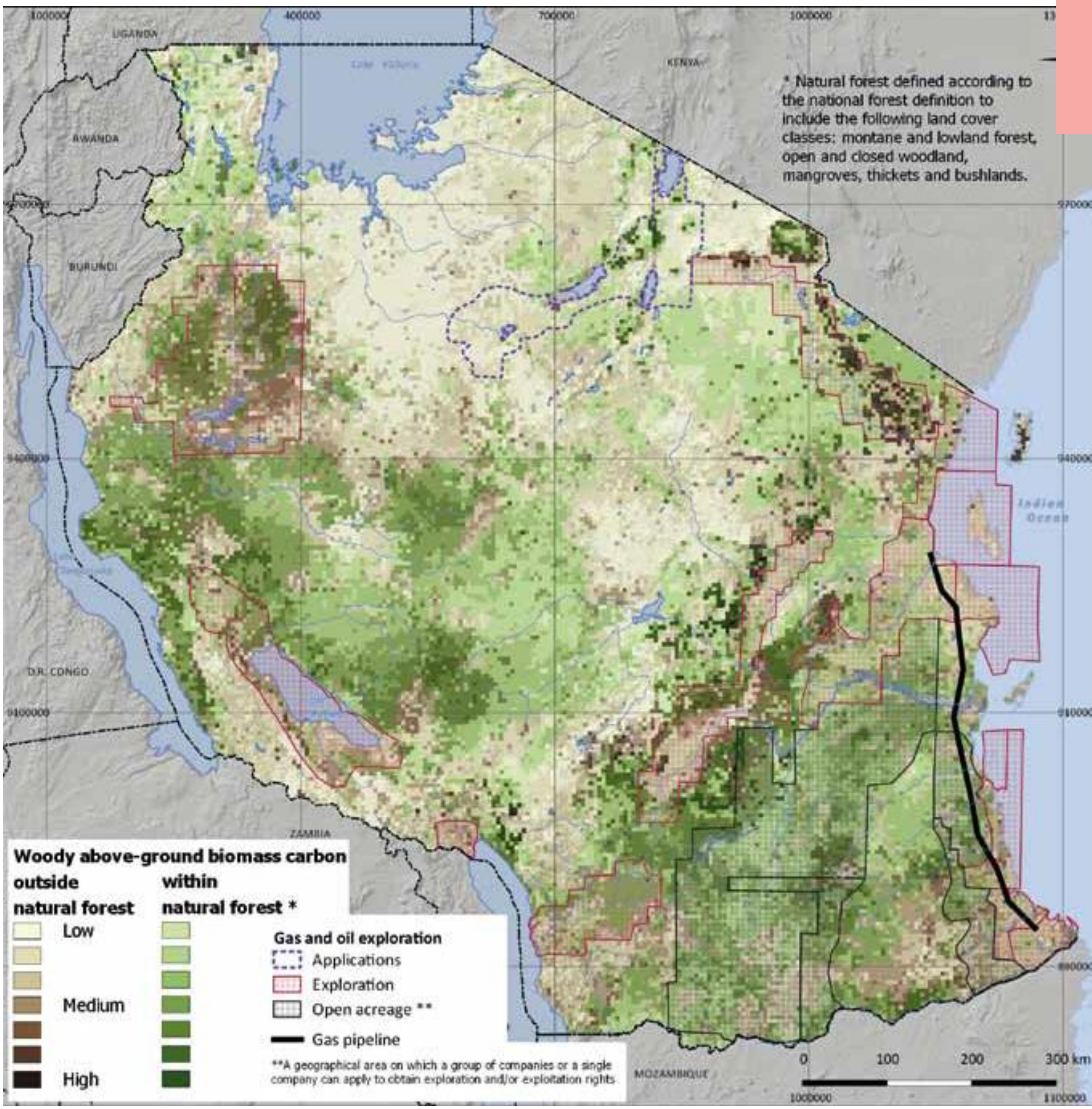
Pressures on forests

For example: Current oil and gas exploration licenses, applications and open acreage in Tanzania



Location of **pressures**, such as oil and gas exploration and population growth help identify where REDD+ implementation is **feasible**

Why is it important to look at benefits beyond carbon?

- Carbon-only approach to REDD+ misses opportunities
- By securing benefits beyond carbon, REDD+ has potential to:
  - draw on wider social and political support, linking REDD+ to wider environmental and societal benefits and sustainable development goals
  - demonstrate it is realizing a broader range of benefits
- Securing additional benefits, avoiding significant risks and minimizing costs may be key to success of REDD+

MULTIPLE BENEFITS OF REDD+

Multiple benefits of REDD+

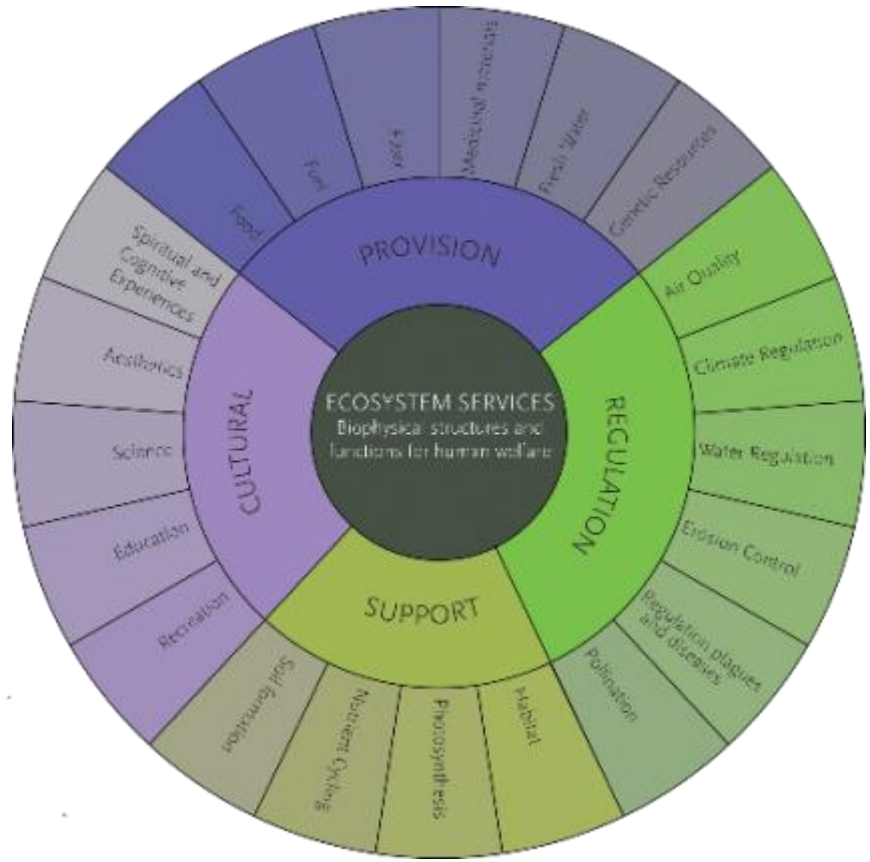
- While main aim of REDD+ is to reduce greenhouse gas emissions and increase carbon dioxide sequestration from the atmosphere, it has the potential to deliver additional environmental and social benefits

- Multiple benefits of REDD+ are all of the benefits – social and environmental – that may result from the implementation of REDD+ (sometimes called “co-benefits”)

- Information on spatial distribution of social and environmental benefits and potential risks, as well as costs, can be used for REDD+ planning

Types of multiple benefits

- REDD+ implementation can help to deliver multiple benefits beyond carbon, which include:
  - Enhancement of ecosystem services (goods and services provided by nature)
  - Biodiversity conservation
  - Livelihood and social benefits
  - Clarified tenure and improved governance of natural resources



How can spatial information be used to explore multiple benefits of REDD+?

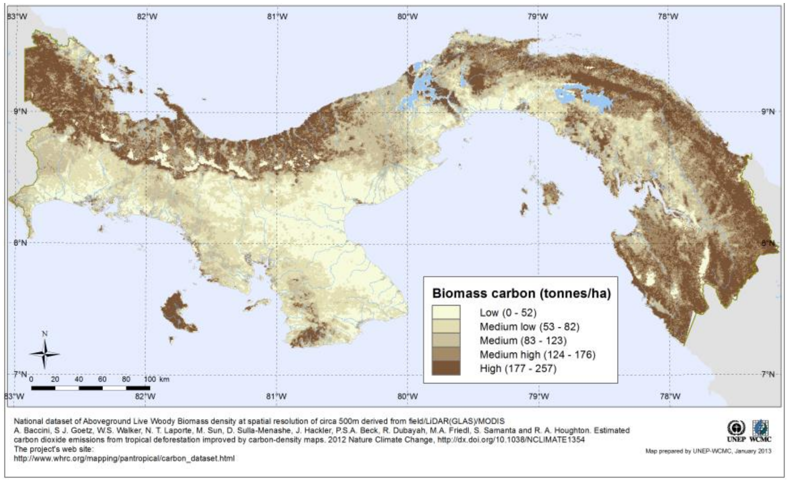
- Improved livelihoods for local communities: location of areas with high poverty density; income inequality; community forestry areas
- Conservation of biodiversity: location of Key Biodiversity Areas; Important Bird Areas; wildlife corridors; endemic species; threatened species
- Protection/enhancement of water quality: location of watersheds; hydropower facilities; soil erosion risk

Benefits vary geographically

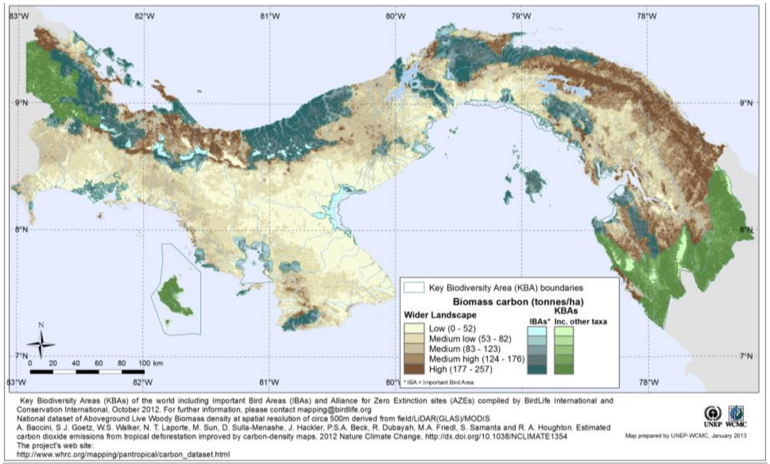
For example: individual benefits of forest in Panama

Biodiversity and ecosystem services distributed unevenly across space; spatial data helps identify areas important for different benefits and combinations of benefits

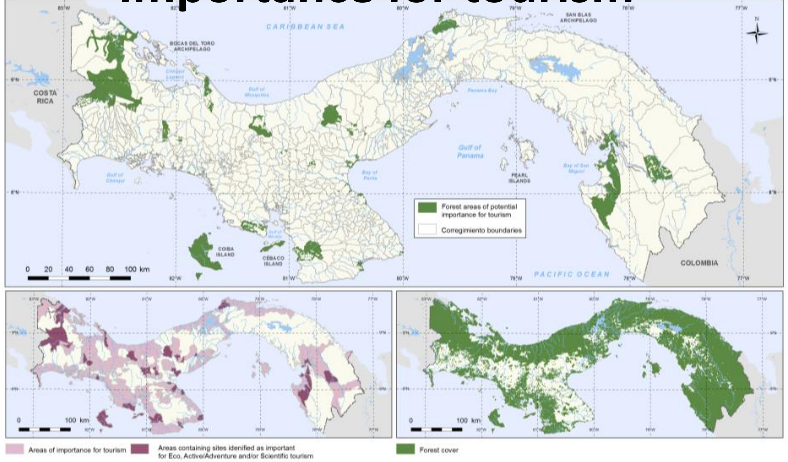
Biomass carbon stocks



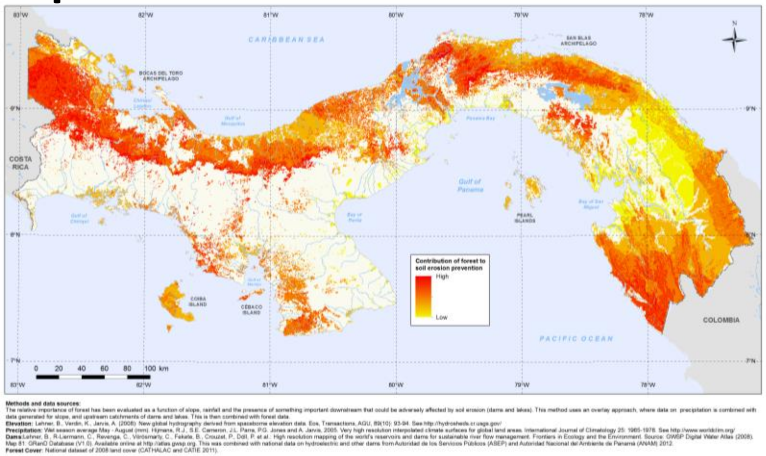
Importance for biodiversity



Importance for tourism

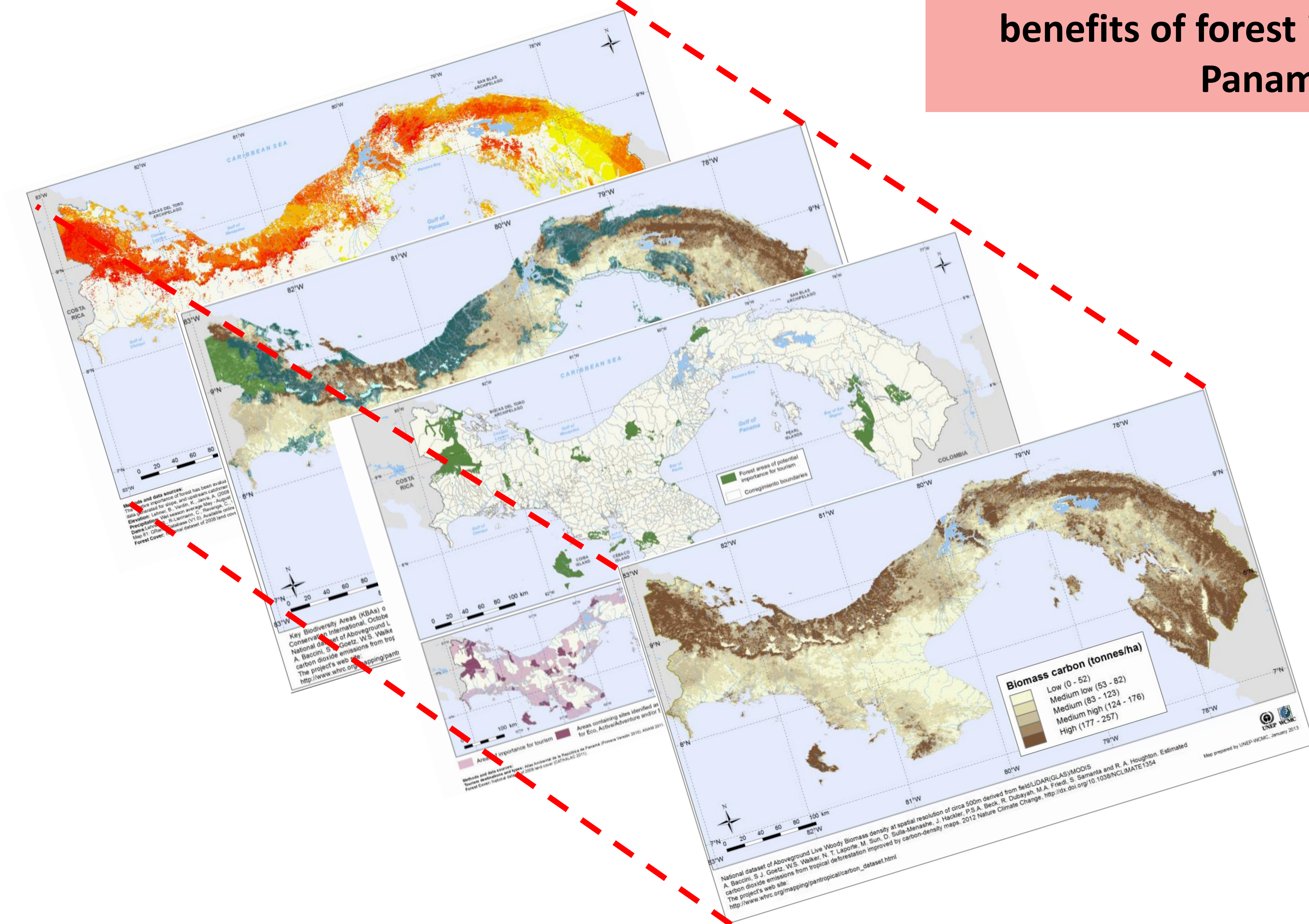


Importance for soil erosion control



Benefits can be overlaid

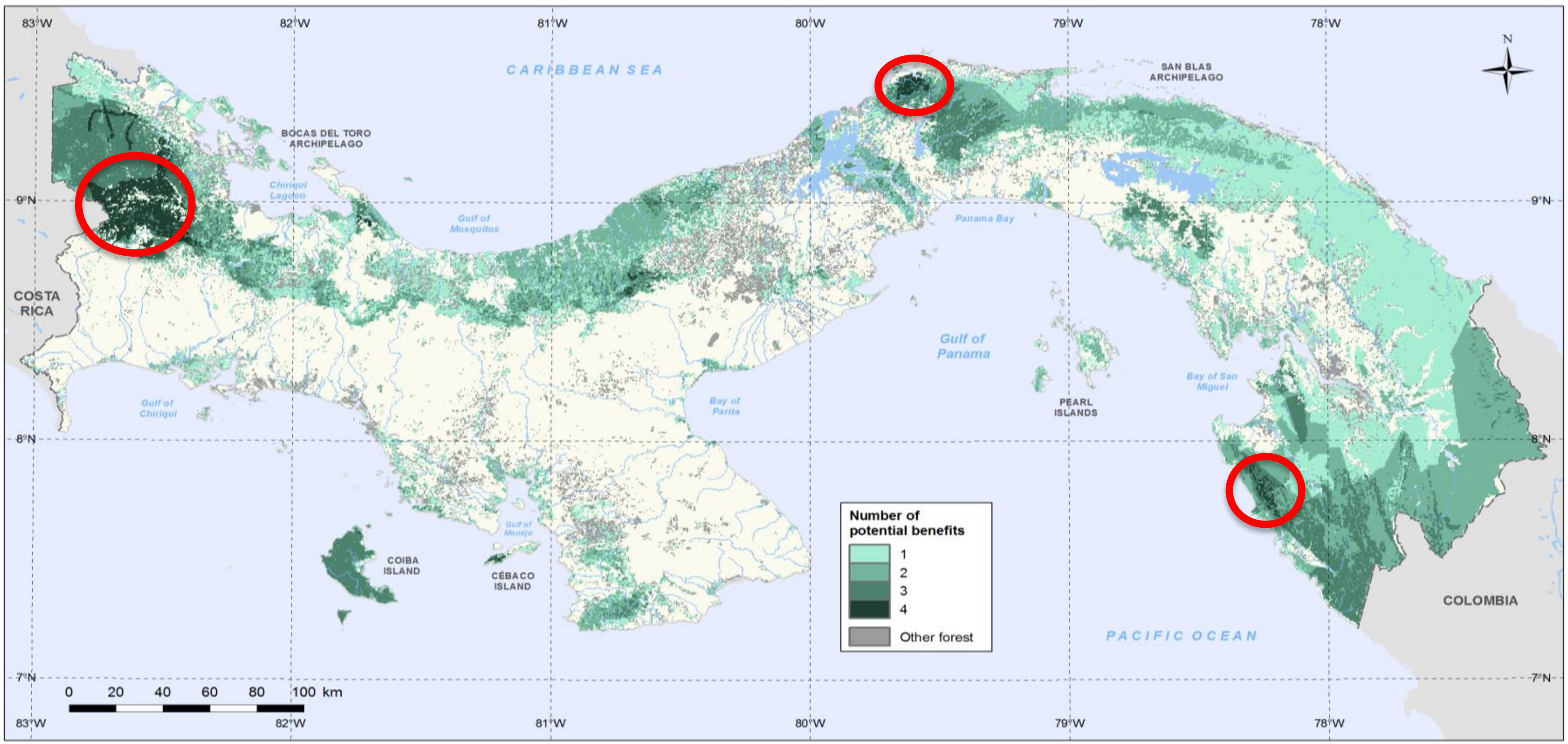
For example: overlaying individual benefits of forest in Panama



Benefits can be counted

For example: multiple benefits of forest in Panama

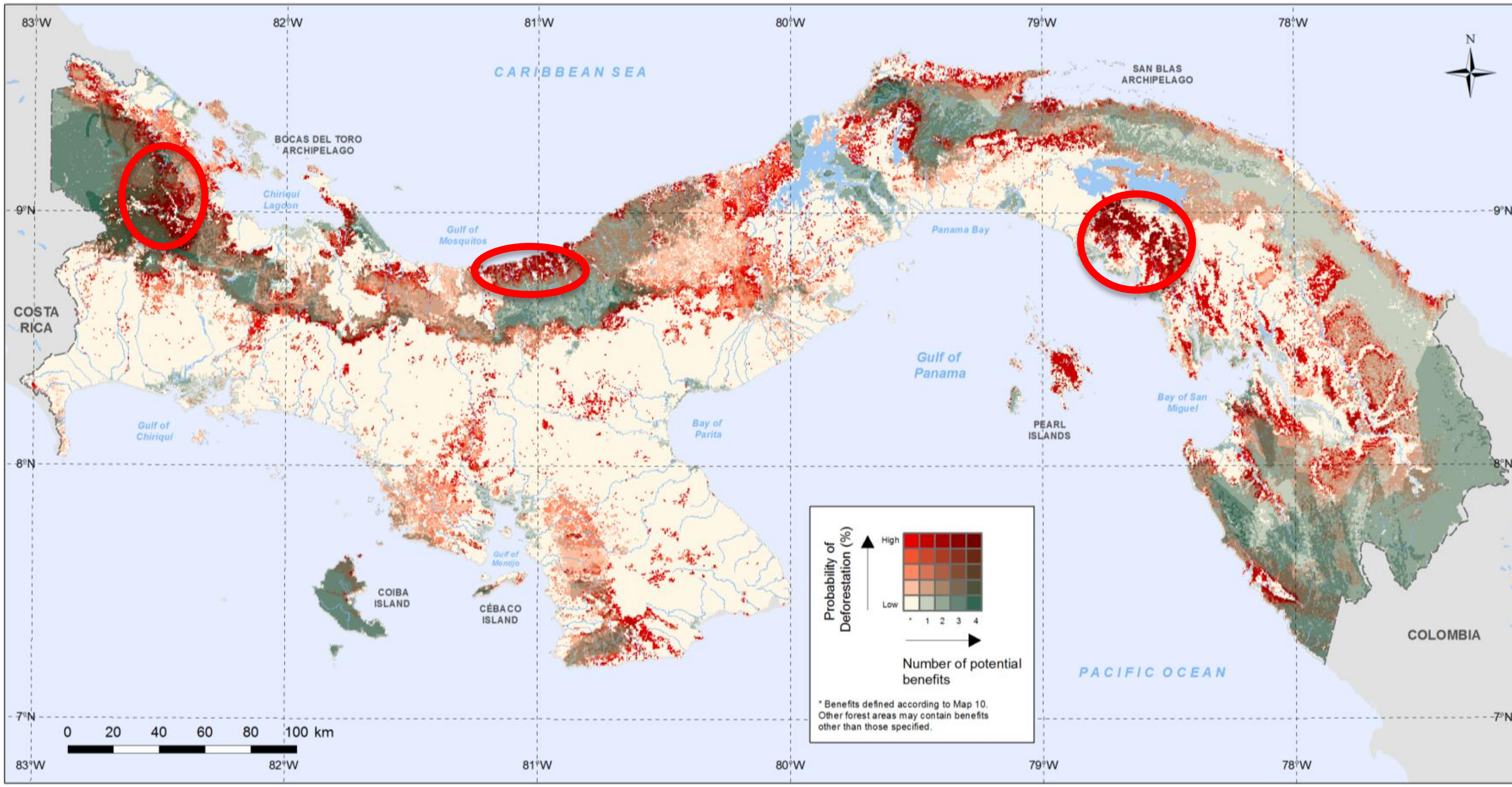
- separate benefits can be added together to identify forest areas of potential importance for a larger number of benefits from REDD+
- all else being equal, greatest priority for REDD+ might be to focus on areas where action to retain or restore forests can potentially provide multiple benefits



Methods and data sources:
Biomass Carbon: Asner, G., Mascaro, J., Anderson, C., Knapp, D., Martin, R., Kennedy-Bowdoin, T., van Breugel, M., Davies, S., Hall, J., Muller-Landau, H., Potvin, C., Sousa, W., Wright, J., and Bermingham, E. (2013) High-fidelity national carbon mapping for resource management and REDD+. Carbon Balance and Management 8:7. http://www.cbmjournal.com/content/8/1/7. Ecosystem-specific conversion factors (IPCC 2006) were used to add below-ground carbon to this map. The top two classes of biomass carbon "medium high" and "high" (see map 3) were used to represent areas of highest importance for carbon in this map. **Tourism:** Atlas Ambiental de la República de Panamá (Primera Versión 2010). ANAM 2011. Tourism destinations generated for the Tourism Master Plan 2007-2020. Destinations have been divided into 8 zones with 26 tourist destinations, which in many cases used administrative political divisions. These were then clipped to forest area (see map 9). **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 mappingbirdlife.org (see map 6). **Soil erosion:** The relative importance of forest has been evaluated as a function of slope, rainfall and the presence of something important downstream that could be adversely affected by soil erosion (dams and lakes).The top three classes from map 8 have been used to identify areas of greatest importance here. Elevation: Lehner, B., Verdin, K., Jarvis, A. (2008): New global hydrography derived from spaceborne elevation data. Eos, Transactions, AGU, 89(10): 93-94. Precipitation: Hijmans, R.J., S.E. Cameron, J.L. Parra, P.G. Jones and A. Jarvis, 2005. Very high resolution interpolated climate surfaces for global land areas. International Journal of Climatology 25: 1965-1978. 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. This was combined with national data on hydroelectric and other dams from Autoridad de los Servicios Públicos (ASEP) and Autoridad Nacional del Ambiente de Panamá (ANAM) 2012. **Forest:** National dataset of 2008 land cover (CATHALAC 2011).

Areas of forest at risk of future deforestation can be highlighted

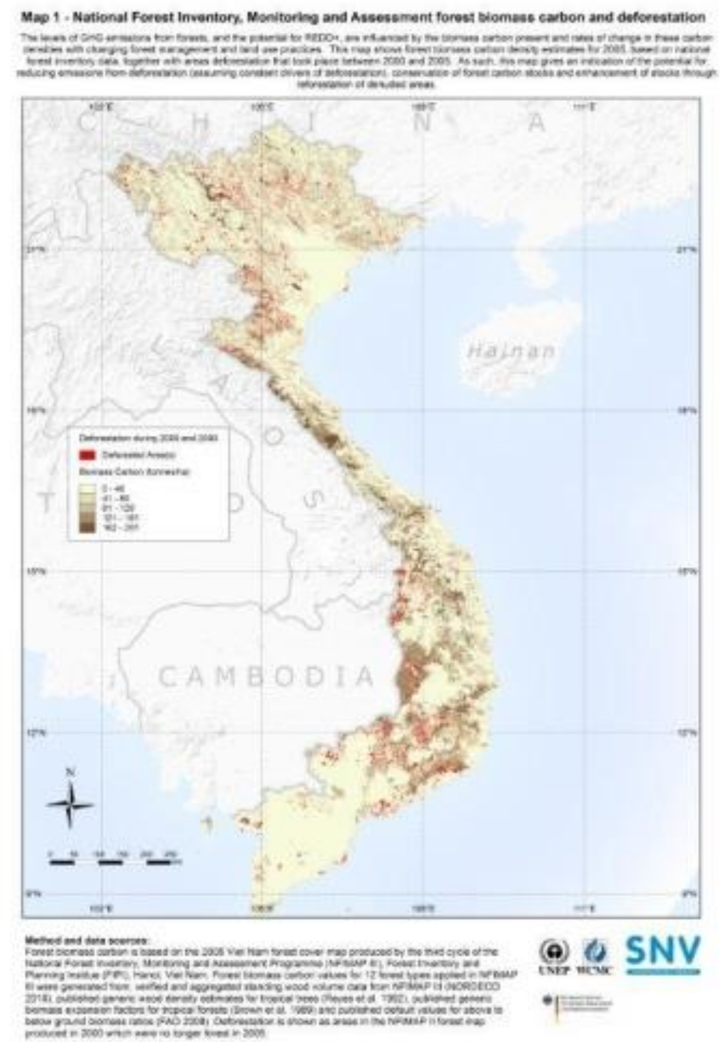
For example: forest areas with potential for multiple benefits at risk of future deforestation in Panama



Methods and data sources:
Probability of Deforestation (2008 – 2028): CATIE (2013). Análisis de cambio de uso de la tierra (1992 – 2008) y formulación de escenarios de deforestación futura de los bosques de Panamá. Turrialba, Costa Rica: Centro Agronómico Tropical de Investigación y Enseñanza (CATIE). This map features the probability of deforestation outputs from the dynamic-EGO model of future deforestation, which have been divided using a quantile classification scheme and combined with biomass carbon.
Multiple benefits: Biomass Carbon: A. Baccini, S J. Goetz, W.S. Walker, N. T. Laporte, M. Sun, D. Sulla-Menashe, J. Hackler, P.S.A. Beck, R. Dubayah, M.A. Friedl, S. Samanta and R. A. Houghton. Estimated carbon dioxide emissions from tropical deforestation improved by carbon-density maps. 2012 Nature Climate Change http://dx.doi.org/10.1038/NCLIMATE1354. See: http://www.whrc.org/mapping/pantropical/carbon_dataset.html. Ecosystem-specific conversion factors (IPCC 2006) were used to add below-ground biomass to this map. In addition, based on expert consultation the above dataset was combined with the national dataset of 2008 land cover (CATHALAC and CATIE 2011), where biomass carbon values for "Rastrojo" were substituted to 46.2 tC/ha and for "Uso agropecuario" to 28.35 tC/ha.The top two classes of biomass carbon "medium high" and "high" (see map 3) were used to represent areas of highest importance for carbon in this map. **Tourism:**Atlas Ambiental de la República de Panamá (Primera Versión 2010). ANAM 2011. Tourism destinations generated for the Tourism Master Plan 2007-2020. Destinations have been divided into 8 zones with 26 tourist destinations, which in many cases used administrative political divisions and then clipped to forest area (see map 9). **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 mappingbirdlife.org. (see map 6). **Soil erosion:** The relative importance of forest has been evaluated as a function of slope, rainfall and the presence of something important downstream that could be adversely affected by soil erosion (dams and lakes).The top three classes from map 8 have been used to identify areas of greatest importance here. Elevation: Lehner, B., Verdin, K., Jarvis, A. (2008): New global hydrography derived from spaceborne elevation data. Eos, Transactions, AGU, 89(10): 93-94. Precipitation: Hijmans, R.J., S.E. Cameron, J.L. Parra, P.G. Jones and A. Jarvis, 2005. Very high resolution interpolated climate surfaces for global land areas. International Journal of Climatology 25: 1965-1978. 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. This was combined with national data on hydroelectric and other dams from Autoridad de los Servicios Públicos (ASEP) and Autoridad Nacional del Ambiente de Panamá (ANAM) 2012. **Forest:** National dataset of 2008 land cover (CATHALAC and CATIE 2011).

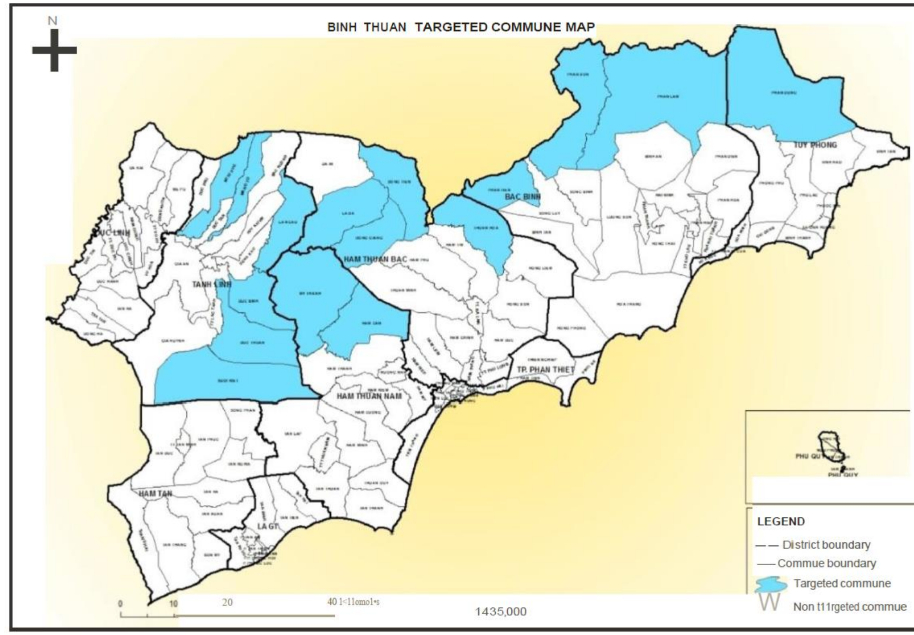
Country experience: Sub-national planning in Viet Nam

- Part of UN-REDD Viet Nam Phase II Programme focused on building capacity for spatial planning, to inform provincial-level REDD+ planning
  - Will present benefits and trade-offs associated with REDD+ actions in particular locations, land-use designations and ecosystems



Country experience: Sub-national planning in Viet Nam

- Initial identification of REDD+ priority areas for 6 pilot provinces used following layers:
  - Forest cover & forest cover change
  - Carbon stocks
  - Forest management categories
  - Poverty
- Overlaid this spatial data to show potential priority areas in provinces by commune



Current collaboration will build on this approach with:
-Stakeholder consultation at provincial level
- capacity building for national and provincial spatial planners
-Incorporation of additional priority spatial information (e.g. future LU plans, biodiversity, ES provision, livelihoods)

POTENTIAL RISKS OF REDD+

Planning for potential risks of REDD+

- REDD+ also carries potential risks, which depend on specific actions and national and local contexts
  - Environmental risks could include:
    - Conversion of degraded natural forest to plantations
    - Displacement of pressures to areas important for biodiversity or ecosystem services
  - Social risks could include:
    - Reduced access to resources for forest users
    - Inequitable sharing of REDD+ benefits
    - Conflicts over land
    - Displacement of forest dependent communities

Cancun safeguards

- Cancun safeguards, agreed by Parties to UNFCCC, aim to guard against harm from REDD+ and enhance benefits
- Countries have agreed to promote and support the Cancun safeguards, and will decide how to apply them
- Designing REDD+ to deliver multiple benefits helps to fulfil the Cancun commitments

The Cancun Agreements: Safeguards for REDD+

Elements of the Cancun Safeguards

- a. Policy alignment (national & international)
- b. Forest governance (transparency & effectiveness)
- c. Knowledge and rights of indigenous peoples &local communities
- d. Full and effective participation of relevant stakeholders, in particular IP & local communities
- e. Natural forest, biodiversity, social & environmental benefits
- f. Address risk of reversals
- g. Reduce displacement of emissions

How can spatial information be used to consider safeguards?

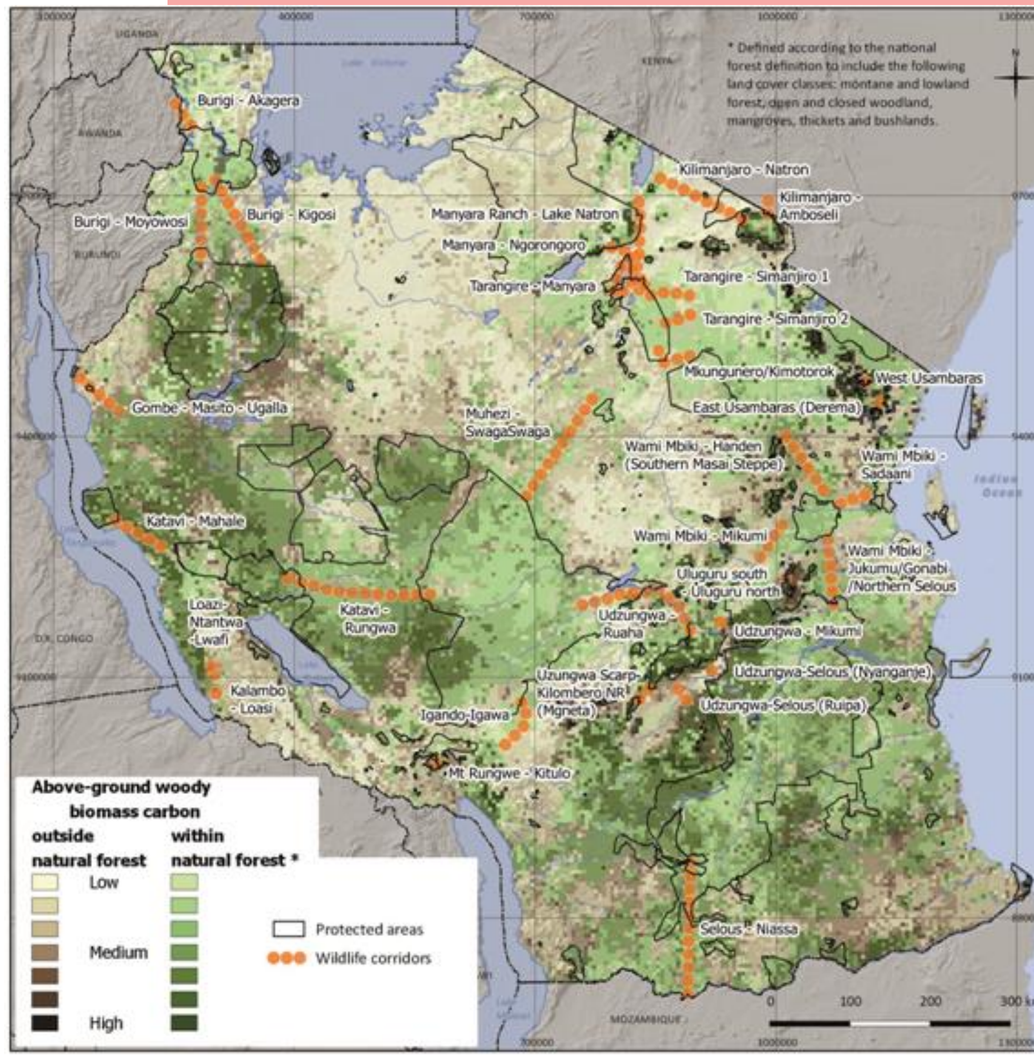
- Maps can help to identify locations where certain REDD+ actions may contravene safeguards (e.g. where natural forest is converted into plantations)
- Maps can help to identify where REDD+ actions can enhance social and environmental benefits (e.g. where biodiversity conservation can be promoted)
- Information from safeguards information systems (SIS) can feed data into maps for REDD+ planning, and spatial analyses can also be used to track indicators relevant to SIS

Using spatial information to support the Cancun safeguards

For example: Important wildlife corridors, protected areas, natural forest and woody biomass carbon in Tanzania

•Safeguard (e) notes REDD+ activities are **not to be used for the conversion of natural forests**, are instead to **incentivize the protection and conservation** of natural forests and their ecosystem services, and to **enhance other social and environmental benefits**

- •Conversion of natural forests to forest plantations or other land uses could lead to the loss of biodiversity



Biomass: NAFORMA woody biomass only. 5km preliminary datset base on field data only.
Natural forest: NAFORMA landuse landcover map 2010.
Wildlife corridors based on information provided at tzwildlifecorridors.org
Protected Areas and Forest Reserves: TFS and WDPA 2013.

The Cancun Agreements (COP16, 2010)

Spatial information can be used in the collection of data for safeguard information systems (SIS):

1. National REDD+ strategy or action plan

2. National forest reference emission level and/or reference level

3. National forest monitoring system

4. SIS: System for providing information on how the REDD+ safeguards are being addressed and respected throughout the implementation of the activities

COSTS OF REDD+

Planning for costs of REDD+

In addition to benefits and risks, there are also economic costs associated with REDD+, which vary spatially:

Costs of REDD+

Opportunity

Costs of income foregone from 'business as usual' (alternative to REDD+) land use

Implementation

Variable costs associated with REDD+ actions

- Investment at the beginning ('up-front costs')
- Annual expenses

Transaction

Costs of starting and maintaining a REDD+ programme

- Development costs
- Costs of bureaucratic processes (e.g. procurement)

Economic valuations and planning for REDD+

- Expressing potential REDD+ impacts on biodiversity and ecosystem services in monetary terms can inform land-use choices by providing information on full costs and benefits, and could change decisions about what REDD+ options are pursued
  - For example, in some areas with high agricultural productivity, carbon payments may not be able to compete with financial incentives for converting tropical forests; demonstrating monetary value of ecosystem services and biodiversity could make a difference
  - while identifying a value is not the same as deriving a direct monetary benefit, can still influence land-use decisions

Estimating benefits and costs of REDD+

Level of analysis	Basic	Advanced
Effort required	Review of existing country/regional relevant socio-economic data in reports and studies, otherwise minimal collection of data (no new primary data collection)	Extensive field work and modelling to collect and map information on relevant physical ecosystems, along with design and implementation of market/social/valuation surveys (*note that a good understanding of a number of specialist economic tools and methodologies is required*)

Combining information on benefits and risks with cost assessments of REDD+...

•can help decision-makers design and locate REDD+ actions that enhance benefits, mitigate risks and reduce costs

What types of spatially explicit economic information can be used to plan for REDD+?

Costs

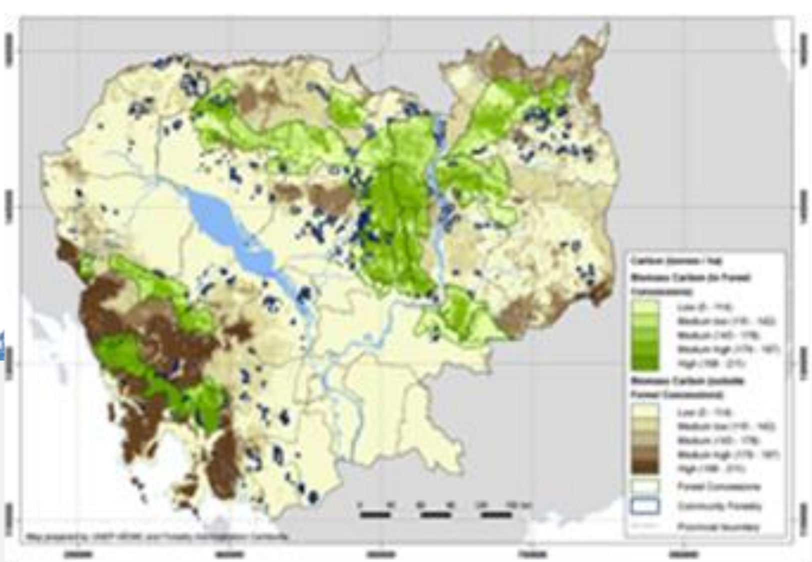
- •Opportunity costs
- •Implementation costs
- •Transaction costs

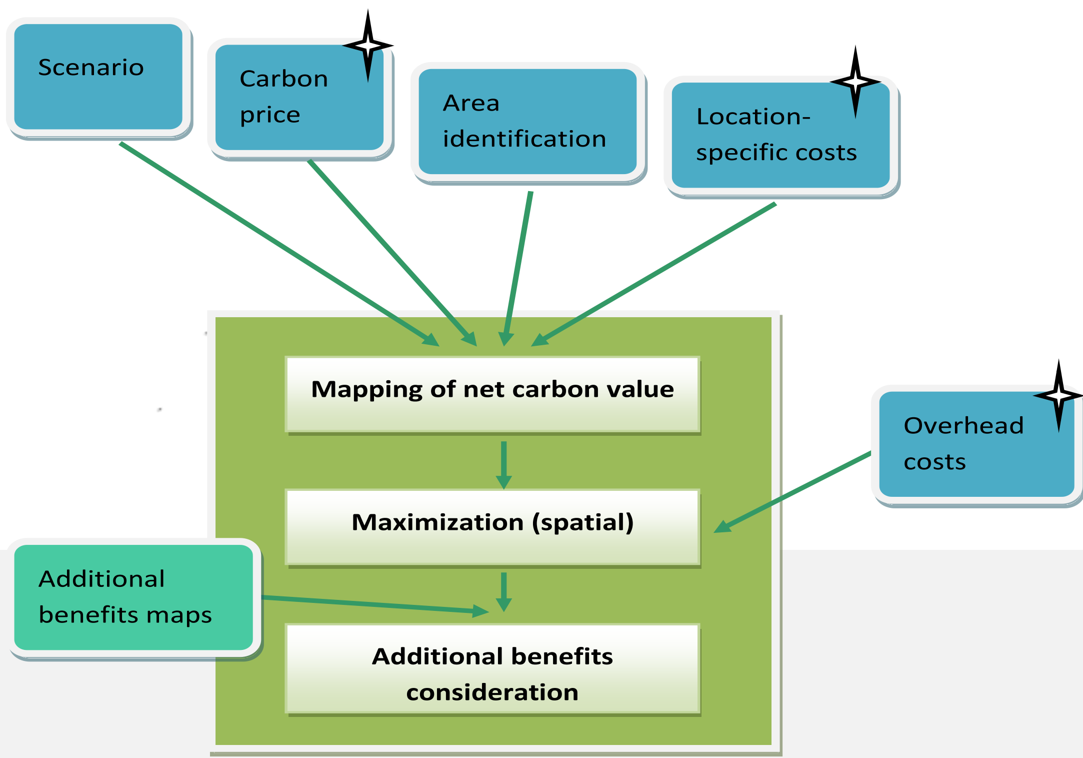
Benefits

- •Soil erosion - impact of downstream water sedimentation on dams
- •Non-timber for products- sustainable harvest levels of food, fibres and medicines, whether marketed or not
- •Nature-based tourism - projected income from tourist expenditure
- •Pollination - forest impacts on existing crop yields

Spatially explicit economic analyses for REDD+

A GIS tool that can be used for REDD+ planning is in development; it will be able to carry out a range of REDD+ spatial economic analyses by varying underlying cost and benefit assumptions; as a first step, an initial version will be developed for selected provinces in Cambodia





Country experience: Costs and benefits of REDD+ activities in Cambodia

- Ongoing work with national consultants and relevant government institutions to identify priority activities and actions relevant for REDD+ objectives in Cambodia
- Plans to list specific actions identified for each of the REDD+ activities, and collate relevant average cost & benefit data (not spatially explicit)
  - Will develop spreadsheet model and present findings to stakeholders at national REDD+ planning meeting

PART 4

IDENTIFYING PRIORITY AREAS FOR REDD+ ACTIONS

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Planning for REDD+ actions

REDD+ activity	Example questions for planning	Example types of spatial information	Example actions
Reducing emissions from deforestation	Where is there forest? What other land uses and types of land cover occur in the landscape? Where are carbon stocks located? What areas are under pressure from deforestation?	Biomass carbon stock Forest cover Land use Land cover Future deforestation risk	Reduce conversion pressure by promoting conservation agriculture
Reducing emissions from forest degradation	Where is forest degradation occurring? What are the drivers of forest degradation?	Areas exposed to fire Charcoal production Observed NTFPs	Sustainable NTFPs harvesting/production; fuelwood alternatives/efficient cookstoves
Conservation of forest carbon stocks	Where are existing protected areas? Where is there current/planned infrastructure and development?	Protected areas Infrastructure (roads, mining, gas and oil concessions)	Strengthening existing protected areas
Sustainable management of forest	What are forest management categories? How is the population distributed?	Land-use designations Community-based forest management Population density	Reduced impact logging; community forestry
Enhancement of forest carbon stocks	What areas are suitable for forest restoration? What type of restoration is most appropriate?	Restoration potential Population density Roads Intensive agriculture Degradation	Forest restoration (through, e.g., assisted natural regeneration); afforestation

How can priority areas for REDD+ actions be identified?

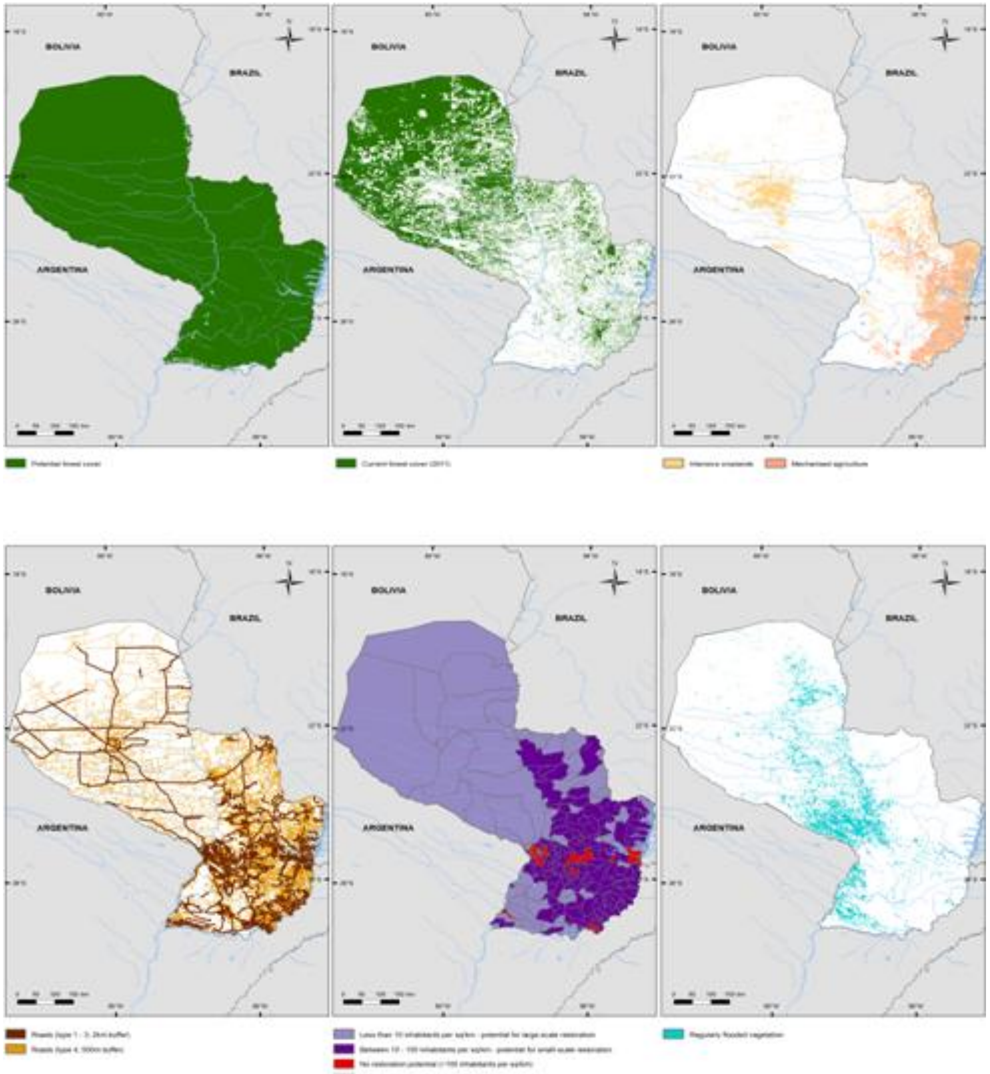
- Based on existing conditions, where are the areas where REDD+ actions can be implemented?
- Which areas are under pressure?
- Which areas would maximize benefits, mitigate risks and reduce costs?
- Which areas should be included?
- What areas should be excluded?

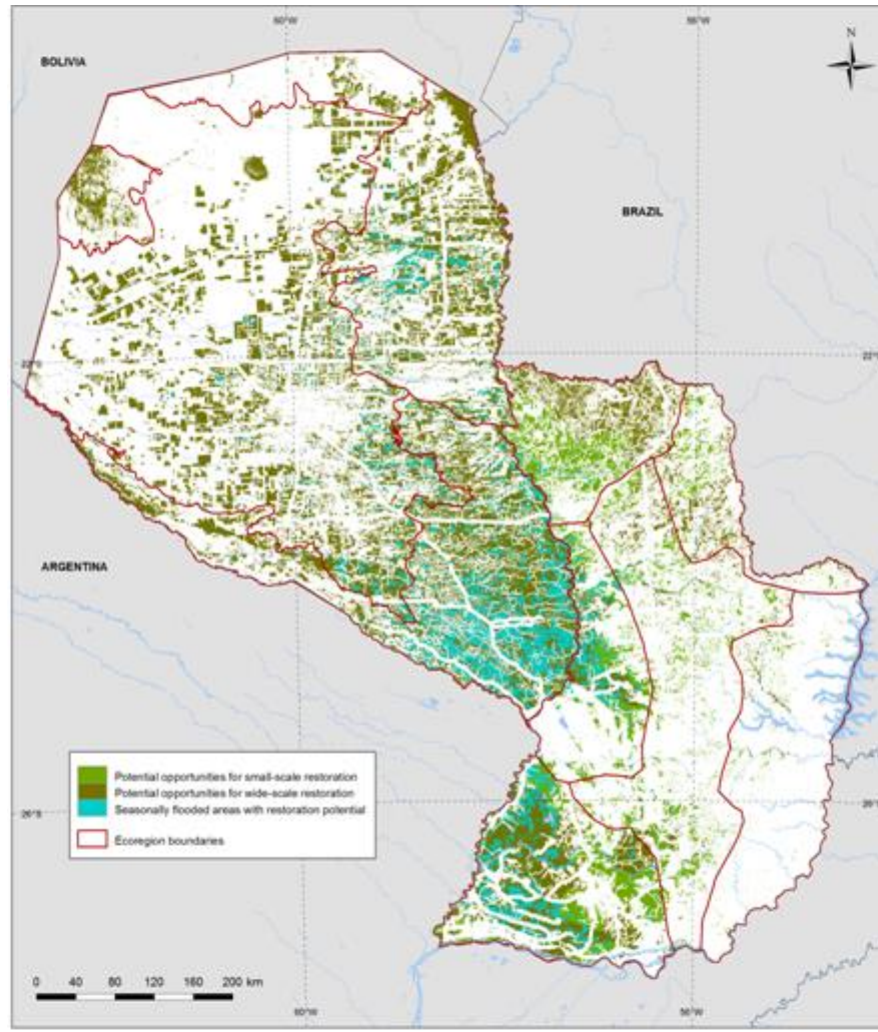
What spatial information can be used to identify priority areas for REDD+ actions?

- Carbon, forests, drivers of deforestation/pressures
- Land designations, administrative boundaries and biophysical characteristics
- Multiple benefits
    - Biodiversity
    - Ecosystem services
    - Social benefits
- Risks (information relevant to the Cancun safeguards)
- Costs (opportunity, implementation, transaction)

Potential opportunities for **forest restoration** have been identified with national stakeholders, taking account of areas where restoration is less likely to be suitable or successful

For example: Forest restoration opportunities in Paraguay

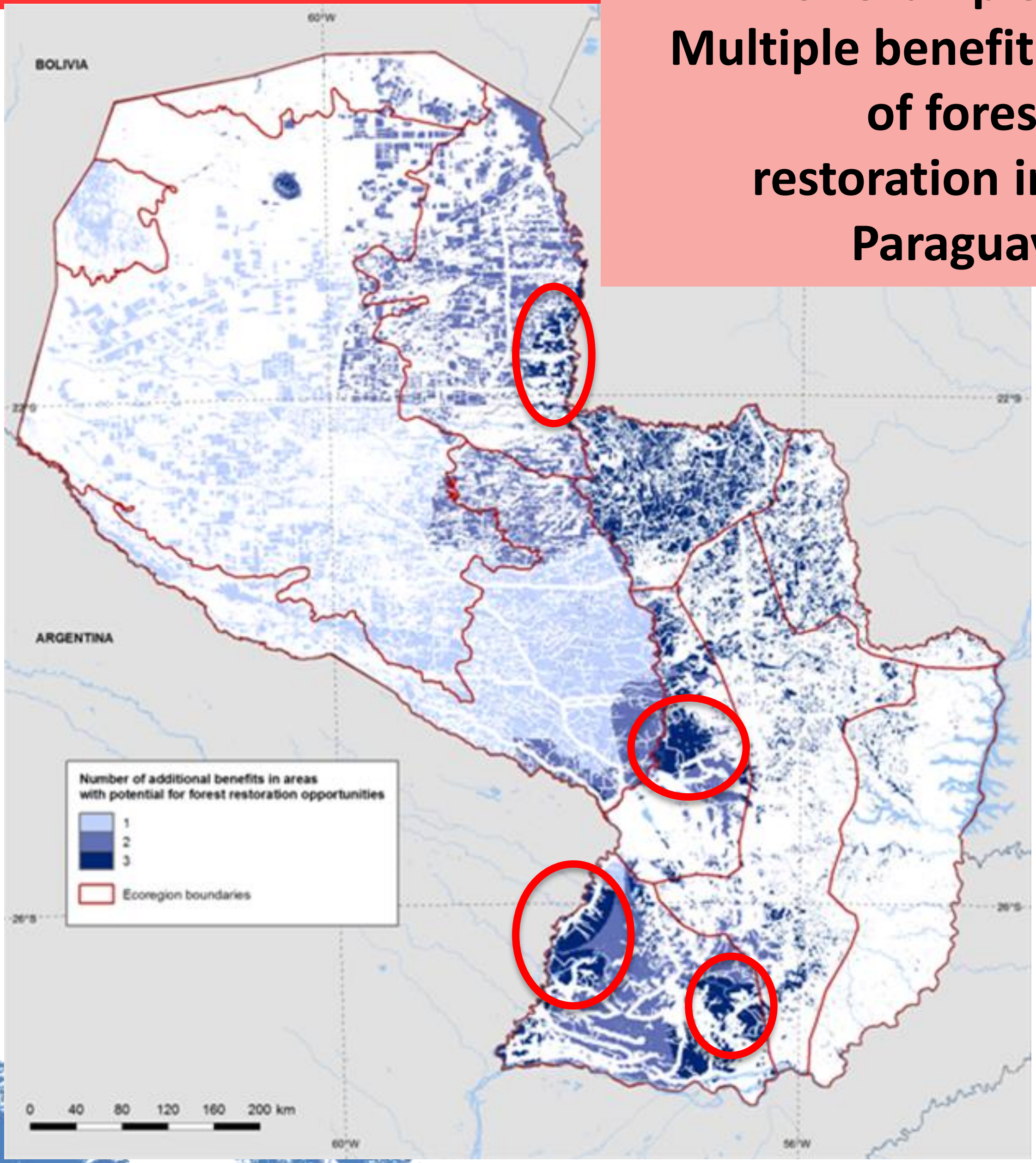




For example: Multiple benefits of forest restoration in Paraguay

REDD+ efforts to restore forest in areas that provide **additional social or environmental benefits**, and where restoration is more likely to be successful, may be the best use of limited resources

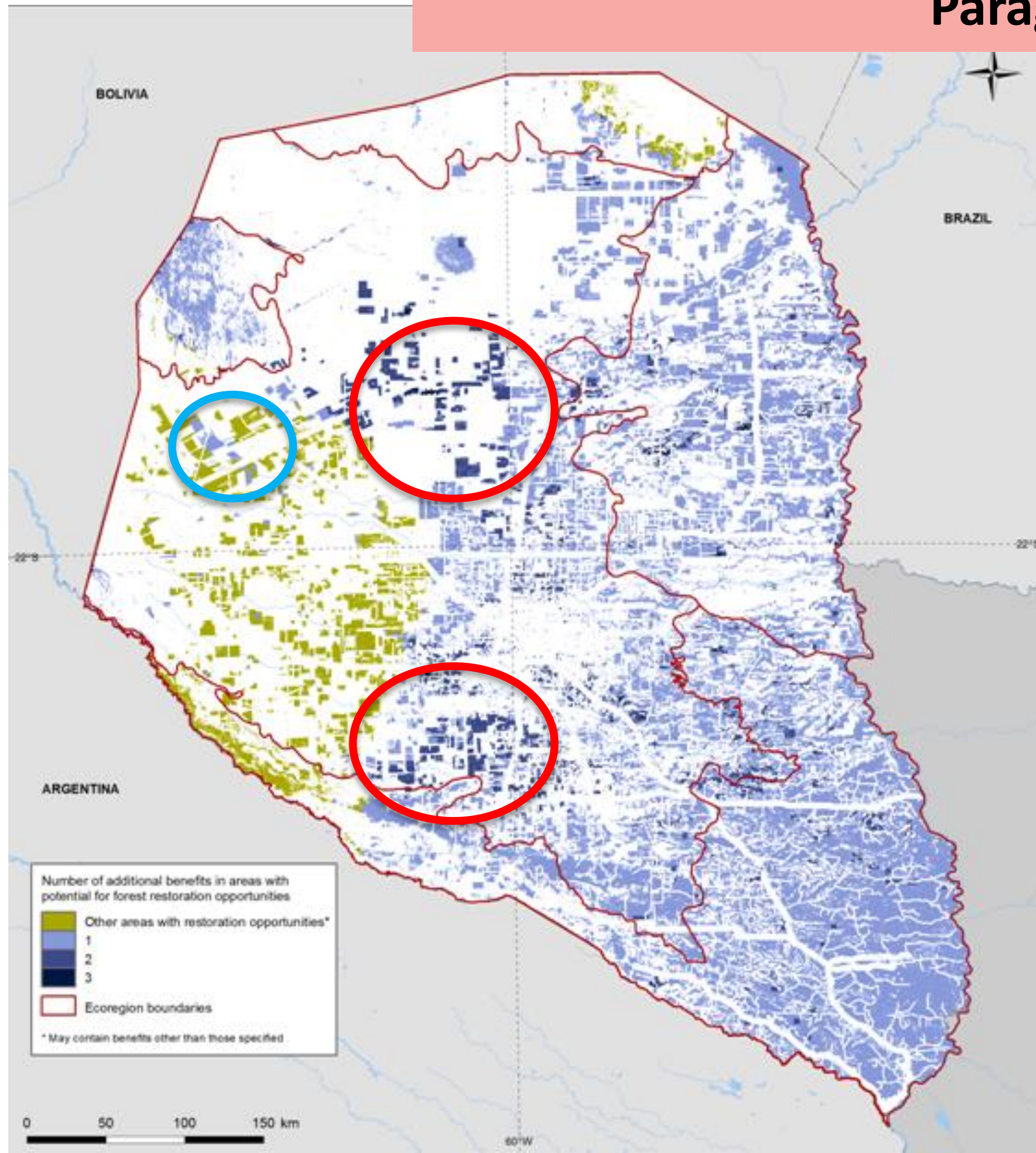
- support for livelihoods
- potential to conserve and enhance biodiversity
- importance of land for soil erosion control



Priority areas depend on benefits, risks & costs selected

For example: Multiple benefits of forest restoration in the Chaco region of Paraguay

- priority sites for endemic species (plants, amphibians, mammals and birds)
- areas considered of value to the diversity of habitat
- fragile ecosystems
- biodiversity corridors (GEF 2003)



Tools and data for spatial analysis

- Various tools are available to support spatial planning for REDD+
  - Should consider software and tools already being used in country for land-use and forest sector planning
- UN-REDD Programme/other publications have guidance on tools, methodologies and other resources for spatial planning, and case studies from countries and provinces/states designing and implementing REDD+
  - Most examples in this presentation are the result of direct mapping and GIS support from the UN-REDD Programme in collaboration with countries
  - Exploring Multiple Benefits Mapping Toolbox developed by UNEP-WCMC provides raster analysis tools to help identify, map and understand relationship between carbon stocks, ecosystem services and biodiversity

PART 5

SUMMARY AND CONCLUSIONS

Planning for REDD+

- Spatial analysis can support land-use planning for REDD+ that enhances potential benefits, reduces potential risks and minimizes costs
- Spatial analysis can inform REDD+ strategy development
  - Development of realistic options for a national REDD+ strategy – including identifying suitable REDD+ actions and priority locations for those actions – will help balance potential benefits and risks as well as costs of REDD+
  - Sub-national scale spatial analysis, informed by multi-stakeholder discussion, can help identify priority areas for REDD+ actions
  - Important to integrate stakeholder priorities and needs into wider consultation and planning processes for REDD+

Thank you!