Global Agenda

Blueprints for a Greener Footprint
Sustainable Development at a Landscape Scale

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Contents

Executive Summary

Achieving sustainable development requires new thinking about how the world meets the demands of a growing global population while also addressing increasing pressure on land and water resources and a changing climate. Investments in development projects for food, water, energy, minerals and infrastructure can help fuel economic growth, improve quality of life and lift people out of poverty. But these investments can also bring environmental impacts and social conflict. As each project is developed, cumulative impacts contribute to a "footprint", which can degrade the health of a landscape and negatively affect communities, nature and the economy.

To take a more pro-active approach to sustainable development, there is an urgent need to transform development planning from the site level for individual projects to scenarios at a larger scale, or a landscape scale; this supports integrated solutions for achieving economic, social and environmental goals.

Such an approach requires development planning:
- At a landscape scale
- In advance of major project decisions
- For a more comprehensive set of values, functions and goals

Landscape-scale planning (LSP) can benefit governments, businesses and communities by supporting more informed development decisions. It promotes comprehensive risk management and offers greater predictability and transparency to businesses and communities. This can reduce conflicts, delays and costs. In addition, LSP may help identify new development options for shared facilities among two or more operators, or broader opportunities for integrated development corridors. Planning at this larger scale also informs strategies for long-term landscape resilience, such as ensuring functional watersheds for clean drinking water, connected habitat for species and buffers against climate effects. In this way, LSP can support progress on global sustainability initiatives, including many of the UN Sustainable Development Goals (SDGs).

Despite its abundant applications for sustainable development, LSP is not common practice. Government policies and institutions are often not set up to perform or fund LSP. Companies and financial institutions tend to be focused on their specific projects and investments. As a result, development planning often proceeds in a more ad hoc project-by-project manner, potentially missing opportunities for larger-scale integrated development solutions.

Transforming development planning will take collective leadership from government, industry, development agencies and financial institutions. While technological advances are rapidly contributing to the ability to execute LSP at a reasonable speed and cost, accelerating LSP adoption also requires breaking down planning silos, supporting public-private initiatives, and increasing resources for landscape-scale blueprints to promote sustainable development.

Introduction

A central development challenge of the 21st century is how to meet demand for a growing global population with expanding consumption levels while ensuring the health of land, water and the climate for future generations. Achieving sustainable development requires explicit recognition that economic development and the environment can no longer be considered in separate spheres. Development is part of, and dependent on, the life-support systems provided by a stable and resilient environment[1].

Investments to meet demand for food, water, energy, minerals and infrastructure can help fuel economic growth, improve quality of life and lift people out of poverty. But these investments can also bring environmental impacts and social conflict. As each energy, mining, infrastructure and agriculture project is developed, the direct, indirect and cumulative impacts[2] contribute to a footprint that reduces the capacity of landscapes and watersheds to support people and nature[3]. Too often this is viewed simply as an "environmental impact" only relevant to natural resource management decisions. But environmental impacts can reverberate across many sectors central to human well-being, including health, food and water security, and national security. Understanding the interconnected values and alternative development scenarios can help head off conflicts before they occur and support more sustainable outcomes.

This paper highlights the urgent need to transform how we plan for development and its cumulative impacts. It calls for a process that starts with planning at a larger scale (i.e. at the landscape or watershed level)[4] before major project investments are made. Seeing this big picture makes clear the opportunities, risks and trade-offs of development decisions beyond what can be achieved by site-level planning for individual projects. Landscape-scale planning (LSP) can support more optimal design and implementation of development to improve economic, social and environmental benefits.

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The central questions addressed by LSP include:
• What resources and functions within the landscape are critical to people and to the long-term health of lands, waters and the climate?
• How might cumulative development activity – from energy, mining, infrastructure, agriculture, and other sectors – affect these resources and functions over time?
• What development opportunities and strategies are possible for addressing trade-offs and improving economic, social and environmental outcomes?

Food still needs to be grown somewhere, metals mined, energy developed and roads built. The good news is evidence suggests the world is producing food, water, materials and energy with less impact per unit of production today than ever before.[5] But there are still impacts. Sustainable development can better succeed when these positive production trends are complemented by development planning at a landscape scale.

Under Pressure: The Future Footprint

Pressure on land, water and the climate could dramatically increase over the next two decades, especially in emerging economies. Unprecedented investments in energy, mining, infrastructure and agriculture (Figure 1) are being planned at a time of deepening global environmental concern. Water scarcity is increasing, with nearly 4 billion people projected to be living in areas affected by severe water stress by 2030.[6] Scientists point to a mass extinction underway due to human activity, with species extinction rates at least 100 to 1,000 higher than the natural rate of extinction.[7] Across more than 10,000 representative populations of mammals, birds, reptiles, amphibians and fish, there has been a 52% reduction in population sizes since the 1970s.[8] Climate change risks are increasing, with surface temperatures projected to continue rising this century in response to atmospheric concentrations of greenhouse gases that are unprecedented in at least the last 800,000 years.[9]

Taken together, the cumulative impacts of future global growth could have a large environmental footprint, degrading natural lands, placing greater demands on water resources and contributing to climate change. For example, development trends for energy, mining, agriculture and urban expansion could cumulatively impact 20% of remaining natural lands globally (Figure 2), doubling the extent of land converted in Latin America and tripling it in Africa.[20]

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Reconciling development imperatives with social and environmental concerns remains a major challenge. Consider the mining sector. On one hand the industry is making strong strides for more responsible mining, leading all sectors in its biodiversity conservation commitments,[21] and envisioning new pathways for sustainable development.[22] On the other hand, conflicts continue to rise sharply, leading to project delays, losses and in some cases abandonment.

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Energy

Investments required to supply the world's energy needs are estimated to be $40 trillion over the next 20 years, with nearly two-thirds of this investment in emerging economies.[10] Globally more than 3,700 major hydropower dams are planned or under construction.[11]

Mining

Mineral demand is expected to increase by more than 50% by 2050.[12] China alone is investing over $100 billion annually into mining projects in Africa, up from $25 billion in 2000.[13]

Infrastructure

The G20 Global Infrastructure Initiative supports increasing global infrastructure investment to $70 trillion over the next 15 years,[14] more than the estimated value of the world's current infrastructure.[15] The combined length of the world's road and rail network will increase by 60% by 2050, with nearly 90% of these additions in developing countries.[16]

Agriculture

Meeting global food demand will require a 60% increase in production by 2050.[17] If current trends to meet global crop demand continue (i.e. greater agricultural intensification in richer nations and greater land clearing in poorer nations) about 1 billion hectares of land will be cleared globally by 2050, with greenhouse gas emissions reaching about 3 gigatonnes per year.[18]

Urbanization

The world urban population will increase to nearly 5 billion by 2030, driving an increase in urban land cover of 120 million hectares – tripling the global urban land area circa 2000.[19]

Figure 1. Growth in energy, mining, infrastructure, agriculture and urbanization

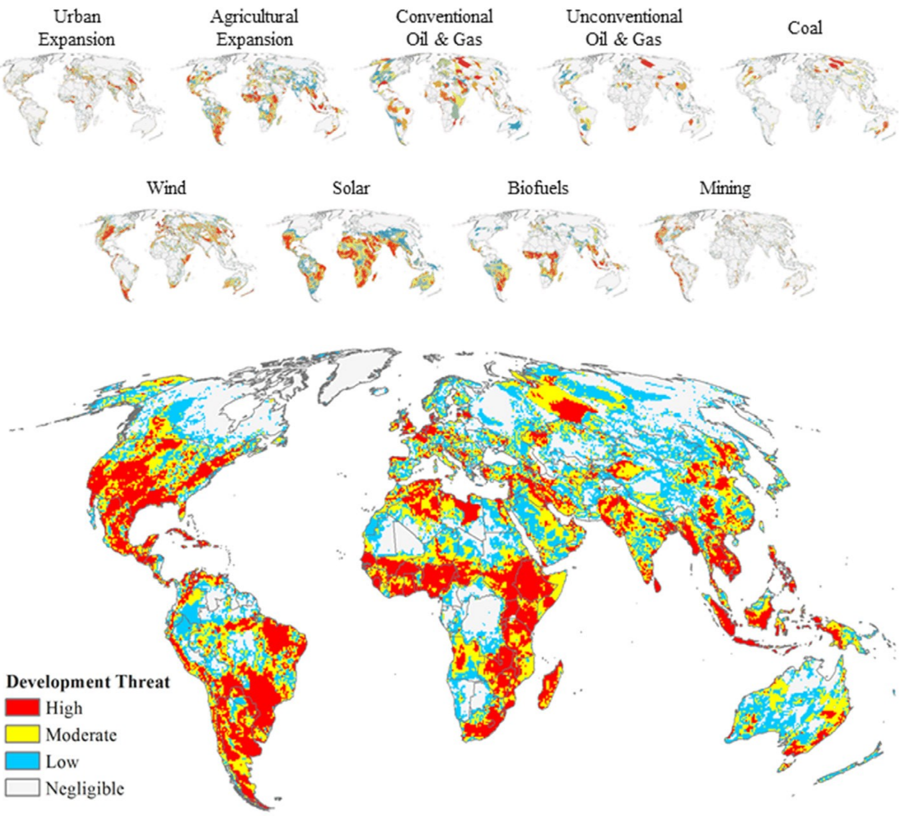

Figure 2. Cumulative future development pressure Source: Oakleaf et al. 2015.

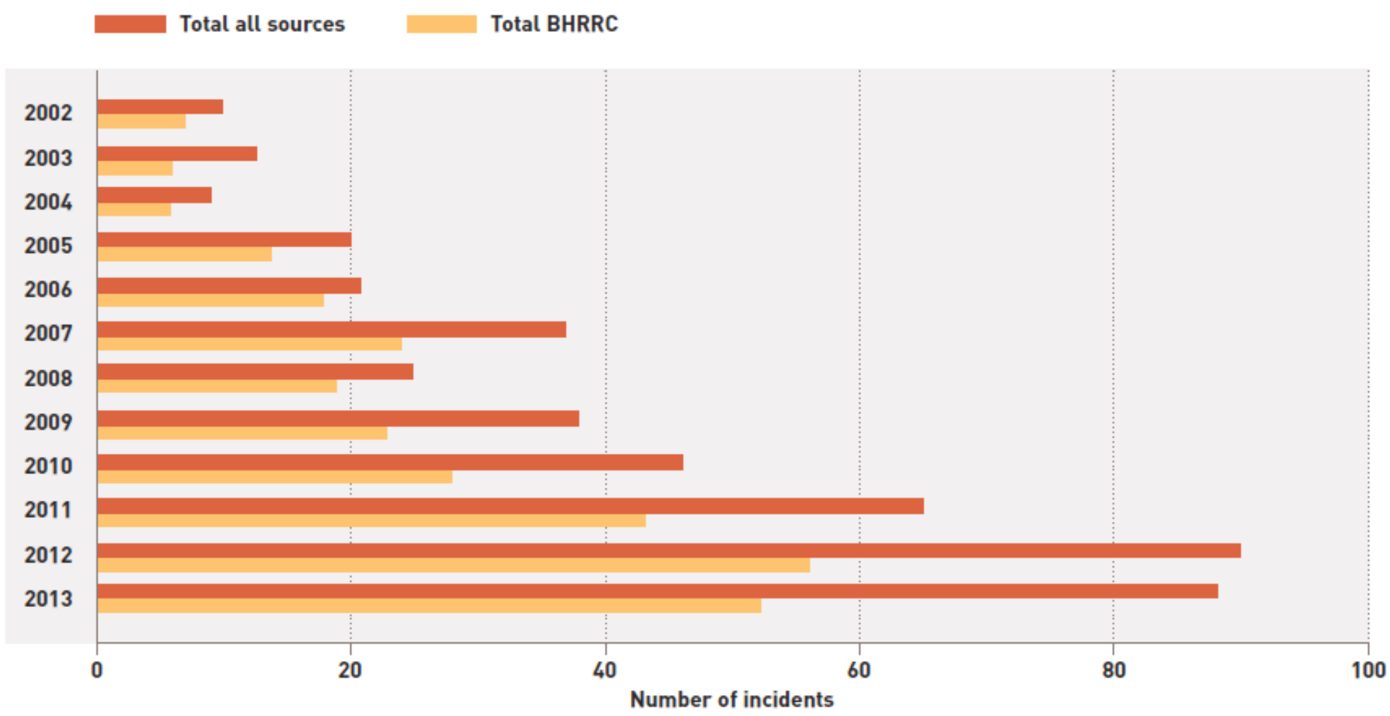

Figure 3. Incidents of company-community conflict (2002-2013) Source: ICMM 2015

A recent study from the International Council on Mining and Metals finds that from 2002 to 2013 incidents of mining project conflicts increased several-fold and environmental concerns were the leading causes of incidents (Figure 3).[23] Such incidents can result in significant costs for companies and investors. Temporary shutdowns and delays at a major mining project with capital expenditure of $3-5 billion can cause losses of about $20 million per week.[24] When a company withdraws from a project altogether the losses can be much greater, such as Anglo American's estimated loss of more than a half billion dollars when it withdrew from the Pebble project in Alaska.[25] The proposed project is located in the Bristol Bay watershed, home to half of the world's wild sockeye salmon – an important resource for the regional economy and local people who fish for subsistence.

The planet's future footprint will fall disproportionately in the developing world as emerging economies grow in Africa, Latin America and Asia. These are regions where countries often lack the policies, processes and blueprints for guiding sustainable development.[26] Moving to a more sustainable path will require going beyond business-as-usual, project-by-project development planning. Governments, businesses, investors and communities must begin with the big picture, focusing on regions where cumulative development pressure is projected to be greatest, and supporting more integrated planning at larger scales to guide sustainable development.

Benefits of Blueprints: Landscape-Scale Planning

Environmental impact assessment, the primary tool for addressing the environmental impacts of major projects (e.g. energy, mining and infrastructure), first emerged in the United States after passage of the National Environmental Policy Act in 1970. Over time nearly every country in the world has adopted this approach. Environmental impact assessments have played a critical role in improving environmental outcomes and will continue to do so, but it is not sufficient for sustainable development.

Increasingly, jurisdictions and communities are seeking assessment of cumulative impacts. For companies who are first to seek approval for a development in a new area, assessing cumulative impacts is challenging. Lack of baseline data, uncertainty about approaches and methods, and concern about straying too far from their potential operational footprint inhibit efforts. Companies that follow with additional proposed developments have similar issues and, in addition, may not have access to data from early developers. Planning at a landscape scale in advance of project investments offers several advantages over what can be achieved through conventional environmental impact assessment[27] and can provide the baseline data that improves company and regulatory efforts to assess cumulative impacts (Figure 4).

A landscape-scale assessment of Mongolia's Gobi Desert shows the landscape- and project-level view. Development

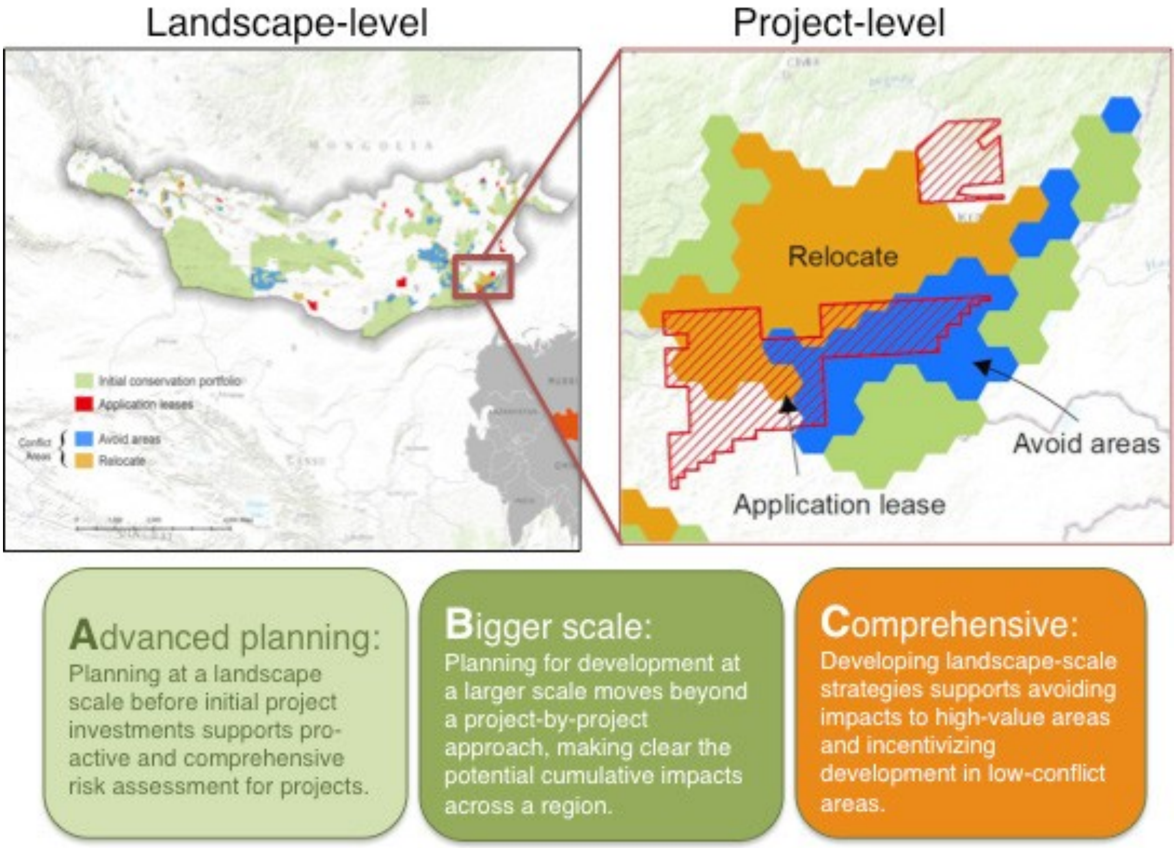

Figure 4. The ABCs of landscape-scale planning benefits

objectives are assessed within the context of a landscape-level conservation plan that highlights critical areas to avoid impacts and allows for cumulative impacts to be considered. The conservation portfolio is shown here in green. Targets represented in the portfolio are the species, habitats, and ecosystem goods or services prioritized in the region. Areas of conflict are shown in orange and blue. Orange areas are where conservation goals can be relocated and met elsewhere allowing the portfolio to be redesigned to accommodate development. Blue are areas where avoidance should be prioritized. For more details see Heiner et al., 2013.

Geospatial data has been used for many years by the energy and minerals sectors to assess the potential of areas to host commodities. Traditionally, governments have provided this data in the form of geological maps as a means of attracting investment, exploration and development, and more recently to support land-use planning and associated decisions. In recent years, geological data has become available digitally and is easily integrated with other information such as land ownership and infrastructure. Landscape-scale data, however, is limited or absent hindering development goals and integration with community needs and conservation priorities.

Landscape-scale planning (LSP) is needed to help define goals for landscape health, provide projections of potential cumulative impacts and identify best options for sustainable development. This benefits governments, businesses and communities in several ways: it informs strategies for avoiding impacts to priority areas and steering project design towards areas of lower social and environmental conflict; and incentivizes mitigation actions for long-term landscape resilience, such as ensuring functional watersheds for clean drinking water, connected habitat for species, and buffers against climate effects.[28]

For project investments, LSP promotes comprehensive risk management, including cumulative impacts and critical dependencies such as water resources.[29] This provides greater predictability and transparency for project proponents and communities throughout a region, and may therefore reduce conflicts and delays, and related costs.[30] In addition, LSP can support new development opportunities with benefits for business and communities. For example, LSP may identify new options for shared facilities among two or more operators offering cost, environmental and sustainability benefits to operators and communities (See Case Experience section below). Such coordinated approaches can contribute to integrated resource corridors, where major projects anchor broader development outcomes for a region.[31]

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Achieving sustainable development goals

By supporting a more sustainable approach to regional

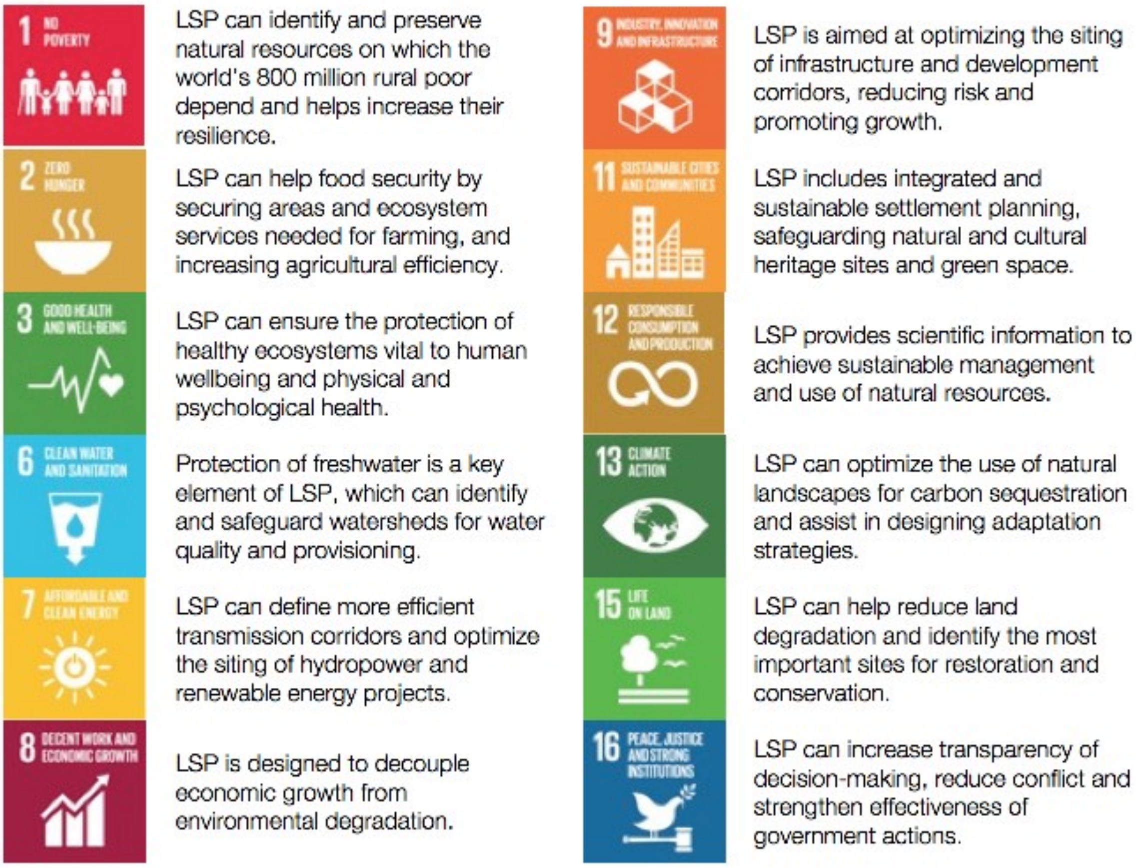

Figure 5: How landscape-scale planning contributes to UN Sustainable Development Goals

development, LSP can contribute towards achieving the UN Sustainable Development Goals[32] (Figure 5). Progress on these goals – for the sustainability of production, food security, creation and persistence of protected areas, resilience of coastal zones, increased carbon sequestration in natural ecosystems, and reduction of degraded lands – will require a spatially explicit priority-setting process to identify sustainable development pathways. Stratification of land use types and development trajectories are implicit in the expression of these global goals and targets, yet well-defined mechanisms for conducting LSP are lacking, making progress on the goals slow and difficult to measure. Having adopted the global goals and targets, national governments and international organizations must now also promote LSP to accelerate implementing activities across the goals.

Defining landscape-scale planning: Framework and process

LSP is an approach for harmonizing multiple goals within the same geographic area, which may be defined by biological, watershed or jurisdictional boundaries.[33] LSP expands the planning vision to larger spatial and temporal scales, to support the management of landscapes for economic development, biodiversity and ecosystem services, food security, social and cultural values, and other key objectives. This helps place individual project plans and land units within their larger economic, social and ecological context to better inform land-use decisions. The approach is pro-active in helping stakeholders find common interests, understand trade-offs and work cooperatively toward more optimal solutions.

LSP draws directly on the disciplines of conservation planning and landscape ecology, both of which emerged some years after environmental impact assessment processes were first established in the 1970s. Early conservation planning focused solely on ways to accomplish biodiversity conservation goals. This involved developing a conservation plan that incorporates the full range of biological and other natural features, how they are currently distributed, and what their minimum viability needs are to persist in the long term.[34]

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LSP expands the conservation planning process to integrate additional landscape values, such as water provisioning, carbon sequestration, cultural values and other ecosystem services, and considers how projected future development and its cumulative impacts could affect goals for landscape health. It is important to note that LSP is not intended to replace project-level environmental and social impact assessment (ESIA). Rather, LSP can serve as a complement to ESIA by highlighting priority areas and resources (i.e. species, ecological systems, ecosystem services) that should be the focus of detailed ESIA studies and data collection. In addition, while there is some overlap conceptually with sectoral or strategic ESIA, LSP differs by taking a spatially explicit and target-driven approach. This helps inform how future land uses may complement or conflict with one another, and provides a basis for understanding trade-offs among landscape values and associated economic, social, and environmental goals.

The commonly accepted process for LSP involves: setting landscape goals; identifying the optimal locations and configuration for maintaining landscape resources and functions, including the viability of natural features; projecting future development and associated long-term cumulative land-use changes; assessing potential complementary and conflicting landscape values and goals; and providing decision-support tools to promote achievement of multiple landscape goals.

Carrying out this process requires, at minimum, a set of data inputs to address questions regarding important areas for maintaining biodiversity and ecosystems services, current landscape conditions, future development potential and goals, and possible conflicts between drivers of land-use change and landscape goals (Figure 6).

Data needs

In most cases LSP can be developed with available data through a process that takes approximately one to three years, depending on the extent of stakeholder engagement and review, landscape complexity and issues, and the plan's level of detail. General data needs for LSP correspond to the inputs in Figure 6, with specific data needs (geology, soil, water, biodiversity, social, future development, etc.) dependent on the LSP context and goals. Typically not all desired data on the

With the advent of many low cost, remotely-sensed data products, even where only minimal field data are available, it is possible to develop a landscape-scale plan that can help inform development and conservation decisions.

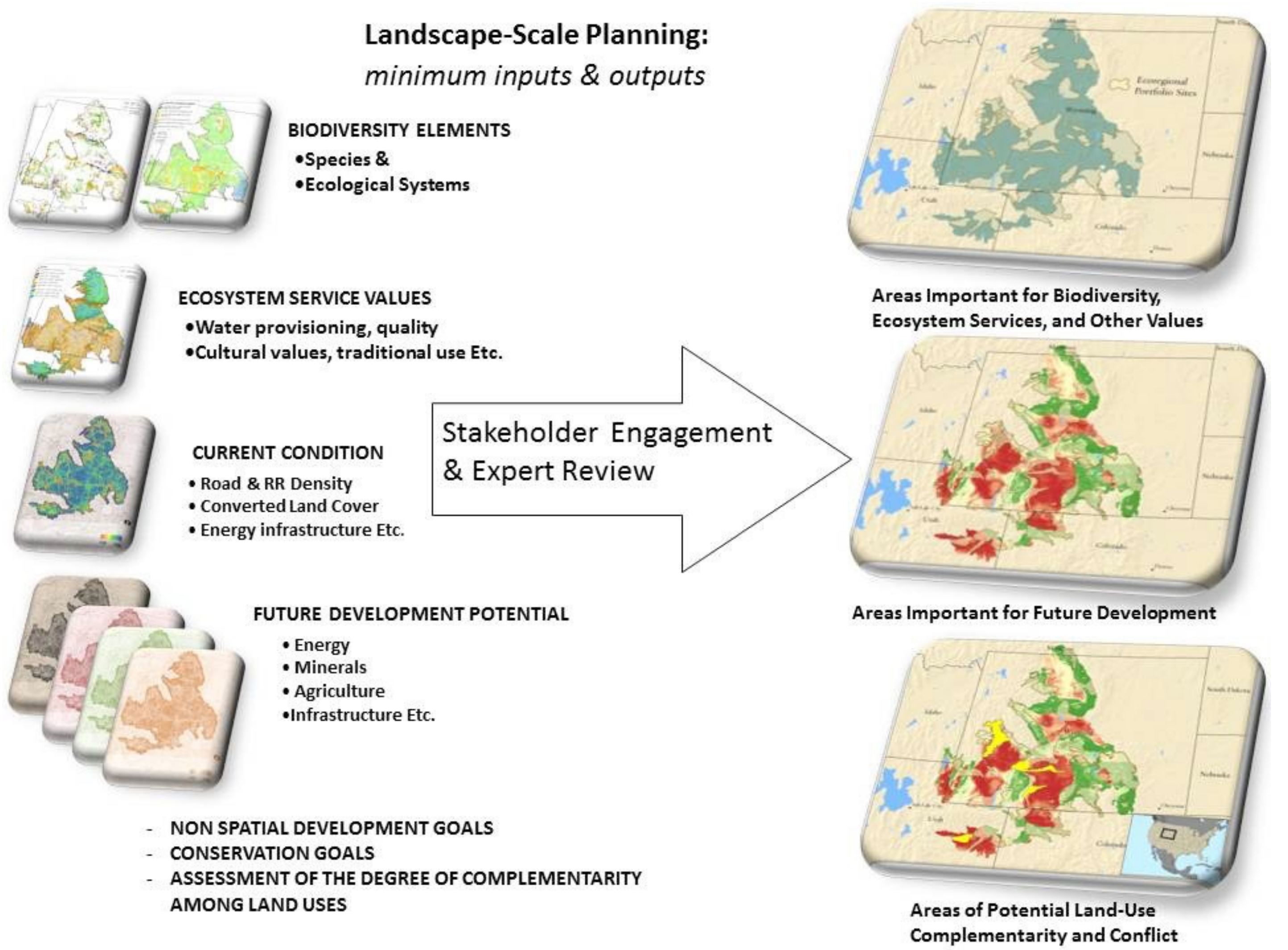

Figure 6. Minimum input needs for landscape-scale planning Source: Adapted from Kiesecker et al. 2010 and Sochi et al. 2013.

landscape and its resources will be available. This is the case around the world, regardless of the financial and human resources available to the team carrying out the planning process. With the advent of many low cost, remotely-sensed data products, even where only minimal field data are available, it is possible to develop a landscape-scale plan that can help inform development and conservation decisions.[35] Incomplete data should not be an impediment; landscape-scape plans can be developed noting where there are data needs and uncertainties, and allowing for updating as these data are acquired over time.

Projecting future land use

Information to support projections of future development activity can be gathered from a variety of sources, including governmental resource management plans, forest management plans, long-range or metropolitan transportation plans, and community growth plans.[36] Predictive modeling approaches can be used where plans do not exist or do not provide details on the distribution of potential development. A wealth of predictive modeling techniques has been used in recent years to predict changes in land cover and residential development,[37] and to predict anticipated agricultural and energy development.[38] These predictive modeling tools can be used to describe landscape-scale development scenarios, helping inform decision-makers and the public about patterns of anticipated development and potential impacts.

Tools

Numerous tools for LSP are available to facilitate: gathering and distributing relevant data (e.g. regional databases that support queries and downloads); conducting analyses and modeling (e.g. vulnerability assessments); visualizing data and analysis/modeling results (including current and potential future conditions); and integrating information into planning for conservation, land use and land management. Although an exhaustive list of tools is beyond the scope of this paper, a good starting point for understanding the scope of tools available is a recent review by NatureServe on LSP tools for natural resource managers.[39]

Stakeholder engagement

LSP requires a stakeholder engagement process, public participation and a planning team to develop the plan. Whereas some stakeholder groups have identifiable representatives (e.g. government, industry), for others it may not be clear. Critically, this can often be the case for the people living in the landscape subject to the planning exercise. While a review of stakeholder engagement processes is beyond the scope of this paper, there are well-established techniques for gathering stakeholder input on a wide range of values.[40] These examples include land-use planning applications for biodiversity conservation, energy and minerals development, and multiple-use of public lands in both developed and developing countries.[41]

Seeing the Big Picture: Advancements in Science, Policy and Practice

Smarter land-use planning will be essential for a sustainable future – to achieve development goals at a time of deepening environmental concern about water-stress, forest loss, land conversion, species decline and climate change. To meet this challenge, a combination of technical advancements, policy improvements and experience in implementation is providing new ways to plan for development at larger scales.

Technical advances

The combination of innovation and technological advances helps practitioners view the world differently and use information and data in new ways, and this drives transformation. Dramatic advancements in remote sensing, geographic information software and spatial modeling capabilities make development planning at a landscape scale possible in ways not imaginable when conventional environmental planning processes were first developed in the 1970s. These advancements support knowledge integration, forecasting and decision-support models, and monitoring frameworks that promote more synergistic solutions for sustainable development.[42]

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Advances in remote sensing are having the most significant impact on LSP. Remotely sensed data are relatively cheap, provide up-to-date information over large geographical areas, and in some cases may be the most practical way to construct base maps for inaccessible regions. The first Landsat satellite was launched in 1972, ushering in a new era in remote sensing, and allowing users today to access over 40 years of data that is both free and easy to use.[43] Landsat sensors focus on the reflectance characteristics of vegetation, greatly enhancing understanding of the dynamics of vegetation and its function in the terrestrial ecosystem. The Landsat programme shows the power and potential of remote sensing data for development planning. Today, it is one of many sources for remotely sensed data.

In addition to new sources of data, practitioners now have new ways of using spatial data to address key questions for development planning and its potential environmental impacts. For example, the explosion of new GIS software modeling tools (e.g. Maxent, Random Forest) supports predictive models for estimating future distribution patterns of resources, such as species, and extrapolating predictions to areas where data has yet to be collected. New tools also allow for the rapid assessment of: habitat quality for biodiversity, habitat connectivity and optimal configurations of habitat to achieve conservation goals. In addition, with growing recognition of the importance of ecosystem services and climate change adaptation, new tools and approaches have been developed to estimate how land-use changes may affect service values and to identify areas with greater resilience to climate effects.[44]

While this is by no means an exhaustive review of tools and technology available to support LSP, it illustrates current planning capabilities for establishing baselines, estimating future development patterns and assessing how resources may respond to future impacts.[45] These advances are helping to extend development planning from the traditional site-based focus to a broader landscape approach, and doing so in a way that can reduce costs and improve outcomes for economic development, landscape health, communities and climate (Table 1).

Policy developments

Government, financial institutions and industry are increasingly promoting LSP as essential for sustainable development. This is evident in new public policies, environmental and social standards of international financial institutions and development agencies, and industry initiatives (see examples below). Central to this movement toward LSP is the need to mitigate environmental impacts in accordance with the "mitigation hierarchy" – a widely adopted policy framework that requires avoiding, minimizing and offsetting impacts[51] (Figure 7).

Where offsets are required, LSP can guide these actions to the best places within the landscape to maximize positive outcomes.

LSP plays an essential role in applying the mitigation hierarchy by assessing multiple future drivers of land-use change and pro-actively identifying opportunities, conflicts, dependencies and trade-offs. This moves application of the mitigation hierarchy beyond a traditional focus on site-level impacts to a bigger landscape-scale picture that can better support development and key values (e.g. water sustainability). In addition, where offsets are required, LSP can guide these actions to the best places within the landscape to maximize positive outcomes. This is increasingly important, as policy development for offsets is advancing rapidly with more than 50 compensatory mitigation programmes in operation — some of which incorporate landscape-level approaches[52] — and several dozen more in development.[53]

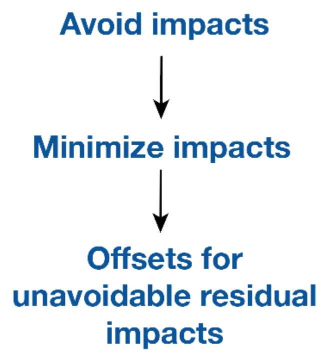


Figure 7. The mitigation hierarchy LSP supports step-wise application of the mitigation hierarchy to avoid impacts, minimize impacts and then offset remaining impacts (offsetting is also often referred to as compensatory mitigation).

Examples of policy developments supporting LSP include:

Public policy: Adoption of landscape-scale planning in the United States

In November 2015, US President Barack Obama issued a presidential memorandum on Mitigating Impacts on Natural Resources from Development and Encouraging Related Private Investment. It establishes principles for mitigation to guide federal agencies in their planning and permitting practices and instructs agencies to adhere to the full mitigation hierarchy – avoid, minimize and compensate. It also directs that: "Large-scale plans and analysis should inform the identification of areas where development may be most appropriate, where high natural resource values result in the best locations for protection and restoration, or where natural resource values are irreplaceable."[54]

On the same day that the memorandum was issued the Department of the Interior, which stewards 20% of US lands, released a departmental manual entitled *Implementing Mitigation at the Landscape-scale*. This manual identifies key principles and processes for landscape-scale mitigation planning and provides instructions to DOI's bureaus and offices on a landscape-scale approach. This follows DOI Secretarial Order 3330 in 2013 – a department-wide policy establishing landscape-scale planning as a central strategy for meeting development and conservation goals.[55]

Department of Interior Secretary Sally Jewell summarized the policy as "encouraging development in the right ways and in the right places…recognizing that there are some places that are too special to develop…Project proponents will be able to invest with certainty and clarity in their projects and support the region's environmental needs, rather than ad hoc, project-by-project mitigation efforts. And by guiding development to the areas of highest resource value and lowest environmental concern, we can reduce the likelihood of conflict and costly delays."[56]

Table 1. Selected studies: Improving outcomes for development, communities and environment through LSP

Study	Context	Findings	Benefits of Landscape-Scale Planning
Optimizing sugarcane development for business and conservation	Kennedy et al. (2015)[46] modeled sugarcane expansion scenarios in the Brazilian Cerrado and quantified the benefits of implementing Brazil's Forest Code at a landscape-level compared to parcel-level compliance.	Compared to a parcel-level approach, landscape-level mitigation reduces business costs by ~4.5% (totaling $19–35 million) while supporting more species, storing more carbon, and improving water quality.	Landscape-level mitigation costs less and generates greater benefits for people and nature than traditional, site-based impact mitigation.
Energy development and cumulative watershed impacts	Evans and Kiesecker (2014)[47] created probability surfaces for wind and shale gas development potential and modeled future energy build-out scenarios for the Central Appalachians region of the US to quantify potential impacts on surface drinking water.	The cumulative impacts of up to 106,004 new wells and 10,798 wind turbines could impact 447,134 ha of forest, causing surface disturbance and fragmentation that affects biodiversity values and the quality of surface water resources for 22 million people.	Taking a forward-looking landscape-scale approach shows the potential cumulative impacts of energy development, informs decisions for avoiding and mitigating impacts, and identifies opportunities for achieving energy and conservation goals.
Dependency of hydropower on forested watershed	Stickler et al. (2013)[48] applied land use, hydrological, and climate models to assess potential effects of deforestation on river discharge and energy generation for the Belo Monte complex in the eastern Amazon.	Under business-as-usual projections of cumulative forest loss to 2050 (40%), simulated power generation declined to only 25% of maximum plant output and 60% of the industry's projections.	Assessing an energy project's dependence on forests in the region can support a more integrated assessment of options and their economic, social and environmental benefits and costs.
Ecosystem service losses for communities due to road development	Mandle et al. (2015)[49] applied the "service-shed" concept – an area providing an ecosystem service to a specific beneficiary – to assess how a proposed Peruvian Amazon road may negatively affect ecosystem services for indigenous communities.	Sites with the highest levels of ecosystem function across the landscape under analysis are not the sites most valuable for the provision of ecosystem services to people affected by road development.	Taking a service-shed approach reduced average unmitigated impacts to drinking water quality more than four-fold for sediment, 16-fold for nitrogen and 38-fold for phosphorus loads, compared to methods relying on ecological processes alone.
Climate impacts due to higher carbon emissions caused by forest fragmentation	Pütz et al. (2014)[50] integrated results from remote sensing and forest modeling to estimate the loss of biomass at forest edges and the potential additional contribution to higher emissions of carbon dioxide (beyond current deforestation estimates) for tropical rainforests in Brazil and globally.	The remaining Brazilian Atlantic forest has 245,173 mainly small fragments with a mean fragment size of 64 ha. Fragmentation has contributed 69 Tg C emissions over 10 years. Globally, fragmentation of tropical forest areas results in up to a fifth more carbon dioxide emitted (0.2 billion tonnes).	The fragmentation effect on carbon emissions decreases considerably with greater forest patch sizes (i.e. less forest edge per hectare of forest). Landscape-scale planning can support larger forest patch sizes and connectivity to reduce emissions caused by degrading edge effects.

Lending standards: International Finance Corporation Performance Standard 6

The International Finance Corporation, a member of the World Bank Group, issued revised performance standards in 2012. Performance Standard 6 (PS6) recognizes "that sustainable development cannot be achieved if either biodiversity or ecosystem services are lost or degraded by development efforts." It requires no net loss of natural habitat and net gain of biodiversity for critical habitat, directing clients to "consider project-related impacts across the potentially affected landscape or seascape."[57]

Regarding landscape/seascape analysis, PS6 guidance calls it "a fundamental step in determining ecologically-appropriate mitigation options that align with broader conservation efforts in the region. Such analyses support decision-making as to whether impacts should be avoided or are appropriate for offsets, and support the selection and design of a mitigation strategy, including offset mitigation, that contributes to regional-level conservation goals rather than solely site-level impacts. …This type of analysis is especially important in preventing the degradation and fragmentation of natural habitat, especially from cumulative impacts."[58] PS6 has since been adopted by the more than 80 Equator Principles Financial Institutions and by extension, their public and private partners, and thus now governs a large percentage of development finance globally.[59]

Industry initiatives: Mining sector catchment-based water management

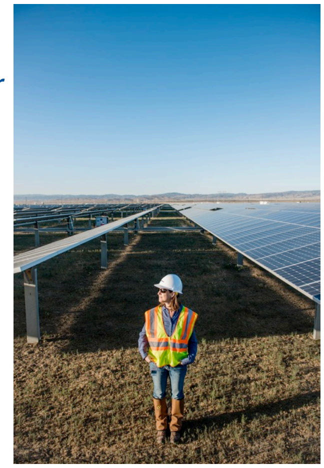
The International Council on Mining and Metals (ICMM), which brings together 23 of the world's largest mining companies to address sustainable development challenges, issued a "Water Stewardship Framework" in 2014 calling for adoption of a catchment-based approach and developed a practical guide for catchment-based water management in 2015.[60] The aim is to move water management from an operational "inside the fence" issue to the catchment level. Catchment-scale planning can identify material water stewardship risks and improve corporate and operational water management by understanding governance processes, water sustainability, high-value water assets, and future users, trends and cumulative impacts.

Case experience

Implementing LSP can be challenging due to the need for government inter-agency coordination, institutional capacity, inclusive stakeholder processes, data and modeling, and sufficient funding to conduct LSP in advance of major project investments. While these challenges are real, when they are surmounted LSP can greatly improve economic, social and environmental outcomes. The cases below illustrate the promise and benefits of LSP for sustainable development.

North America

United States: Identifying solar energy zones for reduced permitting time and costs



This approach has already reduced the project permitting time by more than half.

The US Bureau of Land Management adopted a first-of-its-kind Solar Programmatic Environmental Impact Statement (PEIS) in October 2012 to accelerate utility-scale solar energy development on public lands while minimizing negative environmental, social and economic impacts.[61] The PEIS applies to a six-state region of the southwestern US – Arizona, California, Colorado, Nevada, New Mexico and Utah – assessing the likely deployment of solar energy development over the next 20 years and its direct, indirect and cumulative impacts. It identifies 1,153 km2 of specific locations well suited for production of solar energy (i.e. solar resources, transmission infrastructure and corridors) that are prioritized for development as "solar energy zones." The PEIS also excludes about 320,000 km2 of lands from solar energy development that would not be "the highest and best use of public lands". This approach has already reduced the project permitting time by more than half – the process has taken 10 months instead of 18 to 24 months.[62]

Canada: Incorporating First Nation values and goals in regional cumulative effects plans

Numerous LNG (liquefied natural gas) projects and other developments, including transportation, hydroelectricity and mining, are planned for the North Coast region in the Province of British Columbia. As many as 29 projects are proposed in the traditional territory of the Metlakatla First Nation; these could cumulatively result in significant environmental and socioeconomic changes. An assessment of Metlakatla valued components (e.g. traditional harvests) in the context of regional cumulative effects is underway to help enable the Metlakatla First Nation to participate in regional development to meet their economic, environmental, cultural, social and health goals.[63]

Asia

Mongolia: Supporting sustainable development, nomadic livelihoods, and conservation

Mongolia has vast mineral resources, with much of the country open to mining leases. How mining development takes place will greatly affect Mongolia's economy, environment and traditional nomadic culture, which remains a way of life for one-third of the population. Recognizing this challenge, the Government of Mongolia has supported the development of landscape-scale plans for the country that take into account biological resources, ecosystem services, climate change considerations and projected development.[64] The plans have been developed through a multistakeholder process involving government, companies, academics, NGOs and the public, and are informing decision-making for development and conservation. They are guiding project and infrastructure siting and mitigation, as well as the establishment of new national protected areas and local protected areas – places that will be maintained for nomadic herding and wildlife. The plans will also help guide offset investments from projects such as Rio Tinto's Oyu Tolgoi mine (which provided funding support for the Gobi regional plan) so the offsets provide the highest benefits for landscape health and communities.

How mining development takes place will greatly affect Mongolia's economy, environment and traditional nomadic culture, which remains a way of life for one-third of the population.

Indonesia: Reducing emissions from deforestation

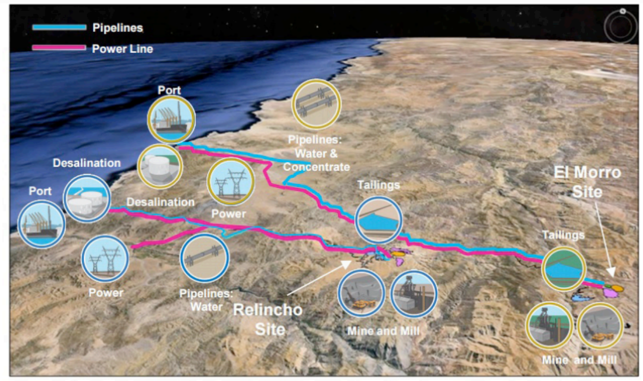
In East Kalimantan's Berau district, deforestation is caused by multiple drivers, including palm oil, logging, coal mining and shifting agriculture. Spatial planning for low-carbon development strategies have integrated mapping of different economic activities to implement Indonesia's REDD+ programme in the district. This REDD+ pilot has been accepted into the Carbon Fund pipeline, which will provide results-based financing for REDD+ in the district.[65]

South America

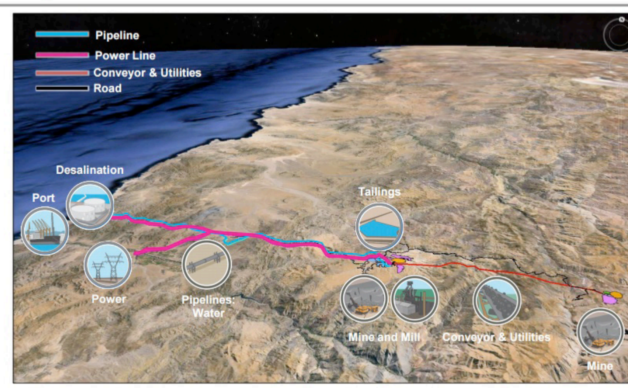
Brazil: Facilitating landscape restoration and conservation

Brazil's Forest Code has long required set-asides for conservation by agriculture, ranging from 20% in the Atlantic Forest up to 80% in forested areas of the Amazon region. The law unintentionally resulted in inefficient and fragmented natural habitats of little biodiversity value, as each landowner was incentivized to designate conservation areas on his or her own land. Beginning in 2005, an in-depth landscape planning process was undertaken to develop a cartographic database integrating land tenure, biodiversity

Before Project Corridor – Duplicate infrastructure



Project Corridor – Common infrastructure



values and development pressure. The resulting identification of an optimized landscape configuration encouraged the government to amend the Forest Code in 2012 to create Environmental Reserve Quotas (Cota Reserva Ambiental – CRAs), a system that allows farmers to pool their required conservation set-asides into large conservation areas. This has led to the creation of exchanges to connect landowners with "surplus" forest to those without sufficient legal forest reserve. The approach has the potential to restore and conserve large and critical landscapes in the Amazon and across the country.

Chile: Sharing infrastructure to reduce costs and the environmental footprint

In northern Chile's Atacama region, two Canada-based mining companies (Teck Resources and Goldcorp Inc.) have created a joint venture to combine their assets across two potential copper mining projects into a single $3.5 billion project. As a result, the environmental footprint will be significantly reduced and capital costs will be less than half the cost of developing the projects

The environmental footprint will be significantly reduced and capital costs will be less than half the cost of developing the projects separately.

separately.[66] Environmental benefits include a single desalination plant, transmission line, concentrator and tailings facility (see Project Corridor). The proposed tailings facility has been moved out of the Huasco River watershed, an agriculturally important area and critical watershed for the town of Vallenar. It should be noted that LSP was not formally undertaken in the region prior to exploration and the discovery of potential economic concentrations of copper. Had this planning been done, it is possible the advantages of joint operation and the project corridor could have been considered earlier in the process of project assessment and community engagement.

Africa

Gabon: Promoting sustainable development based on a freshwater blueprint for the Ogooué River Basin

Gabon is seeking to implement a sustainable development vision (Gabon Vert) and National Land Use Plan process. This will guide future development, which in the Ogooué River Basin could include forestry, mining, hydroelectric energy and infrastructure. Many people of Gabon rely directly on freshwater systems of the basin for their livelihoods and health. In addition, the basin contains a globally important array of species and natural communities dependent on the freshwater system. The government is supporting development of the Ogooué Freshwater Conservation and Management Blueprint to inform economic development and freshwater conservation actions and maintain the natural heritage of the Ogooué Basin for the future. The blueprint will be a decision-support tool that synthesizes spatial models and expert consensus to produce a suite of digital maps that can help to guide sustainable development in the basin.

Liberia: Supporting a national approach for aggregated biodiversity offsets

With World Bank assistance, Liberia is in the process of conducting an integrated planning process to implement aggregated offsets for the mining sector. The resulting roadmap will provide clear guidance for identifying priority offset areas that will clarify land rights and community managed areas, create new protected areas in a coordinated fashion, and provide guidance and risk reduction for mining investments in the country.[67]

Call to Action

Progress on sustainable development goals will require new thinking about how the world meets the demands of a growing global population while also addressing increasing pressure on land, water resources, and the climate. To support a more pro-active approach to sustainable development, an urgent transformation in development planning is needed, moving beyond what can be achieved by site-level planning for individual energy, mining, infrastructure and agricultural projects to larger-scale development scenarios, opportunities and strategies for achieving better economic, social and environmental outcomes.

The call is for development planning:

- At a landscape scale
- In advance of major project decisions
- For a more comprehensive set of values, functions and goals

Transforming development planning will take collective leadership from government, industry, development agencies and financial institutions. It will require policy and institutional changes to break down planning silos, greater capacity and resources for implementation, and transparent processes that promote publicly available information, stakeholder engagement and decision-support tools.

Some specific steps leaders can take to advance landscape-scale planning include:

National and sub-national governments

- **Establish policies that require landscape-scale planning** to guide regional development and permitting. Ensure these policies include mitigation principles and processes that adhere to the mitigation hierarchy of avoid, minimize and offset.

- **Lead processes to develop landscape-scale plans and decision-support tools.** Prioritize resource-rich regions where there is a high probability of major development activities and important social and environmental values. Require science-based and transparent approaches, with spatially explicit information and robust stakeholder engagement.

- **Establish institutional authorities and processes** to resolve conflicts, implement landscape-scale plans, promote integrated development that avoids impacts to high-value areas, and incentivizes mitigation actions for long-term landscape health.

Industry and private sector finance

- **Support landscape-scale planning by facilitating sector cooperation** among multiple project proponents in a region, including sharing data, models and plans as appropriate.

- **Identify opportunities for integrated resource corridors and shared infrastructure**, working with regional and local engagement processes to minimize environmental and social impacts, reduce project-community conflicts and costs, and improve development outcomes.

- **Ensure environmental and social impact assessments are grounded in landscape-scale plans** to improve assessment of cumulative impacts and dependencies, meet performance standards, and support strategic mitigation actions, including offsets. Share assessment data to support continuous improvements in plans and tools.

Development banks and agencies

- **Incentivize and provide financing for landscape-scale planning** by valuing its use and implementation when conducting country assessments or project risk assessments.

- **Promote offset policies in a landscape or national context** to support investments in natural infrastructure and healthy landscapes.

- **Design early planning mechanisms for project preparation** facilities such as the Global Infrastructure Facility to apply landscape-scale planning for the siting of multiple projects.

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