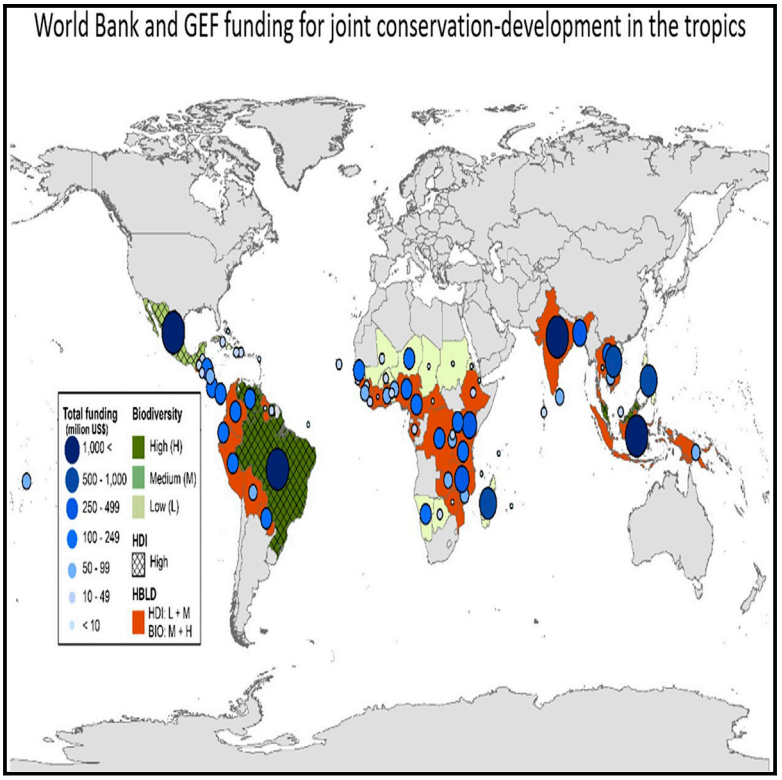
One Earth

Article

The extent and distribution of joint conservation-development funding in the tropics

Graphical Abstract



Highlights

- We calculate funding extent for World Bank joint conservation and development projects
- We show where funding is targeted within the tropics
- We find funding is not driven by conservation or development need
- Governance and political-economic factors appear to drive funding

Authors

James Reed, Johan Oldekop, Jos Barlow, ..., Josh van Vianen, Malaika Yanou, Terry Sunderland

Correspondence

j.reed@cgiar.org

In Brief

This study analyzes the extent and distribution of World Bank and GEF funding for joint conservation and development in the tropics, whether it is directed to areas of greatest environmental and development need, and finally what factors drive funding allocation decisions. Total spending was US$16.5 billion across 75 countries. We find that neither biodiversity nor HDI status are driving funding allocation, but rather that governance and political-economic factors are most likely more influential.

Reed et al., 2020, One Earth *3*, 753–762
December 18, 2020
https://doi.org/10.1016/j.oneear.2020.11.008

CellPress

One Earth

Gold Standard for the Global Goals | 3 tons of CO_2 offset

CellPress OPEN ACCESS

Article

The extent and distribution of joint conservation-development funding in the tropics

James Reed,[1,2,13,*] Johan Oldekop,[3] Jos Barlow,[4,5] Rachel Carmenta,[2,6] Jonas Geldmann,[7,8] Amy Ickowitz,[1] Sari Narulita,[1] Syed Ajijur Rahman,[1,9] Josh van Vianen,[1,10] Malaika Yanou,[1,11] and Terry Sunderland[1,12]

[1]Center for International Forestry Research, Bogor, Indonesia
[2]University of Cambridge Conservation Research Institute, Cambridge, UK
[3]Global Development Institute, The University of Manchester, Manchester M13 9PL, UK
[4]Lancaster Environment Centre, Lancaster University, Lancaster, UK
[5]Universidade Federal de Lavras, Lavras, Minas Gerais 37200-000, Brazil
[6]Tyndall Centre and the School of International Development, University of East Anglia, Norwich, UK
[7]Center for Macroecology, Evolution and Climate, Globe Institute, University of Copenhagen, Universitetsparken 15, Copenhagen E DK-2100, Denmark
[8]Conservation Science Group, Department of Zoology, University of Cambridge, Downing St., Cambridge CB2 3EJ, UK
[9]Department of Ecology, College of Urban and Environmental Sciences, Peking University, Beijing, China
[10]Forest Carbon, Jakarta, Indonesia
[11]University of Amsterdam, Amsterdam, the Netherlands
[12]University of British Columbia, Vancouver, Canada
[13]Lead Contact
*Correspondence: j.reed@cgiar.org
https://doi.org/10.1016/j.oneear.2020.11.008

SCIENCE FOR SOCIETY This study analyzes 381 projects of the World Bank and the Global Environment Facility (GEF) concluded between 1995 and 2013 to show how much money is spent on joint conservation and development in the tropics, where the money is directed, whether it is directed to areas of greatest environmental and development need, and finally what factors drive funding allocation decisions. The total extent of funding was US$16.5 billion across 75 countries, representing approximately US$870 million per year. Countries with high biodiversity and low human development receive no more funding for integrated conservation and development than other countries. Notably, countries with a low biodiversity status receive relatively more funding than highly biodiverse countries and there was no association between development need and funds received. Therefore, we find that neither biodiversity nor human development status explain funding allocation, but rather that governance and political-economic factors are most likely more influential.

SUMMARY

Despite ongoing debates about the viability of sustaining economic growth while maintaining environmental integrity, international sustainability agendas increasingly propose reconciling socio-economic development and global environmental goals. Achieving these goals is impeded by limited funding and a lack of information on where financial flows to integrate environment and development are targeted. We analyze World Bank and Global Environment Facility data to investigate the extent and distribution of such funding across the tropics. We find a misalignment between funding flows and need with highly biodiverse, low development (HBLD) countries receiving no more funding than non-HBLD countries. Countries with low biodiversity receive more funding than highly biodiverse countries and there was no statistical association between a country's development status and funds received. Rather than environment-development need, funding appears to be driven by governance and political-economic factors. Future research should investigate how such factors and funding flows are associated with conservation and development outcomes.

INTRODUCTION

Contemporary international commitments recognize, more than ever before, the importance of reconciling social and environmental agendas to address global sustainability challenges.[1–3] Several of the 20 internationally agreed Aichi biodiversity targets of the Convention on Biological Diversity incorporate a social or economic component (e.g., Targets 1, 2, and 3) and Target 11 specifically calls for a more equitable approach to conservation. In a similar vein, the Sustainable Development Goals (SDGs) are

framed around the pledge to "leave no one behind"—a recognition of the need to support those people furthest behind first—and the commitment to inclusivity is now well established in SDG rhetoric, with an understanding that goals need to be addressed in a holistic manner. This agenda has been widely endorsed by national governments (officially adopted by 193 countries) and is largely considered to be a more equitable approach to development relative to predecessors.

However, this integrated agenda is far from new. The Brundtland report (1987) linked environment and development within its mandate on "Our Common Future" and was followed by the Rio declaration of 1992 that explicitly recognized the inter-related challenges faced by humanity and the environment when attempting to enhance economic development while also halting depletion of natural resources. The post-Rio soundbite declared that "nothing less than a transformation of our attitudes and behavior [is required] to bring about the necessary changes." Governments recognized that fundamental policy changes were needed to develop a "grand survival plan" for humanity that ensured future economic decision making fully considered environmental impacts.[4]

Since 1992, global GDP has continued to rise, funding for biodiversity conservation has increased,[5–8] the global network of protected areas has grown,[9] and global hunger has fallen.[10] Yet since 1970 the number of birds, mammals, reptiles, and amphibians has decreased by more than half[11] while globally aggregated statistics mask important geographic and temporal heterogeneity, persisting inequalities, and sharp declines in environmental health and biodiversity.[12,13] In particular, the global tropics, where many conservation and development challenges intersect, continue to experience alarming losses of biodiversity and areas of persistently low human welfare. The vast majority of the 900 million people living in poverty today reside in sub-Saharan Africa (SSA) and South Asia,[14] with the first increase in global hunger in over a century occurring in 2016,[15] and the largest increase in deforestation in the Brazilian Amazon since records began occurring in 2019 (see http://terrabrasilis.dpi.inpe.br). The continued combination of economic, environmental, and political pressures on tropical land means that poverty, food insecurity, and biodiversity loss remain some of the most pressing concerns of the global environment and development community. Furthermore, these challenges are amplified by an increasingly unstable climate, the impacts of which will be felt hardest by those living in already vulnerable tropical geographies who have limited capacity to respond.[16,17]

In recognition of the need to reconcile global environmental commitments with local economic and socio-cultural realities, a variety of concepts—such as Integrated Conservation and Development Projects, Payments for Environmental Services, Ecosystem Approaches, and Integrated Landscape Approaches—have sought to deliver improved outcomes for both society and environment at regional or landscape scales.[18–21] Furthermore, international development agencies and the big international conservation NGOs have increasingly adopted more holistic strategies within their agendas whereby they aim to better integrate nature and people.[22,23] Despite this recent focus and the widespread appeal of such "win-win" strategies, applied examples of effectiveness at scale have been elusive.[24–27]

Due to the complexity of integrating often conflicting conservation and development agendas, a number of impediments to their effective reconciliation have been identified[28–30] and a number of critiques of the feasibility of such strategies documented.[31–33] Apparent proponents of integrated approaches assert that a major impediment to progress is a lack of funding, with solutions orientating around calls for an increase in funding from both the public and private sectors.[34,35] Such views resonate with the biodiversity conservation literature that has consistently lamented insufficient funding for the protection of nature.[5,36–38] The issue of financial allocation is more contested within the development literature with strong arguments in favor of increased funding for developing countries contrasted with claims that development aid leaves unsustainable legacies, has no effect on growth, or even exacerbates poverty traps.[39–43]

Due to its considerable financial leverage and the normative power of its development theories, the World Bank provides a highly relevant case study to examine the allocation of joint development and environmental funds.[44] In response to pressure from member governments and NGOs, the World Bank increased its commitment to the environment within its project portfolio post-Rio 1992,[45] coinciding with the creation of its sister organization, the Global Environment Facility (GEF).[6] Consequently, the World Bank is now established as the largest international donor to biodiversity conservation,[7,46] spending (combined with the GEF) in excess of US$300 million annually.[47] Having long been recognized for its considerable allocation of funds for development aid, it is reasonable to contend that post-Rio the World Bank has been one of—if not the—principal funder(s) for initiatives that integrate environment and development agendas.[48] With recent commitments to more integrated approaches to land management, funding for joint conservation and development continues to increase, but as yet there is limited analysis of the extent of funding to such initiatives. Our analysis therefore complements previous efforts[48,49] and has a targeted focus on the largest funders and a biome of specific concern for integrated conservation and development efforts. Finally, our index of countries detailing their respective environmental and development needs offers insight into where finances are being invested pre-emptively. As such, we provide a resource for researchers and decision makers detailing previous spending and our analysis can help to inform future conservation and development decision-making.

Here, we use publicly available data sources of the World Bank and the GEF to investigate the extent and distribution of funding for integrated conservation and development since the 1992 Rio Earth Summit. We restrict our analysis to the tropics, which contains the majority of the world's biodiversity, has the highest proportion of threatened species, and has relatively low development status and response capacity that is far below the global North.[17] Our objectives are to determine how much funding has been allocated toward joint conservation and development, identify where funding is directed, assess whether this funding is targeted toward areas of greatest environmental and development need, and finally consider what factors are driving funding allocation.

As integrated environment-development initiatives become more prevalent, major investments are being made; however, "accurate estimates of the financial magnitude of these

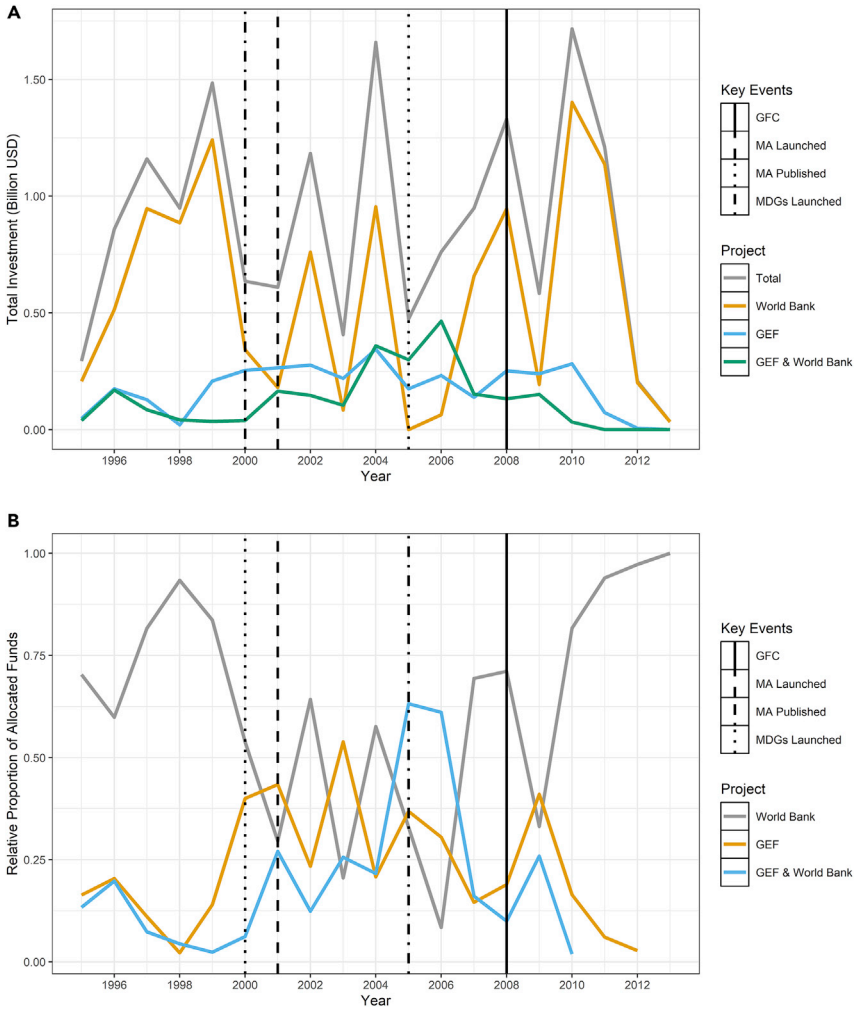


Figure 1. Extent of World Bank and GEF funding

Absolute (A) and relative proportion (B) of funding for World Bank, GEF, and co-funded (GEF & World Bank) integrated environment and development projects from 1995 to 2013 in tropical countries. GFC, global financial crisis; MA, Millennium Ecosystem Assessment; MDGs, Millennium Development Goals.

investments are not available."[22] Given also the apparent lack of evidence regarding the effectiveness of integrated approaches[25,26] and a shortfall in available funding,[35] it is useful to consider the extent and distribution of previous financial flows. To determine effectiveness, an important first step is to better understand where and how funding for integrated conservation and development has been applied.

RESULTS

Allocation of funding for integrated projects

Our study period (1995–2013) was determined by completed projects following the first cycle of post-Rio funding, and data availability (completed projects) thereafter. We specifically targeted World Bank and GEF projects with both an environmental and development component (see the Experimental Procedures). From an initial 2,622 project reports we collated relevant financial flow data for 381 World Bank, GEF, and co-funded (i.e., World Bank and GEF) integrated environment and development projects. Funding was distributed across 75 tropical countries, although both the volume and frequency of funding per country varied greatly (Figures 1 and 2). The absolute volume of funding for the 19-year period was in excess of US$16.5 billion, representing an average investment of almost US$872 million per year. Unless otherwise stated, we refer here to the aggregate spending of both the World Bank and GEF toward integrated projects over the study period.

There was a noticeable increase in financing in the mid to late 1990s, perhaps as a response to the 1992 Earth Summit and pressure from NGOs and member governments. The first half of the last decade (2000–2005) saw a decrease in financing; however—with spikes in 2002 and 2004—it is worth noting that the Millennium Development Goals, which incorporated environmental sustainability targets were established in 2000, and the Millennium Ecosystem Assessment (MA), which explicitly recognized human wellbeing and ecosystem linkages, was launched in 2001. Funding then rose again in the latter half of the last decade, possibly in response to the publication of the MA in 2005, with a noticeable dip in 2009, potentially related to the 2008 economic crash. The large decrease shown for the years 2012 and 2013 is likely not representative of the actual financial commitment for these years; the data were retrieved from completed World Bank/GEF projects and we speculate that a proportion of the evaluation reports for projects concluded in 2012/2013 were yet to be made available at the time of our screening. Regardless, we have shown that there has been considerable investment (in excess of US$16 billion) from the World Bank and GEF toward integrated conservation and development in the tropics.

Funding alignment with environment and development need

We mapped and overlaid the human development index (HDI) and species richness data to identify tropical areas with high biodiversity and low human development scores, which we categorize as highly biodiverse, low development (HBLD) areas (see the Experimental Procedures) and then overlaid this information with the financial flows data obtained from our screening of World Bank and GEF projects. This allowed us to illustrate how funding is targeted to environment and development across the tropics (Figure 2).

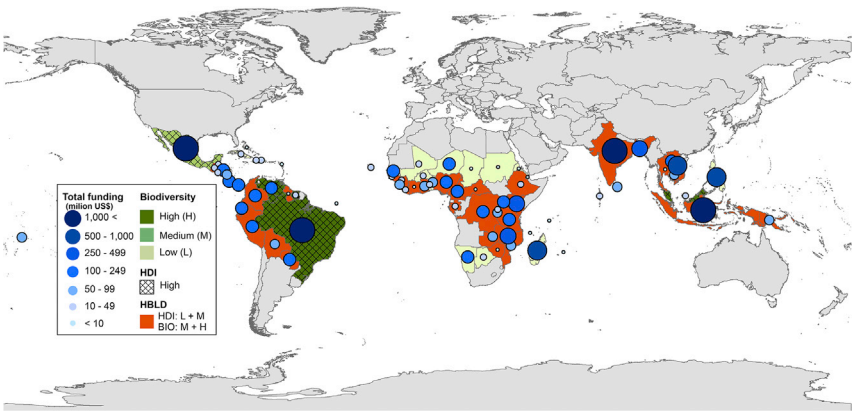


Figure 2. Overlay of World Bank and GEF financial investment with areas of high to low biodiversity and low to high development status in the Tropics

HBLD, high biodiversity low development; HDI, human development index; BIO, biodiversity.

A visual assessment could suggest that the funding for environment and development has been well targeted—areas with greater investment appear to be well-distributed among HBLD countries (Figure 2). For example, biodiversity rich and relatively economically poor areas of Central America, West Africa, and Southeast (SE) Asia have clearly received a significant share of the absolute investment. However, a statistical assessment reveals a more nuanced funding landscape with some interesting patterns related to conservation need, level of development, biodiversity status, and geographic region.

Over the entire study period, there was a large variation in the amount and frequency of funding different countries received (Figure 3). For example, at the lowest end of the spectrum Djibouti and Côte D'Ivoire received approximately US$2 million for one project, while Mexico, Brazil, India, and Indonesia received in excess of US$1 billion each for 81 projects collectively (see Table 2).

Following Sachs et al.[50] we hypothesized that areas of high biodiversity would broadly overlap with areas of low development. We further hypothesized that funding for joint environment and development would correlate well with these identified HBLD countries. However, the evidence did not support this relationship; while HBLD countries are broadly financially supported (35 of the 39 received funding), we found no statistically significant difference in funding per capita or funding per area received between HBLD and non-HBLD countries. There was also no statistical association between a country's development status and funds received measured either in per capita or per area terms. Moreover, we found that countries with low biodiversity received more funding per capita relative to countries with high biodiversity after controlling for land area, governance, and inequality (Figure 4), implying that national biodiversity status is not an influential determinant of donor's funding decisions. We also tested the relationship between threatened species as opposed to high biodiversity (using IUCN red list data) and funding allocation, but again found no statistically significant association (Figure 4).

Given that SSA countries are the World Bank's stated top priority (see http://www.worldbank.org/en/news/press-release/2016/07/12) it is interesting—and of concern—to note the minimal overlap between HBLD countries and investment in this region. Of the 47 SSA tropical countries, 24 were characterized as HBLD. Of these 24, 12 were in the bottom 2 quintiles of funding (i.e., below US$150 million across the study period), with 7 in the lowest quintile (below US$55 million) and 4 received no funding. Malawi received the most funding in SSA both in absolute volume and by unit area (US$301 million and US$2,421 million/km^2, respectively) and yet failed to make the top 10 most highly invested tropical countries by either metric. Indeed, when ranked by funding per unit area, only 6 of the top 20 countries with the highest rates of investment were HBLD countries, with Bangladesh ranked highest in ninth, and only 4 were in SSA (Malawi, Burundi, Gambia, and Rwanda). In terms of absolute volume of investment, SSA is the region with the second highest amount of investment (of four) (Table 1). However, the total investment of US$3.4 billion is dwarfed by the US$8.5 billion committed to Latin America and Caribbean (LAC) (more than half of the total commitment). Both regions had a similar number of projects funded (142 and 148, respectively); however, funding was spread across 39 SSA countries and only 22 LAC countries, indicating a lower average project funding commitment in SSA.

Of the top 5 most heavily invested countries, three (Mexico, Brazil, and Madagascar) are not HBLD countries and yet account for US$7.4 billion (44% of the total investment—see Table 2). Meanwhile, four HBLD countries (Angola, Equatorial Guinea, Republic of Congo, and South Sudan) received zero funding across the study period (Figure 2) and of the five least invested countries, two (Côte D'Ivoire and Zimbabwe) are HBLD (Table 2).

Governance and political-economic factors

The influence of governance on both the targeting and effectiveness of aid spending has been a contested issue.[51–55] Some authors have shown that better governance is positively correlated with aid delivery,[7] while others have shown that donors continue to fund corrupt countries with relative funding to such countries increasing after the Cold War.[56] Focusing on protected areas, Hickey and Pimm[47] showed that World Bank investment decisions are not influenced by a country's governance status. However, our findings show that a significantly greater proportion of finance for joint conservation and development is invested in countries with better governance ratings.

Our results corroborate those of Hickey and Pimm[47] in that "there is no evidence to suggest that countries with lower-cost structures receive more investments." For example, the countries with the lowest average cost structure were Zimbabwe, Djibouti, and the Seychelles, each of which featured in the lowest quintile of absolute funding; these figures, however, are not proportional, and it should also be noted that each of these countries only had a minimal number of projects (<3) across the study period. Finally, consistent with Miller[48] we find that national population size is positively

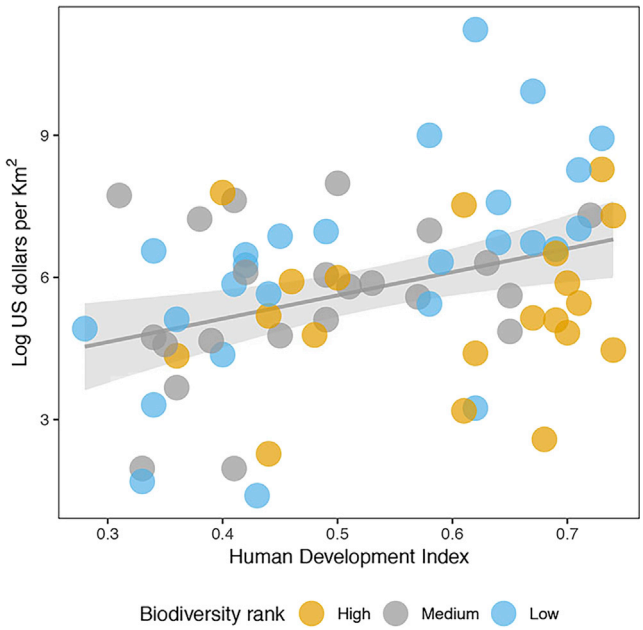


Figure 3. All countries in receipt of funding, with funding received plotted against average HDI

Colors indicate relative biodiversity rank based on combined national-level species richness range data (see Experimental Procedures).

correlated with financing for joint environment and development initiatives.

Of course, there are a multitude of further factors that may influence how the World Bank (and other funding agencies) determines where to invest. For example, it has been widely discussed how World Bank rhetoric on sustainable development has not been matched in reality while the Bank's internal structures incentivize the disbursement of money, yet fail to sufficiently promote or reward environmental impact assessments.[44,57–60] Further factors, not fully considered here, include historical political or military alliances between donor and recipient countries, colonial legacies, securing access to natural resources, and level of socio-political stability within recipient countries (see Hicks et al.,[49] chapter four, for more detailed examples). We found that countries with a higher governance rating received more funds per area (Figure 4D), supporting the idea that stability might be a consideration. Furthermore, recent funding allocation may also be partially driven by other conservation targets, such as climate change mitigation potential. For example, the enormous carbon storage and carbon sequestration values of the humid tropical forests in South America, Central and West Africa, and SE Asia likely explains part of their appeal to funders, while the absence of strong climate change mitigation benefits may explain the lack of funding in some of the dry regions. Finally, several SSA countries that received limited or no funding experienced extended periods of conflict during the study period. Nevertheless, we hope that this study provides a useful preliminary investigation of the amount and distribution of funding for initiatives with integrated environment and development objectives in the tropics, upon which future research, discussion, and decision-making can build.

DISCUSSION

The HBLD areas presented here are intended to stimulate a broader discussion around the targeting, allocation, and appropriate use of funds for both—and particularly joint—environment and development approaches in the tropics. We are not aware of a previous attempt at developing global priority areas for integrated conservation and development. However, Sachs et al.[50] overlaid poverty (using infant mortality as a proxy) and threatened species data that show broadly similar patterns to the maps in this study, with areas of high poverty and species threat mostly located in SSA, South Asia and East Asia, and the Pacific. Meanwhile, conservation planning as a field has a history of identifying priority areas based on, for example, vulnerability,[61] ecosystem services,[62] or more recently "key biodiversity areas" (see http://www.keybiodiversityareas.org/site/mapsearch). Achieving consensus for such priority areas has not been without its challenges[63,64]—not least because both biodiversity and the threats to its conservation are unequally distributed, while reactive and proactive approaches to conservation planning will produce varying priority outcomes.[65] Furthermore, data availability for biodiversity at the national scale is poor. Despite the Convention on Biological Diversity (CBD) requirement of countries to provide such data, we were able to find just two sources of data each representing a single year within our study period. Future effort is needed to develop national and sub-national biodiversity indices; such data would enable longitudinal analysis of biodiversity status and how it relates to other factors.

It is difficult to assess how our findings compare with other studies due to a lack of systematization in reporting and analyzing data across studies and donors,[56] and the limited previous analysis of joint conservation and development financing.[25] However, World Bank and GEF funding for biodiversity aid has previously been estimated at almost US$11 billion for the period 1980–2008, or equivalent to approximately US$393 million annually,[7] with 90% of this allocation targeted toward biodiversity projects linked with development objectives.[48] Meanwhile, Hickey and Pimm[47] suggest that World Bank and GEF spending on biodiversity projects is in the region of US$309 million per annum. Hicks et al.[49] provide the highest estimate we were able to find, reporting that the World Bank spent in excess of US$13 and US$25 billion in the 1980s and 1990s, respectively; these figures, however, are based on environmental aid without the condition to be linked with a development component. Variation in funding numbers can also be attributed to factors, including the extent of in-country co-financing, inconsistency in how projects are classified by researchers, and indeed by the World Bank itself,[46] and differences in the US$ standard rate applied. Additional research is needed to determine the total investment toward integrated conservation and development from across the spectrum of funding sources to better evaluate funding distribution and accurately calculate the shortfall between current spending and global commitments to development and the environment.[35]

Our main finding shows that funding decisions for integrated environment and development projects are neither driven by biodiversity nor HDI status, and SSA countries, in particular, do not receive an amount commensurate with their HBLD status. We suggest this warrants further investigation and consideration

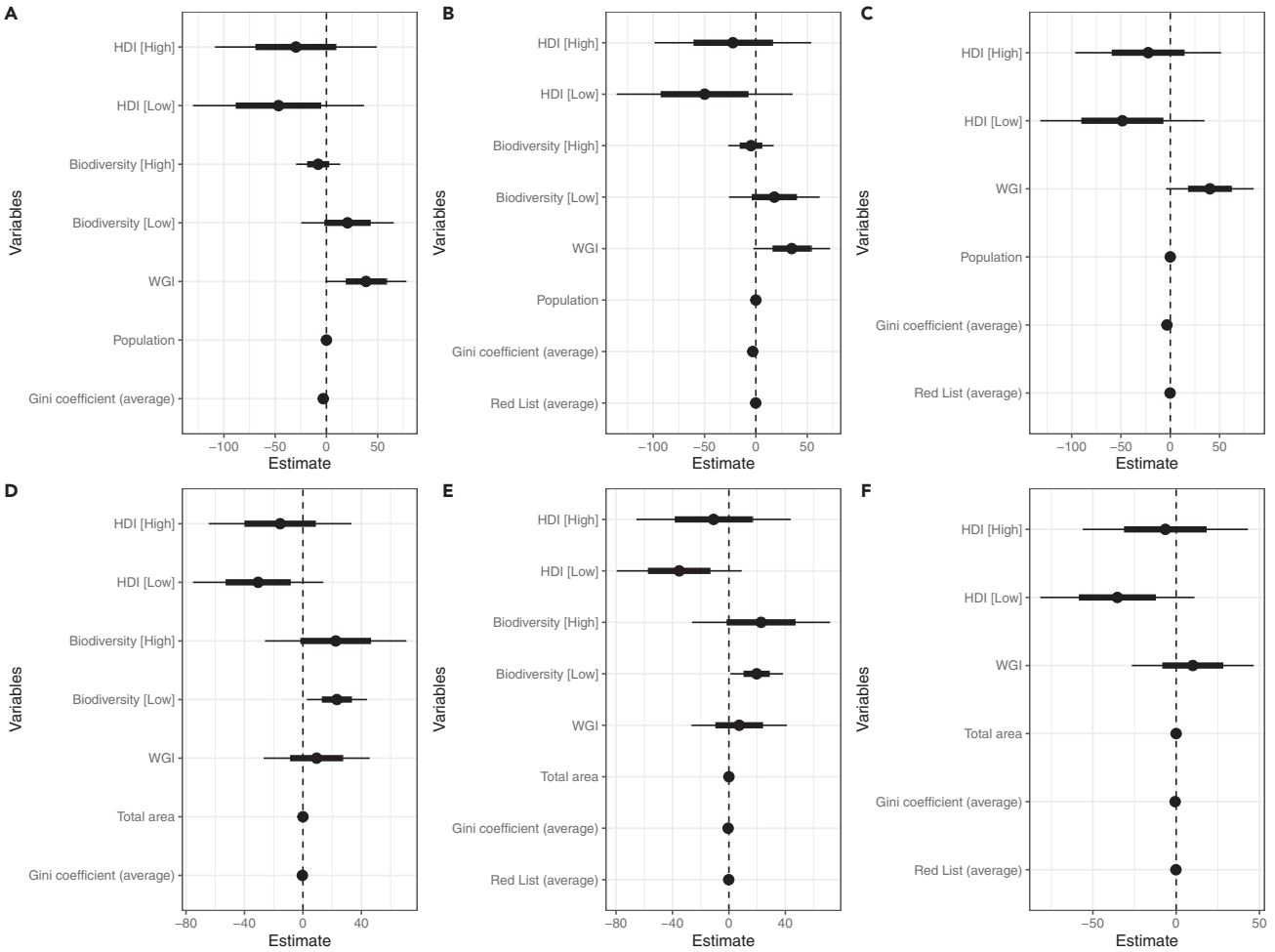


Figure 4. Predictors of joint conservation-development funding

Coefficients of regression models for: (A) funding per area as a function of high and low HDI (baseline is medium), high and low biodiversity (baseline is medium), WGI, population size, and Gini coefficient; (B) funding per area as a function of high and low HDI (baseline is medium), high and low biodiversity (baseline is medium), WGI, population size, Gini coefficient, and red list scores; (C) funding per area as a function of high and low HDI (baseline is medium), WGI, population size, Gini coefficient, and red list scores; (D) funding per capita as a function of high and low HDI (baseline is medium), high and low biodiversity (baseline is medium), WGI, population size, and Gini coefficient; (E) funding per capita as a function of high and low HDI (baseline is medium), high and low biodiversity (baseline is medium), WGI, population size, Gini coefficient, and red list scores; and (F) funding per capita as a function of high and low HDI (baseline is medium), WGI, population size, Gini coefficient, and red list scores. Thick lines of bars represent standard errors and thin lines represent 95% confidence intervals.

for future integrated environment and development funding allocation. While we acknowledge that increasing funding might only be part of the solution to effectively reconciling environment and development agendas, it is important to recognize that for biodiversity conservation at least, the effect of funding has been shown to be significant.[8]

Concluding comments

Our objective for this article was to identify where funding for integrated environment and development has been targeted. Contrary to our hypotheses this study shows that HBLD areas across the tropics receive no more funding for integrated conservation and development than non-HBLD countries. In a similar inverse outcome to our expectation, countries with a low biodiversity rating receive relatively more funding than highly biodiverse countries. Furthermore, we find no statistical association between development status and funds received. Therefore, neither biodiversity nor HDI status are driving funding allocation, and our analysis shows that governance and political-economic factors as proxied by inequality in our models are likely more influential.

Fulfilling the objectives of the SDGs and other internationally agreed commitments toward climate, conservation, and development will require transformational shifts in thinking and the way in which we define and measure progress. It has long been recognized—and is increasingly accepted—that GDP per capita is an inadequate metric for development, and particularly human welfare.[66–68] We must therefore incorporate other variables that cumulatively contribute toward a country's economic, social, and environmental health. It is also widely accepted that financial resources are scarce and "must be used where they can have the largest effect" (see https://www.worldbank.org/). Progress toward international goals with limited resources

Table 1. Regional distribution of total funding for conservation and development

Region	No. of projects	Investment (US$)
East Asia and Pacific	66	2,714,183,508
South Asia	25	1,858,139,739
Latin America and Caribbean	148	8,583,362,104
Sub-Saharan Africa	142	3,411,943,139
Total	381	16,567,628,490

Regions are based on World Bank classification.

therefore demands a concerted financial strategy that prioritizes key areas where multiple benefits can be achieved, including conservation of biodiversity and ecosystems and mitigating the effects of climate change while "leaving no one behind."

Future research to assess the performance of integrated environment-development initiatives is urgently required to enhance our understanding of the appropriateness and effectiveness of global financial flows for such endeavors. Furthermore, future research could disaggregate country-level patterns to achieve a better understanding of in-country flows and the role of particular sites or site dynamics. Our study provides guidance for future investment decisions related to integrated conservation and development across the tropics and generates discussion around how—and why—finances are targeted and ultimately to what effect. Our results suggest that a specific consideration is warranted for those countries recognized as HBLD areas that will be among the most negatively impacted as a result of inaction to the threats of global environmental change.

EXPERIMENTAL PROCEDURES

Resource availability

Lead contact

Further information and requests for data should be directed to the Lead Contact, James Reed (j.reed@cgiar.org).

Materials availability

This study did not generate new unique materials.

Data and code availability

The full dataset for this study is openly available in the CIFOR repository at https://doi.org/10.17528/CIFOR/DATA.00251.

Method summary

This article is based on an analysis of the publicly available datasets of the World Bank and the GEF (all project IDs are provided in the publicly available CIFOR data repository listed above).

In addition to the World Bank and GEF we identified a broad range of institutions that provide funding for initiatives that integrate environment and development objectives; however, a lack of available and transparent data—basic principles for aid organizations (see, for example, Paris declaration on aid effectiveness, 2005)—precluded the majority of sources from being used for this study. Nevertheless, as probably the largest funders of joint environment and development globally, this review of the World Bank and the GEF provides a relevant case study upon which further research can build. Moreover, the World Bank and the GEF should be commended for systematically making project data freely available; the implementation completion and results and terminal evaluation reports provide an excellent—and often underutilized—resource for research examining aid allocation patterns for economic development and environmental conservation,[69] albeit that data can be hidden in voluminous reporting frameworks.

We were interested in identifying where, geographically, the World Bank and GEF invested in projects that incorporated linked environment and development agendas on land in the tropics. Our study period was 1995–2013; the start date was considered to be a realistic point at which joint environment and development projects would be concluded in response to the 1992 Rio Earth Summit. The end date was determined by the most recently concluded project data availability. To overcome issues associated with data inconsistency, this review only focuses on concluded projects.

Search strategy

The World Bank is recognized as a primary funder for international development and so therefore we focused our initial search strategy on the World Bank's environmental topic and corresponding 33 subthemes (ranging from "adaptation to climate change" to "wildlife resources"; see Table S1 for full list) anticipating this would provide a suite of projects that contained both environment and development components.

The GEF was established on the eve of the Rio Earth Summit to address the planet's most pressing environmental problems (see www.thegef.org) and its project database is categorized into eight main focal areas. For this review we applied project type and status filters to capture full size and closed projects from the following GEF focal areas: Biodiversity, Climate Change, Land Degradation, and Multi Focal Area. To further expand our search, we also used Integrated Natural Resource Management filter as our own search term (Table S2).

Supplementary searches

As our screening of the World Bank and GEF projects proceeded and our understanding of the functioning of the respective databases increased, it became apparent that there were limitations to our initial search strategy. As such, we designed and conducted a second search strategy of both the World Bank and GEF databases. For the second World Bank search we selected 10 topic filters and 17 sub-areas (Table S3). For the second GEF search we used the same strategy but included medium size projects.

In total, our searches yielded 2,622 project reports: 1,244 projects from the World Bank and 1,378 projects from the GEF. As the World Bank and the GEF often co-fund projects, we removed duplicates from the dataset and then proceeded with project report screening, data extraction, and analysis.

Project screening

Five reviewers independently screened all captured projects with an implementation completion report (World Bank) or evaluation report (GEF), applying the following inclusion criteria for a project to be included in the final suite of studies: (1) located within the tropics—in part within the Tropics of Cancer and Capricorn (countries listed in Table S4), (2) had a terrestrial land-use focus, and (3) contained both an environmental and developmental objective. A total of 9 months (five reviewers, two full-time and three part-time from June 2017 to April 2018) was required for designing the strategy and extracting project bibliographic data and relevant information for total project cost, duration, environmental and developmental objectives, and outcomes and risk assessment. After removal of duplicates and screening for relevance, from a total of 2,622 reports the final suite of studies for analysis totaled 381 projects (World Bank, GEF, and co-funded projects combined).

Biodiversity and development data

We used proxy indicators for national-level measures of "biodiversity" and "development" to determine highly biodiverse, low development (HBLD) areas. These data consist of the HDI (UNDP—average value across the study period) and spatial overlays of species richness range maps for birds, mammals, and amphibians using data from biodiversitymapping.org that combines data from BirdLife International and the International Union for Conservation of Nature.[70,71] Both the conservation and development measures were transformed into three-level ordinal measures (using tercile values—birds, mammals, and amphibians were ranked individually; a national scale ranking of low, medium, or high was then calculated for both biodiversity and development) and combined into a binary measure of HBLD countries or non-HBLD countries: countries with medium to high biodiversity ranges *and* medium to

Table 2. The 10 countries receiving the Most (n = 5), and the least (n = 5) environment and development funding by volume

	Country	Investment (US$, Millions)	FPU (US$/km^2)	No. of projects	WGI	HDI	Biodiversity status	HBLD country
Most	Mexico	3,520	1,498 (16)	24	−0.11 (M)	0.72 (H)	6 (M)	no
	Brazil	3,200	358 (38)	32	0.03 (M)	0.7 (H)	9 (H)	no
	India	1,340	401 (37)	14	−0.25 (M)	0.53 (L)	7 (M)	yes
	Indonesia	1,040	548 (31)	11	−0.63 (L)	0.63 (M)	7 (M)	yes
	Madagascar	708	1,062 (21)	14	−0.42 (L)	0.49 (L)	5 (L)	no
Least	Djibouti	1.8	79 (63)	1	−0.72 (L)	0.4 (L)	4 (L)	no
	Côte D'Ivoire	2.34	7.15 (73)	1	−1.06 (L)	0.41 (L)	7 (M)	yes
	Comoros	3.43	1,961 (14)	1	ND	0.47 (M)	ND	no
	Seychelles	3.79	7,602 (5)	2	0.21 (H)	0.73 (H)	3 (L)	no
	Zimbabwe	4.26	9.75 (71)	3	−1.35 (L)	0.44 (L)	8 (H)	yes

FPU, funding per unit area, numbers in brackets indicate rank out of all recipient countries in dataset, n = 75. When ranked by FPU, none of the top five recipient countries (Maldives, Samoa, Antigua and Barbuda, Kiribati, Seychelles) are HBLD countries, and Côte D'Ivoire, Central Africa Republic, and Zimbabwe of the bottom five (Sudan, Chad, Côte D'Ivoire, Central Africa Republic, and Zimbabwe) are HBLD countries. WGI, world governance index; HDI, human development index. Biodiversity status reflects our own ordinal ranking for country-level biodiversity: high (H), medium (M), and low (L).

low development ranges (i.e., countries exhibiting relatively high biodiversity and relatively low development) were categorized as HBLD countries (see Figure 2). We use the HDI (http://hdr.undp.org/en/data) as our measure of development because poverty and human wellbeing are increasingly recognized as multi-dimensional and thought of as encompassing more than income and consumption, which have been typically used as measures of development[66]—although we also conduct a robustness test using GDP per capita.

We acknowledge that there are varying frameworks of how funding for conservation and/or development should be prioritized and distributed. For example, the HBLD areas we analyze are areas where medium to high biodiversity status overlaps with low development status. However, an alternative way to prioritize funding would be to target those areas where biodiversity has already been impacted. To test this relationship, we collected threatened species data from the IUCN red list and again took the average country values across the study period and included this as an additional variable in our models (see below). It should also be noted that, despite our inclusion of the Gini coefficient in our analysis, country-level GDP and HDI metrics obscure a high level of regional inequality, especially in the larger countries. For example, the vast majority of the Brazilian Amazon and Caatinga regions have medium to low HDI scores, which is not reflected in the country-level scores; indeed, within the single state of Pará there are 142 municipalities covering the spectrum of very low to high HDI. Finer grained spatial assessments of projects would enable a richer understanding of environment-development funding priorities.

We also collected other publicly available national-level development data, including world governance index (WGI) measures (World Bank Group, 2018), GDP per capita (World Bank Data), Gini index measures of inequality (World Bank Data), population (World Bank Data), and environmental performance index measures (Yale University). We screened projects and collected data between June 2017 and April 2018 and transformed all financial data to 2010 US$ values.

Statistical analysis

We use the various datasets extracted from World Bank and GEF reports and combine these with those extracted from additional data sources (detailed above) to run a series of linear regression models to understand what predicts total funding received (expressed as both US$ per capita and US$ per km^2). All measures were taken as averages across the study period 1995–2013. We ran three models for each outcome: the first outcome was funding per area, regressed as a function of (1) HDI, biodiversity, WGI, population size, and Gini coefficient; (2) included threatened species (red list) to the variables listed in (1); (3) removed biodiversity and retained threatened species. The second outcome was funding per capita—the same set of variables (described above for outcome one) were included across three models with the exception of population, which was substituted for total area. All models were run in Stata 15 using Hubert-White robust standard errors. We also ran the models with regional dummies, but in the end did not include these since they were highly correlated with the other independent variables and since some regions had very few observations (South Asia only had three observations). All models were run using robust standard errors. Descriptive statistics and regression results are provided in Tables S5 and S6, respectively.

SUPPLEMENTAL INFORMATION

Supplemental Information can be found online at https://doi.org/10.1016/j.oneear.2020.11.008.

ACKNOWLEDGMENTS

This study is part of the CGIAR Research Program on Forests, Trees and Agroforestry (CRP-FTA). This collaborative program aims to enhance the management and use of forests, agroforestry, and tree genetic resources across the landscape from forests to farms. Funding for this study was provided by the International Climate Initiative (IKI) of the Federal Ministry for the Environment, Nature Conservation, Building and Nuclear Safety (BMUB) grant 18_IV_084, the United States Agency for International Development (USAID) Forest and Biodiversity Office, and the CGIAR FTA program. R.C. was supported by the Frank Jackson Foundation. We are very grateful for the comments of the anonymous reviewers that helped to improve the manuscript.

AUTHOR CONTRIBUTIONS

J.R. conceived the study. J.R. and J.v.V. designed the study. M.Y., S.N., and J.R. collected the data. J.O., A.I., and J.R. analyzed the data. J.R. wrote the original draft. All authors contributed to developing, writing, reviewing, and finalizing the paper.

DECLARATION OF INTERESTS

The authors declare no competing interests.

Received: January 8, 2020
Revised: September 21, 2020
Accepted: November 20, 2020
Published: December 18, 2020

REFERENCES

1. Cutter A., Osborn D., Romano J., Ullah F. (2015). Sustainable Development Goals and Integration: Achieving a better balance between the economic, social and environmental dimensions. In: Stakeholder Forum, A Study Commissioned by the German Council for Sustainable Development.
2. Costanza, R., Fioramonti, L., and Kubiszewski, I. (2016). The UN Sustainable Development Goals and the dynamics of well- being. Front. Ecol. Environ. *14*, 59.
3. Griggs, D., Stafford-Smith, M., Gaffney, O., Rockström, J., Öhman, M.C., Shyamsundar, P., Steffen, W., Glaser, G., Kanie, N., and Noble, I. (2013). Sustainable development goals for people and planet. Nature *495*, 305–307.
4. Roaf, S., Crichton, D., and Nicol, F. (2009). Adapting Buildings and Cities for Climate Change: A 21st Century Survival Guide (Routledge).
5. Balmford, A., Gaston, K.J., Blyth, S., James, A., and Kapos, V. (2003). Global variation in terrestrial conservation costs, conservation benefits, and unmet conservation needs. Proc. Natl. Acad. Sci. U S A *100*, 1046–1050.
6. Tallis, H., Kareiva, P., Marvier, M., and Chang, A. (2008). An ecosystem services framework to support both practical conservation and economic development. Proc. Natl. Acad. Sci. U S A *105*, 9457–9464.
7. Miller, D.C., Agrawal, A., and Roberts, J.T. (2013). Biodiversity, governance, and the allocation of international aid for conservation. Conserv. Lett. *6*, 12–20.
8. Waldron, A., Miller, D.C., Redding, D., Mooers, A., Kuhn, T.S., Nibbelink, N., Roberts, J.T., Tobias, J.A., and Gittleman, J.L. (2017). Reductions in global biodiversity loss predicted from conservation spending. Nature *551*, 364–367.
9. UNEP-WCMC. (2018). Protected Planet Report (UNEP-WCMC, IUCN and NGS).
10. von Grebmer, K., Bernstein, J., Hammond, L., Patterson, F., Sonntag, A., Klaus, L., Fahlbusch, J., Towey, O., Foley, C., Gitter, S., and Ekstrom, K. (2018). 2018 Global Hunger Index: Forced Migration and Hunger (Welthungerhilfe and Concern Worldwide).
11. IPBES (2019). Global Assessment Report on Biodiversity and Ecosystem Services of the Intergovernmental Science Policy Platform on Biodiversity and Ecosystem Services (IPBES Secretariat).
12. WWF (2018). Living Planet Report: Aiming Higher (WWF).
13. Díaz, S., Settele, J., Brondízio, E.S., Ngo, H.T., Agard, J., Arneth, A., et al. (2019). Pervasive human-driven decline of life on Earth points to the need for transformative change. Science *366*, eaax3100.
14. World Bank; International Monetary Fund (2016). Global Monitoring Report 2015/2016: Development Goals in an Era of Demographic Change. Overview Booklet (World Bank).
15. von Grebmer, K., Bernstein, J., Hossain, N., Brown, T., Prasai, N., Yohannes, Y., Patterson, F., Sonntag, A., Zimmerman, S.M., Towey, O., and Foley, C. (2017). 2017 Global Hunger Index: the inequalities of hunger. Intl. Food Policy Res. Inst.
16. Ericksen, P., Thornton, P., Notenbaert, A., Cramer, L., Jones, P., and Herrero, M. (2011). Mapping Hotspots of Climate Change and Food Insecurity in the Global Tropics (CGIAR Research Program on Climate Change, Agriculture and Food Security (CCAFS)).
17. Barlow, J., França, F., Gardner, T.A., Hicks, C.C., Lennox, G.D., Berenguer, E., Castello, L., Economo, E.P., Ferreira, J., Guénard, B., and Leal, C.G. (2018). The future of hyperdiverse tropical ecosystems. Nature *559*, 517–526.
18. Adams, W.M., Aveling, R., Brockington, D., Dickson, B., Elliott, J., Hutton, J., Roe, D., Vira, B., and Wolmer, W. (2004). Biodiversity conservation and the eradication of poverty. Science *306*, 1146–1149.
19. Oldekop, J.A., Bebbington, A.J., Brockington, D., and Preziosi, R.F. (2010). Understanding the lessons and limitations of conservation and development. Conserv. Biol. *24*, 461–469.
20. Reed, J., Van Vianen, J., Deakin, E.L., Barlow, J., and Sunderland, T. (2016). Integrated landscape approaches to managing social and environmental issues in the tropics: learning from the past to guide the future. Glob. Change Biol. *22*, 2540–2554.
21. Wunder, S., Brouwer, R., Engel, S., Ezzine-de-Blas, D., Muradian, R., Pascual, U., and Pinto, R. (2018). From principles to practice in paying for nature's services. Nat. Sustain. *1*, 145–150.
22. Kareiva, P., Groves, C., and Marvier, M. (2014). The evolving linkage between conservation science and practice at the Nature Conservancy. J. Appl. Ecol. *51*, 1137–1147.
23. McKinnon, M.C., Cheng, S.H., Dupre, S., Edmond, J., Garside, R., Glew, L., Holland, M.B., Levine, E., Masuda, Y.J., Miller, D.C., and Oliveira, I. (2016). What are the effects of nature conservation on human well-being? A systematic map of empirical evidence from developing countries. Environ. Evid. *5*, 1–25.
24. Muradian, R., Arsel, M., Pellegrini, L., Adaman, F., Aguilar, B., Agarwal, B., Corbera, E., Ezzine de Blas, D., Farley, J., Froger, G., and Garcia-Frapolli, E. (2013). Payments for ecosystem services and the fatal attraction of win-win solutions. Conserv. Lett. *6*, 274–279.
25. Sayer, J.A., Margules, C., Boedhihartono, A.K., Sunderland, T., Langston, J.D., Reed, J., Riggs, R., Buck, L.E., Campbell, B.M., Kusters, K., and Elliott, C. (2017). Measuring the effectiveness of landscape approaches to conservation and development. Sustain. Sci. *12*, 465–476.
26. Reed, J., van Vianen, J., Barlow, J., and Sunderland, T. (2017). Have integrated landscape approaches reconciled societal and environmental issues in the tropics? Land Use Pol. *63*, 481–492.
27. Howe, C., Corbera, E., Vira, B., Brockington, D., and Adams, W.M. (2018). Distinct positions underpin ecosystem services for poverty alleviation. Oryx *54*, 1–8, https://doi.org/10.1017/S0030605318000261.
28. Brown, K. (2003). Integrating conservation and development: a case of institutional misfit. Front. Ecol. Environ. *1*, 479–487.
29. Carrasco, L.R., Papworth, S.K., Reed, J., Symes, W.S., Ickowitz, A., Clements, T., Peh, K.H., and Sunderland, T. (2016). Five challenges to reconcile agricultural land use and forest ecosystem services in Southeast Asia. Conserv. Biol. *30*, 962–971.
30. Reed, J., Barlow, J., Carmenta, R., van Vianen, J., and Sunderland, T. (2019). Engaging multiple stakeholders to reconcile climate, conservation and development objectives in tropical landscapes. Biol. Conserv. *238*, 108229.
31. Redford, K.H., Padoch, C., and Sunderland, T. (2013). Fads, funding, and forgetting in three decades of conservation. Conserv. Biol. *27*, 437–438.
32. McShane, T.O., Hirsch, P.D., Trung, T.C., Songorwa, A.N., Kinzig, A., Monteferri, B., Mutekanga, D., Van Thang, H., Dammert, J.L., Pulgar-Vidal, M., and Welch-Devine, M. (2011). Hard choices: making trade-offs between biodiversity conservation and human well-being. Biol. Conserv. *144*, 966–972.
33. Wells, M.P., and McShane, T.O. (2004). Integrating protected area management with local needs and aspirations. Ambio *33*, 513–519.
34. Parker, C., Cranford, M., Oakes, N., and Leggett, M. (2012). The Little Biodiversity Finance Book: A Guide to Proactive Investment in Natural Capital (Global Canopy Programme).
35. Clark, R., Reed, J., and Sunderland, T. (2018). Bridging funding gaps for climate and sustainable development: pitfalls, progress and potential of private finance. Land Use Pol. *71*, 335–346.
36. McCarthy, D.P., Donald, P.F., Scharlemann, J.P., Buchanan, G.M., Balmford, A., Green, J.M., Bennun, L.A., Burgess, N.D., Fishpool, L.D., Garnett, S.T., and Leonard, D.L. (2012). Financial costs of meeting global biodiversity conservation targets: current spending and unmet needs. Science *338*, 946–949.
37. Waldron, A., Mooers, A.O., Miller, D.C., Nibbelink, N., Redding, D., Kuhn, T.S., Roberts, J.T., and Gittleman, J.L. (2013). Targeting global conservation funding to limit immediate biodiversity declines. Proc. Natl. Acad. Sci. U S A *110*, 12144–12148.

38. Coad, L., Watson, J.E., Geldmann, J., Burgess, N.D., Leverington, F., Hockings, M., Knights, K., and Di Marco, M. (2019). Widespread shortfalls in protected area resourcing undermine efforts to conserve biodiversity. Front. Ecol. Environ. *17*, 259–264.

39. Sachs, J., McArthur, J.W., Schmidt-Traub, G., Kruk, M., Bahadur, C., Faye, M., and McCord, G. (2004). Ending Africa's poverty trap. Brookings Pap. Econ. Act. *2004*, 117–240.

40. Easterly, W. (2006). The white man's burden: why the West's efforts to aid the rest have done so much ill and so little good (Oxford University Press).

41. Clemens, M.A., Radelet, S., and Bhavnani, R.R. (2004). Counting chickens when they hatch: the short-term effect of aid on growth (Center for Global Development working paper).

42. Burnside, C., and Dollar, D. (2000). Aid, policies, and growth. Am. Econ. Rev. *90*, 847–868.

43. Savedoff, W.D., Levine, R., and Birdsall, N. (2005). When will we ever learn? Recommendations to improve social development through enhanced impact evaluation (Center for Global Development), p. 15.

44. Weaver, C. (2008). Hypocrisy trap: the World Bank and the poverty of reform (Princeton University Press).

45. Nielson, D.L., and Tierney, M.J. (2003). Delegation to International Organizations: Agency Theory and World Bank Environmental Reform (International organization), pp. 241–276.

46. Powers, R.M., Roberts, J.T., & Tierney, M.J. (2009). Greenwashing or Mainstreaming? New Measures of Environmental Rhetoric and Funding at the World Bank. In Unpublished paper presented at the PLAID Data Vetting Workshop, Washington DC.

47. Hickey, V., and Pimm, S.L. (2011). How the World Bank funds protected areas. Conserv. Lett. *4*, 269–277, 276.

48. Miller, D.C. (2014). Explaining global patterns of international aid for linked biodiversity conservation and development. World Dev. *59*, 341–359.

49. Hicks, R.L., Parks, B.C., Roberts, J.T., and Tierney, M.J. (2010). Greening aid? Understanding the environmental impact of development assistance (Oxford University Press).

50. Sachs, J.D., Baillie, J.E., Sutherland, W.J., Armsworth, P.R., Ash, N., Beddington, J., Blackburn, T.M., Collen, B., Gardiner, B., Gaston, K.J., and Godfray, H.C.J. (2009). Biodiversity conservation and the Millennium Development Goals. Science *325*, 1502–1503.

51. Easterly, W., Levine, R., and Roodman, D. (2004). Aid, policies, and growth: comment. Am. Econ. Rev. *94*, 774–780.

52. Burnside, B.C., and Dollar, D. (2004). Aid, policies, and growth: reply. Am. Econ. Rev. *94*, 781–784.

53. Hansen, H., and Tarp, F. (2001). Aid and growth regressions. J. Dev. Econ. *64*, 547–570.

54. Sachs, J.D. (2006). The end of poverty: economic possibilities for our time (Penguin Books).

55. Tierney, M.J., Nielson, D.L., Hawkins, D.G., Roberts, J.T., Findley, M.G., Powers, R.M., Parks, B., Wilson, S.E., and Hicks, R.L. (2011). More dollars than sense: refining our knowledge of development finance using AidData. World Dev. *39*, 1891–1906.

56. Easterly, W., and Williamson, C.R. (2011). Rhetoric versus reality: the best and worst of aid agency practices. World Dev. *39*, 1930–1949.

57. Wade, R. (1997). Greening the Bank: the struggle over the environment, 1970–1995. The World Bank: Its First Half Century, *vol. 2* (Brookings Institution Press), pp. 611–734.

58. Goldman, M. (2001). The birth of a discipline: producing authoritative green knowledge, World Bank-style. Ethnography *2*, 191–217.

59. World Bank (2001). World Development Report 2000/01: Attacking Poverty (Oxford University Press).

60. Bosshard, P. (2004). The World Bank's Safeguard Policies under Pressure: A Critique of the World Bank's New Middle Income Country Strategy (International Rivers Network).

61. Myers, N., Mittermeier, R.A., Mittermeier, C.G., Da Fonseca, G.A., and Kent, J. (2000). Biodiversity hotspots for conservation priorities. Nature *403*, 853–858.

62. Naidoo, R., Balmford, A., Costanza, R., Fisher, B., Green, R.E., Lehner, B., Malcolm, T.R., and Ricketts, T.H. (2008). Global mapping of ecosystem services and conservation priorities. Proc. Natl. Acad. Sci. U S A *105*, 9495–9500.

63. Mace, G.M., Balmford, A., Boitani, L., Cowlishaw, G., Dobson, A.P., Faith, D.P., Gaston, K.J., Humphries, C.J., Vane-Wright, R.I., Williams, P.H., and Lawton, J.H. (2000). It's time to work together and stop duplicating conservation efforts…. Nature *405*, 393.

64. Smith, R.J., Bennun, L., Brooks, T.M., Butchart, S.H., Cuttelod, A., Di Marco, M., Ferrier, S., Fishpool, L.D., Joppa, L., Juffe-Bignoli, D., and Knight, A.T. (2019). Synergies between the key biodiversity area and systematic conservation planning approaches. Conserv. Lett. *12*, 12625.

65. Brooks, T.M., Mittermeier, R.A., da Fonseca, G.A., Gerlach, J., Hoffmann, M., Lamoreux, J.F., Mittermeier, C.G., Pilgrim, J.D., and Rodrigues, A.S. (2006). Global biodiversity conservation priorities. Science *313*, 58–61.

66. Stiglitz, J. (1998). Towards a new paradigm for development (United Nations Conference on Trade and Development).

67. Naidoo, R., and Fisher, B. (2020). Sustainable development goals: pandemic reset. Nature *583*, 198–201.

68. Hickel, J. (2020). Less is more: how degrowth will save the world (William Heinemann).

69. Kareiva, P., Chang, A., and Marvier, M. (2008). Development and conservation goals in World Bank projects. Science *321*, 1638–1639.

70. Jenkins, C.N., Pimm, S.L., and Joppa, L.N. (2013). Global patterns of terrestrial vertebrate diversity and conservation. Proc. Natl. Acad. Sci. U S A *110*, E2602–E2610.

71. Pimm, S.L., Jenkins, C.N., Abell, R., Brooks, T.M., Gittleman, J.L., Joppa, L.N., Raven, P.H., Roberts, C.M., and Sexton, J.O. (2014). The biodiversity of species and their rates of extinction, distribution, and protection. Science *344*, 1246752.

One Earth, Volume *3*

Supplemental Information

The extent and distribution of joint conservation-development funding in the tropics

James Reed, Johan Oldekop, Jos Barlow, Rachel Carmenta, Jonas Geldmann, Amy Ickowitz, Sari Narulita, Syed Ajijur Rahman, Josh van Vianen, Malaika Yanou, and Terry Sunderland

Table S1: World Bank database search strategy

Topics	**Subareas**	
Environment	*Adaptation to climate change*	*Environmental management*
	Air Quality and clean air	*Environmental Protection*
	Biodiversity	*Environmental strategy*
	Brown Issue and Health	*Environmentally Protected Areas*
	Carbon Policy and Trading	*Forests and Forestry*
	Climate Change and Environment	*Global Environmental Facility*
	Climate change and impacts	*Green Issues*
	Climate Change Mitigation and Green House Gases	*Marine Environment*
	Coastal and Marine Environment	*Montreal Protocol*
	Dryland and Desertification	*Natural Disasters*
	Ecosystems and Natural Habitats	*Natural Resources Management*
	Environment and Energy Efficiency	*Persistent Organic pollutants*
	Environmental disasters and degradation	*Pollution Management and control*
	Environmental economics and policies	*Sustainable Land Management*
	Environmental Engineering	*Tourism and Ecotourism*
	Environmental Governance	*Water Resources Management*
	Environmental Information Systems	*Wildlife Resources*

Table S2: GEF database search strategy

Search Terms	
Focal Area	Biodiversity
	Climate Change
	Land Degradation
	Multi Focal Area
	INRM
Project Type	Full Size
Status	Completed

Table S3: Supplementary search strategy for the World Bank database.

Topics	**Subareas**
Agriculture	*Climate Change & Agriculture*
	Forestry Management
Culture & Development	*Culture in Sustainable Development*
Energy	*Energy & Environment*
	Energy & natural resources
	Energy resources development
Gender	*Gender & Development*
	Gender & Energy
Health, Nutrition & Population	*Environment & health*
International Economics & Trade	*Trade & Environment*
Poverty Reduction	*Poverty, Environment & Development*
Rural Development	*Forestry management*
	Natural Resources Management
	Sustainable Land& Crop Management
Transport	*Transport & Environment*

Water Resources	*Coastal & Marine Resources*
	Water Conservation

Table S4: List of tropical countries included in this study

Antigua And Barbuda	Eritrea	Nicaragua
Bahamas	Ethiopia	Niger
Bangladesh	Gabon	Nigeria
Belize	Gambia	Panama
Benin	Ghana	Papua New Guinea
Bolivia	Guatemala	Paraguay
Botswana	Guinea	Peru
Brazil	Guinea-Bissau	Philippines
Burkina Faso	Guyana	Rwanda
Burundi	Haiti	Samoa
Cabo Verde	Honduras	Senegal
Cambodia	India	Seychelles
Cameroon	Indonesia	Sierra Leone
Central African Republic	Kenya	Sri Lanka
Chad	Kiribati	Sudan
Colombia	Lao PDR	Suriname
Comoros	Liberia	Tanzania
Congo DR	Madagascar	Thailand
Costa Rica	Malawi	Togo
Cote d'Ivoire	Malaysia	Uganda
Cuba	Maldives	Venezuela
Djibouti	Mali	Vietnam
Dominican Republic	Mauritius	Zambia
Ecuador	Mexico	Zimbabwe
El Salvador	Mozambique	
	Namibia	

Table S5: descriptive statistics for Fig. 4

Variable Name	**Mean**	**Standard deviation**
Funding_per_area (km^2)	24.19	91.651
Funding_per_capita	24.37	60.446
High_HDI	0.35	0.479
Low_HDI	0.35	0.479
Medium HDI	0.31	0.464
High Biodiversity	0.27	0.445
Low Biodiversity	0.43	0.498

Medium Biodiversity	0.29	0.459
WGI	-0.46	0.581
Population	3.91e+07	1.34e+08
Total area	6.17e+07	1.19e+08
Gini coefficient	45.11	6.976
Red List	57.85	66.858

Table S6: regression results for Fig. 4

	Funding Per Area						**Funding Per Capita**					
	Model 1		Model 2		Model 3		Model 4		Model 5		Model 6	
Variable	Estimate	SE	Estimate	SE	Estimate	SE	Estimate	SE	Estimate	SE	Estimate	SE
HDI [High]	-29.78	39.46	-22.36	38.13	-22.41	36.99	-15.68	24.41	-10.86	27.36	-6.498	24.81
HDI [Low]	-46.84	41.71	-49.90	42.82	-48.59	41.62	-30.72	22.29	-35.23	22.16	-35.28	23.15
Biodiversity [High]	-8.029	10.78	-4.752	11.05			22.40	24.20	-22.80	24.46		
Biodiversity [Low]	20.59	22.58	17.97	22.05			23.30**	10.33	19.69**	9.326		
WGI	38.74*	19.83	34.89*	18.69	40.21*	22.24	9.294	18.10	7.299	16.92	10.00	18.32
Population	-8.79e-08	5.67e-08	-5.82e-08	4.77e-08	-6.07e-08	5.39e-08			0.00	0.00	0.00	0.00
Total area			0.00	0.00	0.00	0.00	-2.70e-08	2.64e-08	3.40e-09	2.85e-08	1.17e-08	2.65e-08
Gini coefficient (average)	-3.098	1.924	-3.062	1.928	-3.387	2.131	-0.401	1.060	-0.551	1.155	-0.581	1.154
Red List (average)			-0.141	0.0970	-0.191	0.116			-0.117	0.111	-0.141	0.122
Constant	207.2	124.2	209.5	126.3	234.8	147.5	50.24	54.55	62.33	62.22	78.34	63.44
Observations	69		69		69		69		69		69	
R-Squared	0.144		0.149		0.140		0.092		0.100		0.076	

*** p<0.01, ** p<0.05, * p<0.1