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ESTIMATION OF RESOURCES NEEDED FOR IMPLEMENTING THE POST-2020 GLOBAL BIODIVERSITY FRAMEWORK

PRELIMINARY SECOND REPORT OF THE PANEL OF EXPERTS ON RESOURCE MOBILIZATION

SUPPLEMENTARY INFORMATION

The present document provides information complementary to document CBD/SBI/3/5/Add.2, in particular to the analysis provided in section V of that document. Annex I provides details of the modelling methodology used, annex II provides tables, and annex III presents figures.

* CBD/SBI/3/1.

Annex I

ESTIMATING FINANCIAL NEEDS UNDER DIFFERENT SCENARIOS USING DATA FROM THE FINANCIAL REPORTING FRAMEWORK

DETAILS OF THE MODELLING METHODOLOGY

1. Cross-sectional data was collected per country on 15 characteristics from World Bank databases. Gross domestic product (GDP), population density, agricultural area as percentage of total land area, and oil rents as percentage of GDP were included to represent potential pressures on biodiversity, and thus drivers of financial needs. In addition, carbon dioxide (CO_2) emissions were included to represent climate-driven pressures and associated needs. In order to represent institutional conditions and their potential impacts on financial needs, measures of government effectiveness, political stability, control of corruption, regulatory quality, and rule of law were also included. As indications of national biodiversity condition, terrestrial protected area (as percentage of total area), as well as the numbers of threatened mammal species and threatened bird species, were also included. Finally, data on price level and total land area were also compiled for possible inclusion in the models. Tables 1, 2 and 3 in annex II present lists of data specifications, descriptions, sources, and summary statistics for all the data collected.[1]

2. Each model followed the same six steps to obtain projections for future global financial needs. See figure 1 in annex III for a graphical representation of the modelling approach. The steps were as follows:

Step 1. Model a linear relationship between **domestic expenditures of reporting countries**[2] and other country characteristics.

Step 2. Estimate past **domestic expenditures for non-reporting countries** using the linear relationship fitted in step 1.

Step 3. Model a linear relationship between **financial needs of reporting countries** and estimated past domestic expenditures and other country characteristics.

Step 4. Estimate **financial needs for non-reporting countries** using the linear relationship fitted in step 3.

Step 5. Project **future financial needs** per country for 2030 by extrapolating GDP, CO_2 emissions, and agricultural land area in 2030 for three scenarios inspired by Shared Socioeconomic Pathways (SSPs)[3] which also formed the basis for scenarios used in the WWF Global Futures report [4] (business as usual, sustainable pathway, and global conservation).

Step 6. Estimate **future global financial needs** summing up estimated projections of future financial needs by country.

3. To estimate the relationship between average domestic expenditures and other country characteristics for reporting countries (step 1), we used multivariate linear regression models of the form:

$$Domestic\ expenditures_i = \alpha_0 + \alpha_1\ X1_i\ +\ \alpha_2\ X2_i + \cdots + \varepsilon_i \qquad (1)$$

[1] As explained further in CBD/SBI/3/5/Add.2, section V, data on domestic expenditures (79 countries) and financial needs (39 countries) were collected from the financial reporting framework of the Convention.

[2] "Reporting countries" here refers to countries that had provided data through the financial reporting framework; "non-reporting countries" refers to countries that had not reported.

[3] https://www.unece.org/fileadmin/DAM/energy/se/pdfs/CSE/PATHWAYS/2019/ws_Consult_14_15.May.2019/supp_doc/SSP2_Overview.pdf.

[4] Johnson, J.A. et al. (2020). Global Futures: modelling the global economic impacts of environmental change to support policy-making. Technical Report, January 2020. https://www.wwf.org.uk/globalfutures.

where X1, X2 etc. are variables based on (or equal to) country characteristics such as GDP, agricultural land, CO_2 emissions and others. Coefficients (alphas, α) were found using an ordinary least squares method. The method minimizes the sum of the squares of the differences between the observed domestic expenditures values in the data set of reporting countries and those predicted by the linear functions combining country characteristics, as shown in the equation above. We also employed an additional statistical approach using principal component analysis in steps 1 and 2, as discussed below.

4. The first multivariate linear regression model used (MLR-1) was based primarily on the variables used by Waldron et al. (2013).[5] This model was able to explain 74 per cent of the variance in domestic expenditures using 71 observations (see figure 2 for observed domestic expenditures versus predicted domestic expenditures).[6] Given the high correlation among some of the explanatory variables, as indicated by the variance inflation factor (VIF) test value, a second multivariate linear regression model (MLR-2) was developed based on variables that were not highly correlated among themselves (see figure 3 for a correlation matrix of all variables). Model quality was evaluated using the Akaike information criterion (AIC) and variance inflation factor tests (for multicollinearity).

5. Both these models (MLR-1 and MLR-2) included GDP squared, agricultural land, number of threatened bird species, population density, and a governance index created combining linearly the five government-related characteristics (government effectiveness, political stability, control of corruption, regulatory quality, and rule of law) using a principal component analysis methodology. In addition, the MLR-1 model included GDP and total land area (both in natural logarithms, Ln), terrestrial protected area, and average CO_2 reduction. The square of GDP was included due to the assumption that the potential positive relationship between GDP and expenditures dwindles as GDP increases.

6. The main difference between these two models is related to the high correlation among some of the potential explanatory variables. For example, GDP is highly correlated with land area, and number of threatened bird species is highly correlated with number of threatened mammal species (see figure 3). This multicollinearity affects the estimation of coefficients but does necessarily not reduce the predictive power or reliability of the model as a whole. In order to minimize the correlation among variables (see VIF tests in table 4), in addition to the shared covariates, MLR-2 included total land area and CO_2 emissions. Number of threatened mammal species was not included in either of the MLR models due to the high correlation with number of threatened bird species.

7. Domestic expenditures, financial needs, and in MLR-1 GDP and total land area variables were converted into logarithms to obtain normality and a better fit of the model. Columns 2 and 3 in table 4 shows the coefficients estimated by the two MLR models.

8. Both MLR models were similarly able to explain variance of domestic expenditures (R-squared 74 per cent for MLR-1 and 71 per cent for MLR-2). The coefficients for land area, agricultural area, number of threatened bird species, and governance (and in MLR-1 also GDP) were statistically significant to explain variability in domestic expenditures. A marginal increase in total land area, agricultural land, number of threatened bird species, and governance index was associated with higher domestic expenditures. In contrast, we found that a marginal increase in GDP and terrestrial protected areas was associated with lower domestic expenditures.

9. In step 2, domestic expenditures were predicted for non-reporting countries which had characteristics available for the model, using the linear models created in step 1, and reported domestic expenditures values are maintained for reporting countries. After obtaining a prediction for the logarithm

[5] Waldron A. et al. (2013). Targeting global conservation funding to limit immediate biodiversity declines. *Proceedings of the National Academy of Sciences*, 110(29), 12144-12148 (https://ww.pnas.org/content/110/29/12144).

[6] Not all 79 observations could be used, as country characteristics required for the model were not available for all countries.

of domestic expenditures, the predicted domestic expenditure is obtained by exponentiating the logarithm value.

10. In step 3, using values for domestic expenditures ($\widehat{Expenditures_i}$, predicted or reported), we used a second linear regression to estimate the relationship between financial needs reported and domestic expenditures:

$$\text{Ln}(Financial\ Needs_i) = \beta_0 + \beta_1 * \text{Ln}(\widehat{Domestic\ expenditures_i}) + \alpha * Controls + \varepsilon_i \quad (2)$$

11. In step 3, model 1 regressed financial needs on domestic expenditures (predicted or reported) only, while model 2 instead used not only domestic expenditures but also controlled for terrestrial protected areas, number of threatened mammal species, and oil rents, which were not used in the first regression. Both models are able to explain a similar percentage of the variance (72 per cent). Table 5 presents the coefficients for both models.

12. In step 4, financial needs were predicted for non-reporting countries which had data available for all the characteristics needed for the model, using the coefficients found in step 3.

13. Because of the high correlation among country characteristics (see figure 3), we also employed a principal component analysis (PCA) methodology (in steps 1 and 2), which allowed us to use a greater number of country characteristics to predict expenditures than did the MLR models.[7] The PCA model converted the set of all country characteristics into a set of coefficients of an equal number of linearly uncorrelated variables called principal components. The first estimated principal component (PC_1) had the largest proportion of variance from the variability in the country characteristics data, and each succeeding component in turn had the next highest variance. This analysis generated each principal component as a linear combination of all the terms in the model.

14. The principal components coefficients were then used to predict domestic expenditures in steps 1 and 2. The subsequent steps follow the same general process as the MLR models.

15. Table 6 shows the contribution of each principal component (PC) to the total variance. Principal component 1 (PC_1) explained 25 per cent of the total variance and principal component 2 (PC_2) explained 22 per cent of the variance. Each subsequent principal component explained less variance than the previous one. If the eigen value of a principal component was less than one, the contribution of that principal component was not considered to be substantial for the analysis. Based on the distribution of explained variance, the first six principal components explained 86 per cent of the variance.

16. The variance for principal component 1 (PC_1), which explained most of the variance (25 per cent), came mainly from economic activity and total land area, in the same direction. The variance for principal component 2 (PC_2) came mainly from governments' actions, also both in the same direction. The variance for principal component 3 (PC_3) was mainly due to CO_2 emissions. The variance for principal component 4 (PC_4) came from oil rents and agricultural land area, in opposite directions. The variance from principal component 5 (PC_5) was due to population density and number of threatened species, in the same direction. Finally, the variance for principal component 6 (PC_6), which explained only 7 per cent of the variance for all variables, originated mainly from population density and terrestrial protected areas, in opposite directions. Table 7 shows the coefficients estimated for each principal component based on each of the country characteristics.

[7] Hotelling, H. (1933). Analysis of a complex of statistical variables into principal components. *Journal of Educational*
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17. After estimating all the factors for each observation, we modelled a multivariate linear regression to estimate domestic expenditures using the principal components factors as explanatory variables:

$$Domestic\ expenditures_i = \alpha_0 + \alpha_1\ PC1_i + \alpha_2\, PC2_i\ + \cdots + PC14_i + \varepsilon_i \qquad (3)$$

where *i* is for all countries with observations available for all variables. See table 8 for the output from the multivariate linear regression based on the PCA.

18. In step 2, domestic expenditures for non-reporting countries were predicted using the coefficients estimated from the linear regression estimated between reported domestic expenditures and the principal components predictors above.

19. In step 3, a linear regression was estimated between the logarithm of financial needs reported and the logarithm of predicted domestic expenditures estimated in step 2. Table 9 presents the coefficients found for this linear regression. Similarly to MLR-2, this model was able to explain 70 per cent of the variance of financial needs with 39 observations.

20. In step 4, financial needs were predicted for all non-reporting countries which have all characteristics available using the coefficients found in step 3.

21. All the estimations above are considered evaluations of current needs and do not represent future needs. Predicted current needs were estimated using past average domestic expenditures and financial needs, and the available past country characteristics values.

22. To estimate future needs, in step 5, three scenarios were proposed inspired by the Shared Socioeconomic Pathways (SSP1 and SSP5) which were also adapted for use for the WWF Global Futures report (business as usual (BAU), sustainable pathway (SP), and global conservation (GC)). For each of these scenarios, GDP, CO_2 emissions, and agricultural land were projected to the year 2030. Table 10 provides a summary of the assumptions for each scenario.

23. After projecting GDP, CO_2 emissions, and agricultural land for the year 2030, values were used in the two linear regressions and the PCA model estimated in step 1 to project future domestic expenditures. With these new projected values of domestic expenditures, the linear regression estimated in step 3 was used for each model to project the financial needs for the year 2030.

Annex II

TABLES

Table 1. List of country characteristics included in the models

Country characteristic	Year	Unit
Domestic expenditures	Avg. 2006-2015	US$
Financial needs	Avg. 2014-2020	US$
Gross domestic product (GDP)	2010	US$
Total land area	2018	Square km
Agricultural land	2018	Percentage of total area
Terrestrial protected areas	Avg. 2006-2018	Square km
CO_2 emissions	Avg. 2006-2018	Kg per PPP $ of GDP
Number of threatened mammal species	2018	Sum of species
Number of threatened bird species	2018	Sum of species
Price index	2011	Index
Population density	Avg. 2006-2018	Population/land area
Oil rents	Avg. 2006-2018	Percentage of GDP
Government effectiveness	Avg. 2006-2018	Index
Political stability	Avg. 2006-2018	Index
Control of corruption	Avg. 2006-2018	Index
Regulatory quality	Avg. 2006-2018	Index
Rule of law	Avg. 2006-2018	Index

Note: Domestic expenditures and financial needs were obtained from the financial reporting framework of the Convention on Biological Diversity. All the other country characteristics were collected from World Bank databases.[8] PPP=purchasing power parity.

[8] https://data.worldbank.org/, https://www.worldbank.org/en/programs/icp#5, https://info.worldbank.org/governance/wgi/Home.

Table 2. Data description, source and link for analysis per country

Country characteristic	Description	Source	Link
Gross domestic product (GDP)	GDP at purchaser's prices is the sum of gross value added by all resident producers in the economy plus any product taxes and minus any subsidies not included in the value of the products. It is calculated without making deductions for depreciation of fabricated assets or for depletion and degradation of natural resources. Data are in constant 2010 U.S. dollars. Dollar figures for GDP are converted from domestic currencies using 2010 official exchange rates. For a few countries where the official exchange rate does not reflect the rate effectively applied to actual foreign exchange transactions, an alternative conversion factor is used.	World Bank national accounts data, and OECD National Accounts data files.	https://data.worldbank.org/indicator/NY.GDP.MKTP.KD
Total land area	Land area is a country's total area, excluding area under inland water bodies, national claims to continental shelf, and exclusive economic zones. In most cases the definition of inland water bodies includes major rivers and lakes.	Food and Agriculture Organization, electronic files and website.	https://data.worldbank.org/indicator/AG.LND.TOTL.K2
Agricultural land	Agricultural land refers to the share of land area that is arable, under permanent crops, and under permanent pastures. Arable land includes land defined by the FAO as land under temporary crops (double-cropped areas are counted once), temporary meadows for mowing or for pasture, land under market or kitchen gardens, and land temporarily fallow. Land abandoned as a result of shifting cultivation is excluded. Land under permanent crops is land cultivated with crops that occupy the land for long periods and need not be replanted after each harvest, such as cocoa, coffee, and rubber. This category includes land under flowering shrubs, fruit trees, nut trees, and vines, but excludes land under trees grown for wood or timber. Permanent pasture is land used for five or more years for forage, including natural and cultivated crops.	Food and Agriculture Organization, electronic files and website.	https://data.worldbank.org/indicator/AG.LND.AGRI.ZS

Country characteristic	Description	Source	Link
Terrestrial protected areas	Terrestrial protected areas are totally or partially protected areas of at least 1,000 hectares that are designated by national authorities as scientific reserves with limited public access, national parks, natural monuments, nature reserves or wildlife sanctuaries, protected landscapes, and areas managed mainly for sustainable use. Marine areas, unclassified areas, littoral (intertidal) areas, and sites protected under local or provincial law are excluded.	World Database on Protected Areas (WDPA) where the compilation and management is carried out by United Nations Environment Programme World Conservation Monitoring Centre (UNEP-WCMC) in collaboration with governments, non-governmental organizations, academia and industry. The data is available online through the Protected Planet website (protectedplanet.net).	https://data.worldbank.org/indicator/ER.LND.PTLD.ZS
CO_2 emissions	Carbon dioxide emissions are those stemming from the burning of fossil fuels and the manufacture of cement. They include carbon dioxide produced during consumption of solid, liquid, and gas fuels and gas flaring.	Carbon Dioxide Information Analysis Center, Environmental Sciences Division, Oak Ridge National Laboratory, Tennessee, United States.	https://data.worldbank.org/indicator/EN.ATM.CO2E.PP.GD
Number of threatened mammal species	Mammal species are mammals excluding whales and porpoises. Threatened species are the number of species classified by the IUCN as endangered, vulnerable, rare, indeterminate, out of danger, or insufficiently known.	United Nations Environment Programme and the World Conservation Monitoring Centre, and International Union for Conservation of Nature, Red List of Threatened Species.	https://data.worldbank.org/indicator/EN.MAM.THRD.NO
Number of threatened bird species	Birds are listed for countries included within their breeding or wintering ranges. Threatened species are the number of species classified by the IUCN as endangered, vulnerable, rare, indeterminate, out of danger, or insufficiently known.	United Nations Environment Programme and the World Conservation Monitoring Centre, and International Union for Conservation of Nature, Red List of Threatened Species.	https://data.worldbank.org/indicator/EN.BIR.THRD.NO
Price index	The set of 2011 ICP results contains data for 199 countries that participated in the ICP 2011 from these regions or economic groupings: Africa, Asia and the Pacific,	International Comparison Program (ICP) 2011	https://www.worldbank.org/en/programs/icp#5

Country characteristic	Description	Source	Link
	the Caribbean, the Commonwealth of Independent States (CIS), Eurostat-OECD, Latin America, Western Asia, singleton economies, and the Pacific Islands. Also included are estimates for non-benchmark economies. The data covers 26 expenditures categories for goods and services, and several indicators including PPPs, expenditure shares of GDP, total and per capita expenditures in US dollar both in exchange rate terms and PPP terms, and price level indices.		
Population density	Population density is midyear population divided by land area in square kilometers. Population is based on the de facto definition of population, which counts all residents regardless of legal status or citizenship--except for refugees not permanently settled in the country of asylum, who are generally considered part of the population of their country of origin. Land area is a country's total area, excluding area under inland water bodies, national claims to continental shelf, and exclusive economic zones. In most cases the definition of inland water bodies includes major rivers and lakes.	Food and Agriculture Organization and World Bank population estimates.	https://data.worldbank.org/indicator/EN.POP.DNST
Oil rents	Oil rents are the difference between the value of crude oil production at world prices and total costs of production.	Estimates based on sources and methods described in "The Changing Wealth of Nations: Measuring Sustainable Development in the New Millennium" (World Bank, 2011).	https://data.worldbank.org/indicator/NY.GDP.PETR.RT.ZS
Government effectiveness	Government effectiveness captures perceptions of the quality of public services, the quality of the civil service and the degree of its independence from political pressures, the quality of policy formulation and implementation, and the credibility of the government's commitment to such policies.	https://info.worldbank.org/governance/wgi/Home/downLoadFile?fileName=ge.pdf	https://info.worldbank.org/governance/wgi/Home
Political stability	Political Stability and Absence of Violence/Terrorism measures perceptions of the likelihood of political instability and/or politically motivated violence, including terrorism.	https://info.worldbank.org/governance/wgi/Home/downLoadFile?fileName=pv.pdf	https://info.worldbank.org/governance/wgi/Home

Country characteristic	Description	Source	Link
Control of corruption	Control of corruption captures perceptions of the extent to which public power is exercised for private gain, including both petty and grand forms of corruption, as well as "capture" of the state by elites and private interests.	https://info.worldbank.org/governance/wgi/Home/downLoadFile?fileName=cc.pdf	https://info.worldbank.org/governance/wgi/Home
Regulatory quality	Regulatory quality captures perceptions of the ability of the government to formulate and implement sound policies and regulations that permit and promote private sector development.	https://info.worldbank.org/governance/wgi/Home/downLoadFile?fileName=rq.pdf	https://info.worldbank.org/governance/wgi/Home
Rule of law	Rule of law captures perceptions of the extent to which agents have confidence in and abide by the rules of society, and in particular the quality of contract enforcement, property rights, the police, and the courts, as well as the likelihood of crime and violence.	https://info.worldbank.org/governance/wgi/Home/downLoadFile?fileName=rl.pdf	https://info.worldbank.org/governance/wgi/Home

Table 3. Summary statistics for data used in the models

Country data	Obs	Sum	Mean	St. Dev.	Max	Min
Domestic expenditures (US$ million)	73	58,045	795.14	2,233	17,000	0.04
Financial needs (US$ million)	39	18,653	478	1,310	8,000	0.01
Gross domestic product (GDP) (US$ billion 2010)	203	69,979	345	1,368	16,000	0.04
Total land area (Sq. km)	210	126,482,938	602,300	1,759,384	16,000,000	2
Agricultural land (% of total land)	206		37.93	22.33	82.97	0.51
Terrestrial protected areas (% total land)	207		16.85	12.30	54.41	0.10
CO_2 emissions (Kg per PPP $ of GDP)	191		0.27	0.20	1.32	0.02
Number of threatened mammal species (N)	210	3,377	16	22	191	-
Number of threatened bird species (N)	210	4,596	22	25	175	-
Price index (base = 100)	182		82.11	37.44	209.63	36.36
Population density (Pop/land area)	210		418	1,928	18,861	-
Oil rents (% of GDP)	195		3.89	9.34	48.99	-
Government effectiveness (Index)	200		(0.02)	0.98	2.22	(2.30)
Political stability (Index)	202		(0.01)	0.98	1.87	(2.82)
Control of corruption (Index)	200		(0.02)	0.98	2.25	(1.71)

Regulatory quality (Index)	200	(0.01)	0.98	2.18	(2.36)
Rule of law (Index)	202	(0.00)	0.98	2.05	(2.39)

Note: Based on data on domestic expenditures and financial needs obtained from the financial reporting framework of the Convention on Biological Diversity, and other country characteristics from World Bank databases.[9]

[9] https://data.worldbank.org/, https://www.worldbank.org/en/programs/icp#5, https://info.worldbank.org/governance/wgi/Home.

Table 4. Multivariate linear regressions used to estimate past domestic expenditure

Dependent variable: Ln(Domestic expenditures)		
Explanatory variables	MLR-1 coefficients	MLR-2 coefficients
Ln(GDP)	-2.712*	
GDP squared	0.0624**	0.00474
Ln(Total land area)	0.4151*	
Total land area		0.607***
Agricultural land	0.0214**	0.0200**
Terrestrial protected areas	-0.0081	
CO_2 emissions		0.0768
Average CO_2 reduction	-0.0744	
Number of threatened bird species	0.0143**	0.0153**
Population density	-0.0004	0.000766
Governance index	0.686***	0.659***
Constant	40.14**	6.181***
White-Huber Standard Errors (heteroscedasticity robust)	Yes	Yes
Akaike information criterion (AIC)	268.01	268.72
Variance inflation factor (VIF)	375.35	2.52
Observations	71	71
R-squared	0.74	0.71

Note: *** p-value<0.01, ** p-value<0.05, * p-value<0.1. VIF is accepted anywhere below 10.

Table 5. Coefficients for linear regressions used to estimate past financial needs (step 3 after using MLR-1 and MLR-2 for steps 1 and 2)

Dependent variable: Ln(Financial needs)		
Explanatory variables	Step 3 Model 1 coefficients	Step 3 Model 2 coefficients
Ln(Predicted past domestic expenditures)	0.977***	0.860***
Terrestrial protected areas		0.00667
Number of threatened mammal species		0.0110
Oil rents		0.0859*
Constant	0.862	2.12
Observations	39	39
R-squared	0.72	0.72

Note: *** p-value<0.01, ** p-value<0.05, * p-value<0.1.
Step 3 Model 1 uses past domestic expenditures predicted using MLR-1, or reported expenditures where available; Step 3 Model 2 uses past domestic expenditures predicted using

MLR-2, or reported expenditures where available.

Table 6. Variance explained by each principal component (PC)

Principal components	Eigen value	Proportion of variance	Cumulative proportion of variance
PC1	1.87	0.25	0.25
PC2	1.77	0.22	0.47
PC3	1.43	0.15	0.62
PC4	1.11	0.09	0.71
PC5	1.06	0.08	0.79
PC6	1.02	0.07	0.86
PC7	0.86	0.05	0.91
PC8	0.68	0.03	0.95
PC9	0.52	0.02	0.97
PC10	0.46	0.02	0.98
PC11	0.42	0.01	0.99
PC12	0.31	0.01	1.00
PC13	0.05	0.00	1.00
PC14	0.03	0.00	1.00

Table 7. Coefficients for the first six principal components

	PC1	PC2	PC3	PC4	PC5	PC6
Country characteristic	Principal component coefficients					
Ln(GDP)	**0.50**	(0.10)	0.05	0.06	0.14	0.18
GDP squared	**0.50**	(0.11)	0.05	0.06	0.14	0.18
Total land area	**0.37**	0.28	0.07	(0.05)	0.27	(0.09)
Government effectiveness	0.19	**(0.49)**	0.03	(0.06)	(0.02)	0.07
Political stability	(0.03)	**(0.48)**	0.01	(0.12)	(0.09)	(0.21)
Price index	0.16	**(0.44)**	0.06	(0.03)	0.29	0.07
CO_2 emissions	0.18	(0.01)	**(0.62)**	(0.09)	(0.23)	(0.15)
Ln(GDP)*CO_2 emissions	0.24	(0.02)	**(0.60)**	(0.08)	(0.21)	(0.13)
Oil rents	0.06	0.13	(0.19)	**0.70**	0.31	(0.06)
Agricultural land	0.04	0.21	(0.06)	**(0.63)**	0.19	0.35
Population density	(0.04)	(0.20)	0.08	0.25	**(0.53)**	**0.53**
Number of threatened mammal species	0.29	0.25	0.28	0.01	**(0.39)**	(0.12)
Number of threatened bird species	0.35	0.19	0.26	(0.00)	**(0.37)**	(0.16)
Terrestrial protected areas	0.03	(0.20)	0.23	(0.11)	0.00	**(0.62)**

Table 8. Results of linear regression for domestic expenditures using principal components as explanatory variables

Dependent variable: Domestic expenditures	
Explanatory variables	Coefficients (alphas)
Principal component 1	1.12***
Principal component 2	-0.16
Principal component 3	0.24**
Principal component 4	-0.49**
Principal component 5	0.43
Principal component 6	0.17
Constant	17.30***
Observations	68
R-squared	0.65

Note: *** p-value<0.01, ** p-value<0.05, * p-value<0.1. Fourteen principal components were used in the model; only the first six are shown here.

Table 9. Coefficients for linear regression to estimate financial needs (step 3 for model using principal component analysis for steps 1 and 2)

Dependent variable: Ln(Financial Needs)	
Explanatory variables	Coefficients
Ln(Predicted domestic expenditures)	0.94***
Constant	1.3860
Observations	39
R-squared	0.70

Note: *** p-value<0.01, ** p-value<0.05, * p-value<0.1.

Table 10. Assumptions for scenarios to project financial needs to the year 2030

Country characteristic	Scenario		
	Business as Usual (BAU)	**Sustainable Pathway (SP)**	**Global Conservation (GC)**
Gross domestic product (GDP)	GDP increases at the average 2008-2018 growth rate for each country until 2030	GDP increases at the average 2008-2018 growth rate for each country until 2030	GDP grows at half the average 2008-2018 rate for each country until 2030
CO_2 emissions	CO_2 emissions increase at the average 2008-2018 growth rate for each country until 2030	CO_2 emissions are kept constant at 2018 levels for each country until 2030	CO_2 emissions are reduced by 30% from 2018 levels for each country by 2030
Agricultural land as percentage of total land	Agricultural land increases at the average 2008-2018 growth rate for each country until 2030	Agricultural land is reduced by 10% from 2018 levels for each country by 2030	Agricultural land is reduced by 30% from 2018 levels for each country by 2030

Annex III

FIGURES

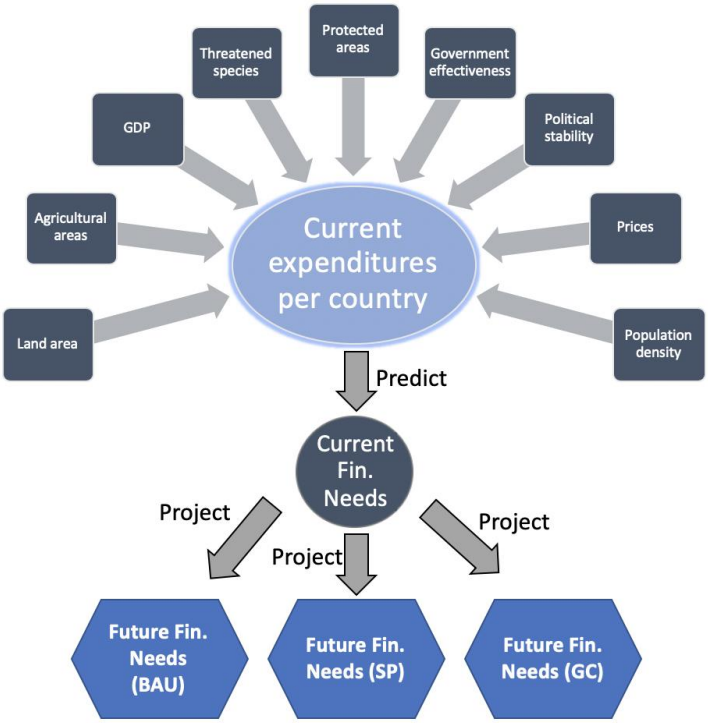

Figure 1. Representation of the modelling approach based on the 6 steps

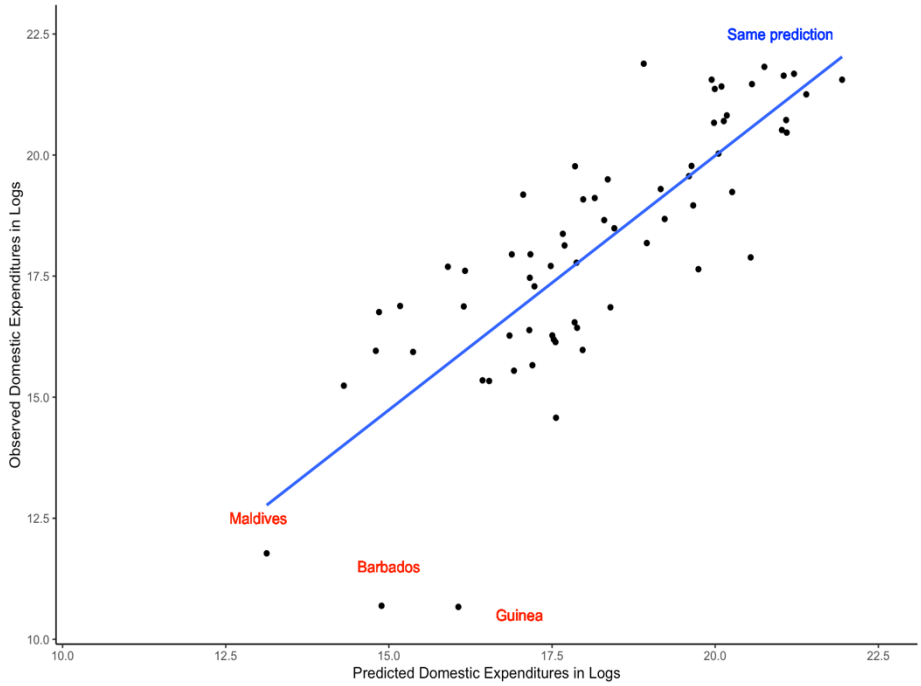

Figure 2. Observed domestic expenditures versus domestic expenditures predicted using the multivariate linear regression

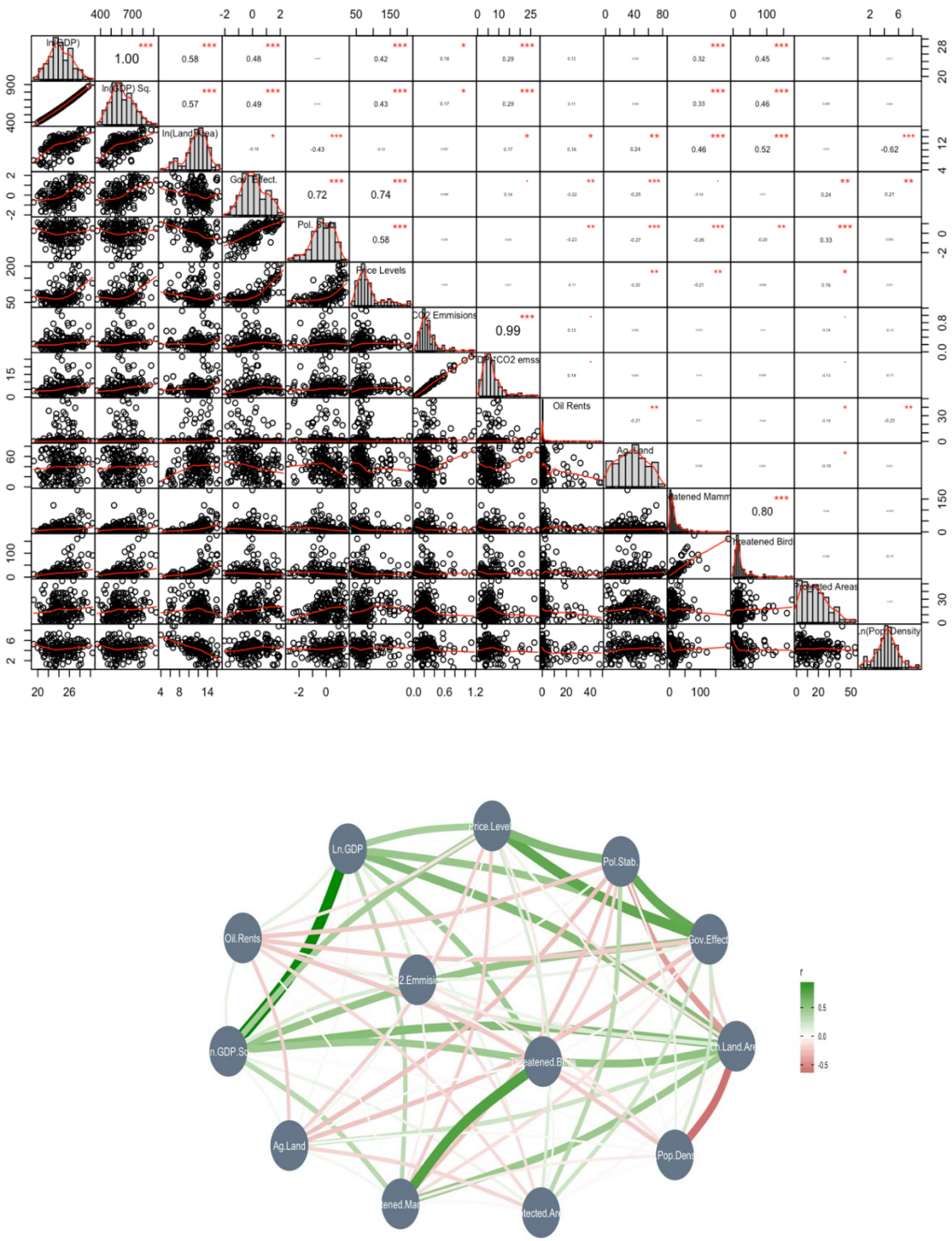

Figure 3. Correlation matrix of country characteristics used in the models (top), and graphical representation of the correlations among the variables (bottom)