**SUPPLEMENTARY TEXT S1**

**Supplementary text S1**

**List of commodity groups (bold lettering) and their components.**

Source: researchtrade.Earth of Chatham House 2018; <https://resourcetrade.earth/>. Note that each subgroup is further divided in other groups (see the above website for details).

**Agricultural Products**

* Cereals, dairy, eggs and honey
* Fish and aquatic resources
* Horticulture
* Live animals
* Meat
* Oil seeds
* Other agricultural products
* Pulses
* Roots and tubers
* Rubber and gums
* Stimulants, tobacco, spices

**Fertilizers**

* Mixed fertilizers
* Nitrogenous fertilizers
* Organic Fertilizers
* Phosphatic fertilizers
* Potassic fertilizers

**Forestry products**

* Board and plywood
* Fuel wood and charcoal
* Lumber and sawn wood
* Wood pulp, chips and waste products

**Fossil fuels**

* Coal
* Gas
* Oil
* Other fossil fuel products

**Metal and minerals**

* Industrial minerals
* Iron and steel
* Metals not specified
* Nonferrous metals
* Precious metals
* Specialty metals

**Pearls and gemstones**

* Diamonds
* Pearls
* Precious and semiprecious stones

**Global Food Security Index (FSI)**

The Global Food Security Index, developed by the Economist Intelligence Unit and sponsored by Corteva Agriscience, the Agriculture Division of DowDuPont, considers three core pillars of food security— Affordability, Availability, and Quality & Safety—across 113 countries. The index is a dynamic, quantitative, and qualitative benchmarking model, constructed from 28 unique indicators, that provides an objective framework for evaluating food security across a wide range of countries worldwide. By creating a standardized metric around food security, the FSI empowers users to explore issues surrounding food security—including the rankings and results—and draw conclusions for policy, business operations and future research.

The model, in addition to assessing food affordability, availability and quality, includes a category on natural resources and resilience. The Natural Resources & Resilience category measures a country’s exposure to the impacts of a changing climate; its susceptibility to natural resource risks; and how a country is adapting to these risks. When applied, it acts as an adjustment factor on countries’ food security scores.

Food security is defined as the state in which people always have physical, social and economic access to sufficient and nutritious food that meets their dietary needs for a healthy and active life. This framework is based on the internationally accepted definition established at the 1996 World Food Summit (<http://www.fao.org/WFS/>).

The FSI (2018) is available at https://foodsecurityindex.eiu.com/.

**Human Development Index (HDI) from the UN Development Program (**<http://hdr.undp.org/en/content/human-development-index-hdi>**;** http://hdr.undp.org/en/countries**)**

The Human Development Index (HDI) is a summary measure of average achievement in key dimensions of human development: a long and healthy life, being knowledgeable and having a decent standard of living. The HDI is the geometric mean of normalized indices for each of the three dimensions.

The health dimension is assessed by life expectancy at birth, the education dimension is measured by mean of years of schooling for adults aged 25 years and older, and expected years of schooling for children of school entering age. The standard of living dimension is measured by gross national income per capita. The HDI uses the logarithm of income to reflect the diminishing importance of income with increasing GNI. The scores for the three HDI dimension indices are then aggregated into a composite index using the geometric mean.

**Modelling the current and future (2050 & 2100) risk of extinction**

***Land use areas under different scenarios***

We briefly describe the method to obtain the projected number of primate species threatened with extinction in each country (*for details see Chaudhary & Mooers, 2018*). We first downloaded the global gridded maps for current (2016) and two future points in time (2050 and 2100) from the land use harmonization (LUH2) dataset website (*Hurtt et al. 2019;* [*http://luh.umd.edu/data.shtml*](http://luh.umd.edu/data.shtml)*)* that provide the fraction of each of 12 land use types for each (0.25° × 0.25° resolution) cell under six representative concentration pathway (RCP) and shared socio-economic pathway (SSP) combination scenarios. We calculated the area of each land use type in each grid cell by multiplying the fractions with the total cell area. Finally, for each point in time (2016, 2050, and 2100) and scenario, we calculated the area (km2) of each of the 12 land classes in each of the 804 terrestrial ecoregions by overlaying the area maps with ecoregion boundaries.

The 12 land use classes include 2 classes of primary undisturbed natural vegetation (forests, non-forests) and 10 human land uses (see Table 2). The 10 human land uses comprise two secondary (regenerating) vegetation land use classes (forest, non-forest), two grazing (pasture, rangeland), one urban, and five cropland (C3 annual, C3 permanent, C4 annual, C4 permanent, and C3 nitrogen fixing crops) uses. C3 and C4 correspond to temperate (cool) season crops and tropical (warm) season crops, respectively.

The six scenarios are RCP 2.6 SSP-1, RCP4.5 SSP-2, RCP 7.0 SSP-3, RCP 3.4 SSP-4, RCP 6.0 SSP-4, and RCP 8.5 SSP-5. Each RCP describes an alternative future climate scenario with a specific radiative forcing (global warming) target (e.g., 2.6, 3.4, 4.5, 6.0, or 8.5 W/m2) to be reached by the end of the century through the adoption of mitigation efforts. Radiative forcing under each scenario is often considered as a proxy for the expected amount of atmospheric warming. The RCP8.5 scenario represents highest global warming, whereas the lower RCPs signify lesser predicted warming.

Five SSPs have been developed (SSP-1 to SSP-5) providing different trajectories of future socio-economic development and including possible trends in population, income, agriculture production, food and feed demand, and global trade, as well as land use (Popp et al. 2017). The SSP-1 (sustainability—taking the green road) scenario represents a world shifting towards a more sustainable path, characterized by healthy diets, low waste, reduced meat consumption, increasing crop yields, reduced tropical deforestation, which, together collectively “respects the environmental boundaries” (*Van Vuuren et al. 2017*). The SSP-2 is a business-as-usual (middle of the road scenario) scenario characterized by development along historical patterns such that meat and food consumption converge slowly towards high levels, trade is largely regionalized, and crop yields in low-income regions catch up with high-income nations, but the land use change is incompletely regulated, with continued tropical deforestation (although at declining rates) (*Fricko et al. 2017*). The SSP-3 (regional rivalry—a rocky road) scenario represents a world with resurgent nationalism, increased focus on domestic issues, almost no land use change regulations, stagnant crop yields due to limited technology transfer to developing countries, and prevalence of unhealthy diets with high shares of animal-based products and high food waste (*Fujimori et al. 2017*). In SSP-4 (inequality—a road divided), the disparities increase both across and within countries such that high-income nations have strong land use change regulations and high crop yields, while the low-income nations remain relatively unproductive with continued clearing of natural vegetation. Rich elites have high consumption levels, while others have low consumption levels (*Calvin et al. 2017*). The SSP-5 (fossil fueled development—taking the highway) scenario is characterized by rapid technological progress, increasing crop yields, global trade, and competitive markets, where unhealthy diets and high food waste prevail. There are medium levels of land use change regulations in place, meaning that tropical deforestation continues, although its rate declines over time (*Kriegler et al. 2017*).

***Countryside species-area relationship model***

For each year and scenario, we fed the estimated areas of each of 12 land use types into the countryside species–area relationship (SAR; *Chaudhary & Brooks, 2017*) to estimate the number of species projected to go extinct ($Slost) $as a result of total human land use within a terrestrial ecoregion *j* as follows:

|  |  |
| --- | --- |
| $$flost\_{j}=1- \left(\frac{Anew\_{j}+ \sum\_{i=1 }^{10}h\_{i,j}∙A\_{i,j}}{Aorg\_{j}}\right)^{z\_{j}}$$ | (1) |

Here, $flost\_{j}$ is the fraction of total number primate species projected to go extinct in ecoregion *j*, $Aorg\_{j}$ is the total ecoregion area, $Anew\_{j}$ is the remaining natural habitat area in the ecoregion under a particular scenario (primary vegetation forests + primary vegetation non-forests) obtained from LUH2 dataset maps, $h\_{i,j}$ is the affinity of primates to the land use type *i* in the ecoregion *j* (which is based on what fraction of the total primate species in an ecoregion can utilize that human land use type), $ A\_{i,j} $ is the area of a particular human land use type *i* (total of 10) obtained from LUH2 dataset maps, and $z\_{j}$ (*z*-value) is the SAR exponent. Following Chaudhary and Brooks (2017), we obtained the *z*-values ($z\_{j}$) from Drakare et al. (2006), and the taxon affinities ($h\_{g,i,j}$) to different land use types from the habitat classification scheme database of the IUCN (*IUCN, 2015*). Validation exercises have shown that countryside SAR performs well in predicting the observed fraction of species listed as threatened with extinction on the IUCN Red List (*IUCN, 2019*) in a region (see *Chaudhary & Brooks, 2017; Chaudhary & Mooers, 2018*).

The projected fraction of species loss ($flost\_{j}$) per ecoregion is then allocated to the 10 different land use types *i* according to their area share $A\_{i,j}$ in the ecoregion *j* and the affinity ($h\_{i, j}) $ of primates to them. The allocation factor $a\_{i,j}$ for each of the 10 human land use types *i* (such that for each ecoregion *j*, $\sum\_{i=1}^{10}a\_{i}$ = 1) is as follows (*Chaudhary & Mooers, 2018*):

|  |  |
| --- | --- |
| $$a\_{g,i, j}= \frac{A\_{i, j}∙(1- h\_{g, i, j})}{\sum\_{i=1}^{10}A\_{i, j}∙(1- h\_{g, i, j})}$$ |  (2) |

The contribution of different land use types towards the total fractional loss in each ecoregion is then given by the following:

|  |  |
| --- | --- |
| $$flost\_{i,j}=flost\_{j}×a\_{g,i, j}$$ |  (3) |

Equation (3) thus provides the projected fraction of primate species loss caused by a particular land use in a particular ecoregion. We then calculate the fraction of primates threatened with extinction for each of the 61 countries and the contribution of different land use types to the total fractional loss based on the share of ecoregion and different land use types within a country (*Chaudhary & Mooers, 2018*).See supplementary Table S1 for projected fraction of primates threatened with extinction per country under current and all six future scenarios and supplementary Table S2 for contribution of each of 10 human land use types to total species threatened with extinction.

Given land use mix for a particular year (e.g. in 2016 or 2050 or 2100) in a region, the species-area relationship (SAR) provides the predicted number of species 'committed to extinction' (i.e. threatened with extinction) which is equal to the number of species who have already gone extinct plus extinction debt (i.e. number of species whose population is declining and its just a matter of time before they will go extinct because there isn't enough habitat available for sustaining their population). The SAR model predicts the equilibrium species richness (i.e. number of species that will remain if the habitat loss ceases at current levels). The SAR cannot predict the timing of extinctions, the sequence of extinctions, or how many species have already gone extinct (Chaudhary & Brooks, 2017). Subtracting the SAR predicted estimates for two years (e.g. 2016 and 2050) will indicate the increase in the number of species threatened with extinction but cannot indicate how many of these species have already succumbed to extinction. For this reason, the SAR estimates have a value because they can flag regions where a high number of extinctions are expected in near future and thus there is a 'window of conservation opportunity' (see Wearn et al. 2012). Also, note that SARs only model the extinctions due to land use change (habitat loss) and do not model the extinctions due to climate change, hunting, capture for the pet trade, or infectious disease.

**References**

Chaudhary, A. and Brooks, T.M., 2017. National consumption and global trade impacts on biodiversity. *World Development*. <https://doi.org/10.1016/j.worlddev.2017.10.012>

IUCN, 2019. International Union for Conservation of Nature. The IUCN Red List of Threatened Species. Version 2018-2. <http://www.iucnredlist.org>

IUCN (2015). International union for conservation of nature. Habitat Classification Scheme Version, *3*, 1 <http://www.iucnredlist.org/technical-documents/classification-schemes/habitats-classification-scheme-ver3>

Chaudhary, A. and Mooers, A., 2018. Terrestrial Vertebrate Biodiversity Loss under Future Global Land Use Change Scenarios. *Sustainability*, *10*(8), 2764.

Hurtt, G.; Chini, L.; Sahajpal, R.; Frolking, S.; Calvin, K.; Fujimori, S.; Klein Goldewijk, K.; Hasegawa, T.; Havlik, P.; Heinemann, A.; et al. Harmonization of global land-use change and management for the period 850–2100. *Geosci. Model Dev*. (in preparation). Available online: <http://luh.umd.edu/data.shtml> (accessed on 2 December 2018).

Drakare, S.; Lennon, J.J.; Hillebrand, H. The imprint of the geographical, evolutionary and ecological context on species—Area relationships. *Ecol. Lett.* 2006, 9, 215–227.

Popp, A.; Calvin, K.; Fujimori, S.; Havlik, P.; Humpenöder, F.; Stehfest, E.; Bodirsky, B.L.; Dietrich, J.P.; Doelmann, J.C.; Gusti, M.; et al. Land-use futures in the shared socio-economic pathways. *Glob. Environ. Chang*. **2017,** 42, 331–345.

Van Vuuren, D.P., Stehfest, E., Gernaat, D.E., Doelman, J.C., Van den Berg, M., Harmsen, M., de Boer, H.S., Bouwman, L.F., Daioglou, V., Edelenbosch, O.Y. and Girod, B. Energy, land-use and greenhouse gas emissions trajectories under a green growth paradigm. *Glob. Environ. Chang.* **2017,** 42, 237-250.

Fricko, O.; Havlik, P.; Rogelj, J.; Klimont, Z.; Gusti, M.; Johnson, N.; Kolp, P.; Strubegger, M.; Valin, H.; Amann, M.; et al. The marker quantification of the Shared Socioeconomic Pathway 2: A middle-of-the-road scenario for the 21st century. *Glob. Environ. Chang*. **2017,** 42, 251–267.

Fujimori, S.; Hasegawa, T.; Masui, T.; Takahashi, K.; Herran, D.S.; Dai, H.; Hijioka, Y.; Kainuma, M. SSP3: AIM implementation of shared socioeconomic pathways. *Glob. Environ. Chang*. **2017,** 42, 268–283.

Calvin, K.; Bond-Lamberty, B.; Clarke, L.; Edmonds, J.; Eom, J.; Hartin, C.; Kim, S.; Kyle, P.; Link, R.; Moss, R.; et al. The SSP4: A world of deepening inequality. *Glob. Environ. Chang*. **2017,** 42, 284–296.

Kriegler, E.; Bauer, N.; Popp, A.; Humpenöder, F.; Leimbach, M.; Strefler, J.; Baumstark, L.; Bodirsky, B.L.; Hilaire, J.; Klein, D.; Mouratiadou, I. Fossil-fueled development (SSP5): An energy and resource intensive scenario for the 21st century. *Glob. Environ. Chang*. **2017,** 42, 297–315.

Wearn, O.R., Reuman, D.C. and Ewers, R.M., 2012. Extinction debt and windows of conservation opportunity in the Brazilian Amazon. *Science*, *337*(6091), 228-232.