Appendix 1. Governing equations and parameters used to calculate production possibility frontiers (PPFs) in Figure 3, which provides a stylized representation of the tradeoffs between agricultural production and species richness at the national scale, and at local scales within 3 different ecological regions, in Mexico.

General species-area and agricultural production-area functions

The trade-off between the biodiversity or species richness \( (S) \) that can be sustained from land area in natural habitat \( (A_H) \) on the one hand, and the agricultural production \( (P) \) that can be derived from land area dedicated to crops \( (A_C) \) can be expressed mathematically as follows: The total land area \( (A_T) \) under consideration can be partitioned between habitat \( (A_H) \) and crop \( (A_C) \) production such that

\[
A_T = A_H + A_C. \tag{A1.1}
\]

Both species richness and agricultural production are a function of area such that

\[
S = \alpha A_H^z \tag{A1.2}
\]
\[
P = \beta A_C \tag{A1.3}
\]

where \( z \) is the slope of the log-log relationship between \( S \) and \( A_H \), \( \alpha \) is a constant (y-intercept) and \( \beta \) is the crop yield per unit area. The relationship between species richness \( (S) \) and agricultural production \( (P) \) can thus be written as:

\[
S = \alpha (1 - P/\beta)^z \tag{A1.4}
\]

Calculations of stylized PPFs for Figure 3

Figure 3 provides an example of an aggregated land area, in this case the country of Mexico, that is subdivided into three regions \( (i=1,2,3) \), each of which has different biophysical capacities to support agriculture and biodiversity. The full spatial extent of the aggregated region, \( A_T \), is set to unity; \( m_i \) is the fraction of total land area apportioned to the regional subdivision \( i \), and these values also sum to unity.

\[
m_1 + m_2 + m_3 = A_T = 1 \tag{A1.5}
\]

The regional-level coefficient \( \alpha_i \) is the y-intercept log-log species-area relationship for region \( i \), and influences the total number of species that can accumulate in a given area of land in that region; \( z_i \) is the slope of the log-log species-area relationship for region \( i \).
Crop area, $A_{Ci}$, for each region $i$ is the total land area less the area conserved as habitat for biodiversity $A_{Hi}$,

$$A_{Ci} = m_i A_{Hi}$$  \hfill (A1.6)

and total crop area for the aggregated regions, rearranged from (A1.1) is $A_{CT} = A_T - A_{HT}$.

Each region has a different capacity to produce food, determined by the coefficient, $\beta_i$. Total crop productivity at the aggregate national scale, $P_T$, can be written as

$$P_T = \beta_1 A_{C1} + \beta_2 A_{C2} + \beta_3 A_{C3}$$ \hfill (A1.7)

$$P_T = \sum \beta_i A_{Ci}$$

Each region has a different capacity for maintaining species diversity, determined by parameters $\alpha_i$ and $z_i$. The total number of species ($S_T$) that can accumulate in the nation if all land is conserved as habitat for biodiversity is the sum of each parcel:

$$S_T = \sum (m_i A_{Hi})^{z_i}$$ \hfill (A1.8)

Table A1.1: Parameters used to simulate three distinct ecological regions ($i=1,2,3$) and generate PPFs in Figure 3.

<table>
<thead>
<tr>
<th>Region $(i)$</th>
<th>Region label in Figure 3</th>
<th>$\alpha_i$</th>
<th>$z_i$</th>
<th>$\beta_i$</th>
<th>$m_i$</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>A</td>
<td>20</td>
<td>0.3</td>
<td>10</td>
<td>0.25</td>
</tr>
<tr>
<td>2</td>
<td>B</td>
<td>10</td>
<td>0.26</td>
<td>15</td>
<td>0.35</td>
</tr>
<tr>
<td>3</td>
<td>C</td>
<td>5</td>
<td>0.27</td>
<td>20</td>
<td>0.4</td>
</tr>
</tbody>
</table>

R-code to run the example shown in the paper can be found at [https://github.com/cavender/Trade-offs](https://github.com/cavender/Trade-offs).