

Global evidence of human well-being and biodiversity impacts of natural climate solutions

In the format provided by the
authors and unedited

Supplementary Materials for *Global evidence of human well-being and biodiversity impacts of natural climate solutions*

September 9, 2024

Contents

1	Background	2
2	Querying the scientific literature	2
2.1	Generating search queries and obtaining abstracts	2
2.2	Comparing English to non-English language data	3
3	Determining article relevance and NCS co-impacts	6
3.1	Distance-based filtering	6
3.2	Unsupervised learning to determine an abstract's NCS pathway and impact category	7
3.2.1	Fitting the BERTopic model	7
3.2.2	Generating topic descriptions for inspection	7
3.3	Categorizing and labeling the topics into NCS pathways and co-impacts	8
3.4	Comparison with external manually curated dataset	10
4	Variable extraction	12
4.1	Geolocating articles	12
4.2	Cost information	16
4.3	Indigenous People and Local Communities (IPLC)	19
4.4	Biome	19
4.5	Biodiversity	20
5	Descriptive Analysis	20
5.1	Need versus action countries for the manage and restore pathways	20
5.2	Measuring associations	20
5.3	Cumulative Rank Indexing and Analysis	21
6	References	29

1. Background

Natural climate solutions (NCS) is a new term aggregating many existing bodies of research and practice which have terminologies that vary across academic disciplines. The central challenge facing our research was thus analyzing a wide universe of potentially relevant scientific abstracts about NCS, and maximizing inclusion of related work while minimizing the inclusion of completely irrelevant studies. We developed a machine learning (“ML”) approach leveraging state-of-the-art large language models and well-supported unsupervised ML models (topic models, [1]) from computational linguistics. Our analytic approach offers several advantages given the potential pitfalls facing this project, which we describe in detail below. Henceforth, the term “NCS co-impacts” will refer to a combination of at least one NCS pathway and co-impact type. Given the frameworks we utilized this resulted in 242 combinations.

Because NCS co-impacts are a re-mapping of existing practices and academic research, it was imperative that our evidence map reflect categories that actually emerged from the data. As the first effort to cover all possible NCS co-impacts, we did not know which of the 22 NCS pathways and 11 co-impact categories, including all possible pairwise combinations (NCS co-impacts), may have any coverage in the academic literature. Therefore, the supervised or semi-supervised approaches used in previous large-scale ML evidence mapping for climate impacts would not fit our objectives [e.g., 2, 3]. Additionally, there were formidable logistical and practical hurdles in creating a labeled dataset for NCS co-impacts: conservatively, this would require finding at least 12,100 abstracts that are relevant, which could mean potentially labeling over 50,000 articles.

Unsupervised ML topic models are widely used for similar efforts to map the literature where there are no *a priori* set of categories. For example, unsupervised topic models have been used to determine categories related to climate change discourse [4–6], environmental issues [7, 8], conservation science [9], methodological advancements in urban studies [10], education [11], political movements [12], legal documents in China [13], and international governance [14]. Not only do topic models allow categories to emerge from the data, they also facilitate expert review of the model results allowing for a data-driven process embedded with human checks. Topic models do so by creating products for expert review drawn from clusters of documents; these clusters emerge from similarities and differences inherent to the data, and the resulting topic outputs are representative and at a sufficiently small scale to make expert review tractable [15, 16]. Such an approach is superior for our purposes to a random search to create labeled data; a principled training and test dataset would call on us to perform representative sampling of the abstracts (which prior to this study was unknown), and clustering documents is a robust way to induct categories. In that case, one would essentially reproduce the topic modeling pipeline. Another major benefit of our approach is that this pipeline can be reused on new abstracts, and re-run on additional datasets to identify potential NCS co-impacts topics as necessary.

Below, we describe the steps shown in Figure 1 and Figure S1.

2. Querying the scientific literature

2.1. Generating search queries and obtaining abstracts

To find the relevant literature, we created distinct search queries for 242 pairwise combinations of NCS pathways (n=22) and co-impacts (n=11). As we explain in further detail below, we created “broad” and “focused” versions of the search queries for each NCS co-impact (q = 484 search

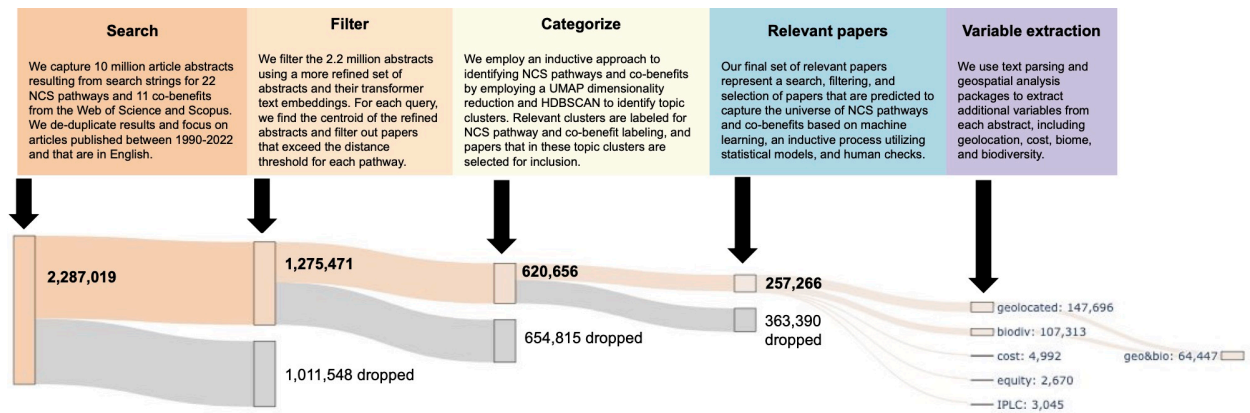


Figure S1: The full evidence base generation process, starting with querying academic databases, using unsupervised learning with large language models to categorize scientific abstracts to NCS co-impacts, and text parsing or geospatial analysis packages to extract additional variables.

strings, see Extended Data Tables 3-6). To generate the search queries, we included terms for NCS pathways from Griscom et al. [17] and the IUCN’s definition of NCS [18], and human well-being domains from McKinnon et al. [19], and biodiversity and environmental co-impacts stem from the IPBES [20].

In developing the search queries, we scanned a wide range of scientific and gray literature to ensure we captured the breadth of research and technical and ecological aspects related to each specific NCS and co-impact. Specifically, we reviewed roughly 200 abstracts to refine and validate the search queries for each NCS and co-impact. To ensure relevance, we reviewed around 100 retrieved abstracts for each focused search query to be sure that over 95% of the citations captured by these searches pertained to NCS pathways and co-impacts. Moreover, the focused search results were nested within the broad searches; that is, a subset of the literature identified with the broad searches would include the focused results.

We used the application programming interface (“API”) to query the Scopus and Web of Science academic citation databases in August 2022, and collected citation metadata, including authors, title, and date of publication. For each manuscript, we generated a unique identification hash from key publication attributes, and added it to an Elasticsearch database. We anticipated that similarities between some NCS pathways would result in overlapping search results. We therefore identified and removed duplicates. The total dataset of de-duplicated abstracts included 2.28 million unique abstracts. For each abstract, we recorded the corresponding NCS pathways and co-impacts for the search queries that yielded that citation.

2.2. Comparing English to non-English language data

The English language dominates scientific publishing, comprising 93 and 95% of all manuscripts indexed in Scopus and Web of Science, respectively [21]. As a result, English language search terms dominate in the development of search strings for global assessments [22], including global stocktakes relevant to climate change, public health, and medicine [2, 3, 23]. Therefore, we sought to evaluate 1) the degree to which our corpus contained non-English language articles with English language abstracts, and 2) the overlap between our corpus and searches conducted in

Mandarin and Spanish. The former indicates the proportion of our corpus that presents evidence in languages other than English, while the latter evaluates the degree to which our corpus aligns or diverges from a multilingual search.

We note that there are substantial challenges in conducting multi-lingual evidence mapping exercises. While it would be ideal to capture studies in as many languages as possible, this would also mean that search strings would have to be developed and validated for 22 pathways and 11 co-impacts for each additional language, a substantial requirement. Furthermore, the training data and instruction-tuning data for current LLMs are heavily biased towards English with limited validity for non-English and non-Latin script languages [24–27]; therefore, extending global assessments to non-English language studies could introduce a significant source of bias and noise in a pooled dataset. We examined the 1.5M abstracts in our dataset returned from Web of Science where there were automatically tagged language attributes. Note that our search could and did return English-language abstracts associated with non-English language articles. We observed that 4% of the articles were written in non-English languages, including Spanish, French, Portuguese, Chinese, and Indonesian (Figure S2). That 96% of our data comprised English-language articles aligns with past bibliometric and scientometric research [21].

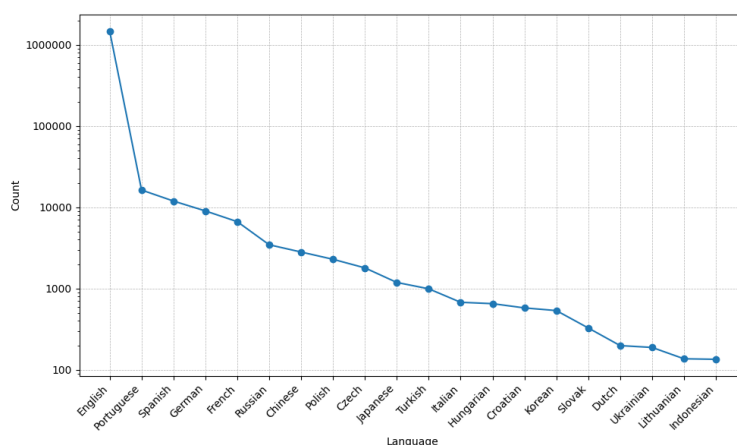


Figure S2: The distribution of languages captured in our evidence map pipeline (log scale).

We then investigated the overlap for several focal NCS pathway-co-impact combinations between the results returned for English-language search strings versus those translated by experts in the author team to two languages. First, we translated strings to Chinese (authors CHC and LL), which has the second largest number of first-language and second-language speakers after English at 1.1 billion vs. 1.46 billion, and the second largest number of manuscripts indexed in Scopus at 2.8% of manuscripts [21]. We also translated search strings to Spanish (authors CHC and MC), which has the fourth largest number of first-language and second-language speakers at 560M, and the second largest number of manuscripts indexed in Web of Science at 1.3% [21]. We found extremely high overlap (over 95% on average) for each of the assessed queries run in Spanish or Chinese and the abstracts included in our database (Table S1).

Given these additional checks, overall we are confident that our evidence map presents robust patterns. These findings align with past studies comparing English language data versus non-English language data in global scientometric assessments.

Focusing on English language papers is also supported by additional studies that assess related

Table S1: The counts and degree of overlap for additional searches in Spanish and Chinese for the NCS pathways and co-impacts with the largest amount of evidence.

Language	NCS pathway	Co-Impact	Match	All	Overlap %
Spanish	Natural Forest Management	Economic living standards	634	671	94.49%
Spanish	Natural Forest Management	Material living standards	342	361	94.74%
Spanish	Natural Forest Management	Environmental co-benefits	840	879	95.56%
Spanish	Grazing - Improved feed	Economic living standards	537	575	93.39%
Spanish	Grazing - Improved feed	Material living standards	649	681	95.30%
Spanish	Grazing - Improved feed	Environmental co-benefits	266	290	91.72%
Spanish	Avoided forest conversion	Economic living standards	1316	1365	96.41%
Spanish	Avoided forest conversion	Material living standards	680	719	94.58%
Spanish	Avoided forest conversion	Environmental co-benefits	2031	2120	95.80%
Chinese	Natural Forest Management	Economic living standards	47	49	95.92%
Chinese	Natural Forest Management	Material living standards	22	23	95.65%
Chinese	Natural Forest Management	Environmental co-benefits	94	97	96.91%
Chinese	Grazing - Improved feed	Economic living standards	195	198	98.48%
Chinese	Grazing - Improved feed	Material living standards	124	127	97.64%
Chinese	Grazing - Improved feed	Environmental co-benefits	311	318	97.80%
Chinese	Avoided forest conversion	Economic living standards	93	99	93.94%
Chinese	Avoided forest conversion	Material living standards	35	36	97.22%
Chinese	Avoided forest conversion	Environmental co-benefits	329	337	97.63%

literature. For example a meta-analysis of biodiversity conservation studies reported that while around one-third of scientific manuscripts are published in non-English languages [28], non-English language studies tended to use less robust methodology and therefore could not be included in downstream meta-analyses at the same rate, and that English language manuscripts covered 80% of the global grid cells included in the authors' analyses [29].

3. Determining article relevance and NCS co-impacts

We used a two-step process to filter and categorize abstracts. We first filtered abstracts based on distance to the centroid of the abstracts for each NCS pathway returned from the focused search queries; the centroid exemplifies a highly representative document for each NCS pathway. We then fitted an unsupervised ML topic model to identify NCS co-impact categories that emerged from the filtered data. Finally, our procedure culminated in identifying "relevant" abstracts where our topic model indicated that a paper was statistically associated with one or more NCS co-impact.

3.1. Distance-based filtering

The first filtering step involved comparing results from "focused" versus the more inclusive "broad" search queries. We refer to abstracts found through the broad search queries as "broad abstracts" and those found through the more focused queries as "focused abstracts". The focused search queries allowed us to confidently generate a set of narrowly defined but highly relevant abstracts, which could then be used to statistically identify other likely relevant broad abstracts that were missed in the more constrained focused searches. In total, we obtained around 801,798 focused abstracts and 1,485,221 additional broad abstracts. Notably, the broad queries allowed us to sample twice as many abstracts than the focused queries alone would have returned. In the initial distance-based filtering step, we aggregated abstracts into coarser NCS pathways, rather than finer NCS co-impacts, to avoid having very imbalanced clusters of abstracts, as there was more evenness in the number of citations across pathways compared to pathways and co-impacts.

Following the BERTopic pipeline [10, 30], we used the SentenceBERT ("SBERT") large language model to convert each of the 2.2 million article abstracts to a numeric representation of 768 numbers [31, 32]. For each of the 22 pathways, we calculated the centroid of all of the focused abstracts, as our focused queries were designed to hone in on highly pertinent literature. A centroid can be thought of as an idealized document that is highly representative of the set of focused abstracts yielded by our queries for an NCS pathway. Note that each pathway's centroid may not correspond to an actual abstract, but may rather be a vector of values located amongst the most representative abstracts for each pathway in a 768-dimensional space.

Using the SBERT embeddings for each abstract, we calculated the cosine distance for each focused abstract with the corresponding pathway centroid. We then found a threshold distance by iteratively decreasing the distance to the centroid and dropping focused abstracts beyond that threshold. We determined the cut-point at which a 1% step closer in threshold distance yielded less than a 1% reduction in the proportion of the focused abstracts that were dropped. This resulted in a distance threshold for each NCS pathway.

For each broad abstract, we calculated its distance to all possible focused query centroids because broad abstracts were especially likely to be associated with more than one NCS pathway. Looking across all of the pathways associated with each broad abstract, we calculated the minimum

distance to each pathway’s centroid. If the distance to the pathway centroid was less than the pathway’s threshold, then we included that broad abstract, otherwise we filtered it out. In total, this resulted in 1,275,471 distance-filtered abstracts.

3.2. Unsupervised learning to determine an abstract’s NCS pathway and impact category

3.2.1 Fitting the BERTopic model

From our preceding work using SBERT to embed the abstract text, we fitted an unsupervised learning model to identify topics that emerged from the abstracts. Specifically, we used a modification of topic modeling, a popular and well-supported method for identifying themes that emerge from text corpora [1]. Traditional topic modeling relied on simpler bag-of-words features, but advances in language modeling now permit researchers to move towards automatically detecting categories in data that have relatively nuanced differences, such as scientific abstracts [10]. Similar to recent research identifying climate change belief and skeptic viewpoints [6] or media coverage of education during COVID19 [11], we used the BERTopic model approach to identify which NCS co-impact categories emerged in our dataset of 1.28 million abstracts.

First, we reduced the dimensionality of the abstract embeddings using the UMAP algorithm [33]. Compared to other dimensionality reduction approaches (e.g., t-SNE or PCA), UMAP has improved computational performance and superior performance in preserving both local and global differences in high-dimensional data, even when these data are projected to a lower-dimensional representation. This reduced the data from a 768-dimensional vector to a 3-dimensional vector, which is more amenable for density-based clustering [30]. We then clustered the resulting lower-dimensional data with the HDBSCAN algorithm [34]. HDBSCAN finds regions of high density to identify clusters, and penalizes clouds of points that have relatively few data points and which are spread far apart from one another. The totality of these steps constitutes the BERTopic modeling approach [30]

In performing the BERTopic model, we used Bayesian hyperparameter optimization to determine the best parameters for UMAP and HDBSCAN [30]. Our approach balances practical constraints with rigor. Note that each run of these two steps required 30 minutes to complete. Without the use of Bayesian optimization, it would have been computationally impossible to perform a complete grid search over the 5.6 million possible parameter combinations (i.e., it would require 319.6 years without parallelization and extensive computational costs with parallelization). The optimized hyperparameters resulted in a final solution with 800 topics (Figure S3) and 17.5% less noise than the original solution, which used the default BERTopic hyperparameters.

3.2.2 Generating topic descriptions for inspection

Topic modeling integrates expert review alongside the data-driven identification of clusters of documents that have shared topics. The coding team (CC, JE, BER, YJM, LL, PF) reviewed and coded the 800 topics for their relevance for providing information on NCS pathways and co-impacts. Each abstract was assigned to its most probable topic.

To perform this task, we found descriptions for each topic using a modified term frequency-inverse document frequency (“TF-IDF”) approach, called cluster-TF-IDF, or c-TF-IDF [30]. In c-TF-IDF, all of the abstracts identified as members of a topic are treated as a single document. Across the 800 topic “documents”, we then applied TF-IDF. This yields a topic-word matrix that

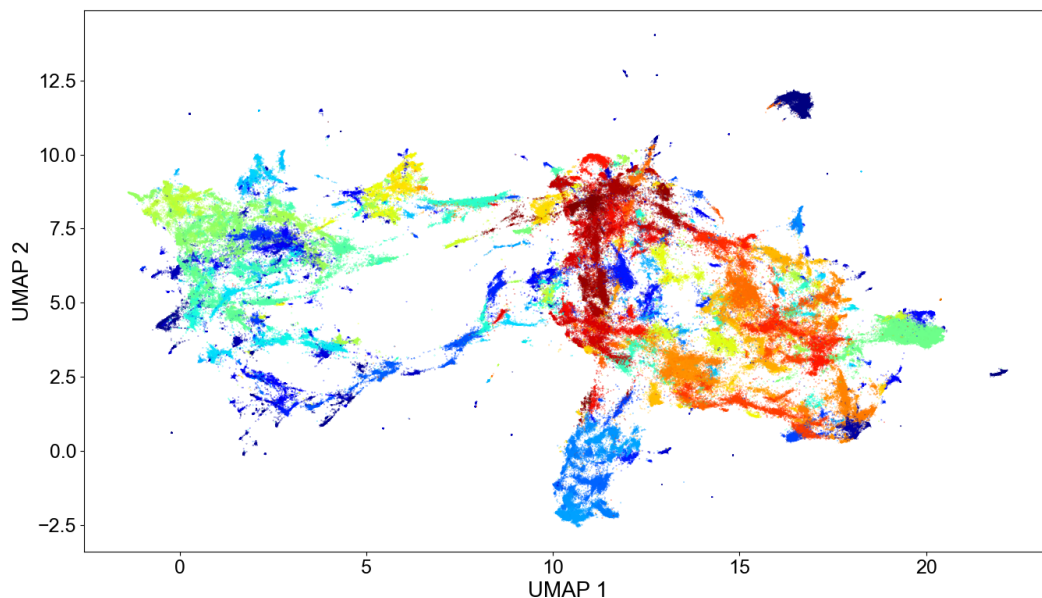


Figure S3: A depiction of the 800 topics generated by the optimized BERTopic model. The axes correspond to the first two dimensions of the UMAP dimensionality reduction. Each topic is colored according to its topic number in a rainbow color ramp (e.g., topic 1 is colored dark blue and topic 800 is colored dark red).

shows the importance of a word to a topic. We also applied this approach to find the distinctive terms from the search queries that generated each of the documents in a topic (Table S2).

3.3. Categorizing and labeling the topics into NCS pathways and co-impacts

We performed iterative rounds of coding to categorize the topics until there was full agreement among the coding team. We examined each topic based on the following features (Table S2):

- The topic description, or the 40 most distinctive terms based on c-TF-IDF.
- The distinctive search query terms for the documents in a topic.
- The distribution of search pathways (NCS pathway and co-impact) that generated the documents in a topic cluster.
- 10 exemplar focal abstracts, which had the highest assignment probability for a given topic cluster.

We initially coded the 800 topics for relevance and then performed a review of disagreements (Extended Data Table 7). Relevant topics clearly pertained to NCS pathways and co-impacts. It is possible for many topics to have overlapping NCS pathways and co-impacts. For example, one topic may be labeled as wetland restoration, human health, and biodiversity, while another topic

Topic #	Topic description	Topic search keywords	Search query pathway distribution	Search query co-benefit distribution	Search query combination distribution (TOP 10)
426	['methane', 'nitrate', 'methane production', 'fermentation', 'methanogenesis', 'nitroethane', 'methane emission', 'methanogen', 'nitrocompound', 'ch4 production', 'rumen', 'volatile fatty acid', 'acetate', 'reduce methane', 'ruminant', 'enteric methane', 'feed', 'dietary', 'supplement', 'nitrate supplementation', 'nitrate npa', 'ch4 emission', 'biochar', 'methane ch4', 'butyrate', 'dietary nitrate', '3nitrooxypropanol', 'ruminal methane', 'ruman fluid', 'neoh comparison monensin', 'intake', 'enteric ch4', 'rumen fermentation', 'nitrate diet', 'sheep', 'methanogenic', 'ruminal methane production', 'reduction methane', 'forage', '910 anthraquinone']	['methan', 'nitrate', 'fermentation', 'ferment', 'nitrite', 'ruminant', 'supplement', 'enteric methan', 'additive', 'dose', 'emission', 'digest', 'intake', 'feed', 'fauna', 'reduce', 'bacteria', 'forage', 'hydro', 'urea', 'product', 'biochar', 'hay', 'greenhouse gas', 'cattle', 'barley', 'animal', 'alfalfa', 'abundance', 'dry', 'oat', 'toxic', 'sodium nitrate', 'increase', 'organism', 'oxi', 'experimental', 'soy', 'fiber', 'respiratory']	#15: 85 (39.72%) #14: 80 (37.38%) #13: 41 (19.16%) #12: 3 (1.4%) #3: 2 (0.93%) #4: 1 (0.47%) #8: 1 (0.47%) #10: 1 (0.47%)	#J: 89 (25.87%) #K: 57 (16.57%) #D: 53 (15.41%) #C: 38 (11.05%) #A: 31 (9.01%) #F: 25 (7.27%) #H: 17 (4.94%) #I: 15 (4.36%) #B: 13 (3.78%) #G: 5 (1.45%) #E: 1 (0.29%)	#15J: 83 (14.07%) #14K: 54 (9.15%) #15D: 52 (8.81%) #14D: 49 (8.31%) #13J: 41 (6.95%) #15C: 37 (6.27%) #14A: 30 (5.08%) #13D: 28 (4.75%) #13K: 28 (4.75%) #14F: 24 (4.07%)
637	['urban', 'urban forest', 'city', 'urban tree', 'urban forestry', 'residential', 'forestry', 'tree canopy', 'forest', 'ecosystem service', 'green space', 'urban forest management', 'urban area', 'municipality', 'tree canopy cover', 'ecosystem', 'area', 'woodland', 'benefit urban', 'urban green', 'landscape', 'garden', 'urban woodland', 'tree inventory', 'environmental', 'land', 'urbanization', 'management urban', 'tree planting', 'tree urban', 'green infrastructure', 'tree city', 'tree population', 'vegetation', 'forest management', 'arboriculture', 'urban tree canopy', 'urban environment', 'suburb', 'spatial']	['tree', 'green space', 'tree cover', 'forestry', 'benefit', 'canopy', 'forest', 'green', 'socioeconomic', 'planting', 'woodland', 'tree planting', 'structure', 'manag', 'aesthetic', 'economic', 'ecosystem', 'forester', 'landscape', 'econom', 'value', 'native tree', 'area', 'natur', 'ecolog', 'wellbeing', 'tree density', 'ecol', 'develop', 'nature', 'environment', 'recreation', 'educat', 'greenspace', 'land', 'environmental justice', 'vegetation', 'vegetat', 'stakeholder', 'population']	#3: 448 (60.79%) #1: 72 (9.77%) #2: 70 (9.5%) #5: 69 (9.36%) #4: 25 (3.39%) #10: 16 (2.17%) #22: 15 (2.04%) #11: 7 (0.95%) #7: 6 (0.81%) #21: 3 (0.41%) #12: 2 (0.27%) #20: 2 (0.27%) #9: 1 (0.14%) #15: 1 (0.14%)	#K: 404 (49.57%) #H: 99 (12.15%) #I: 78 (9.57%) #J: 67 (8.22%) #A: 62 (7.61%) #C: 26 (3.19%) #B: 22 (2.7%) #G: 22 (2.7%) #D: 16 (1.96%) #F: 13 (1.6%) #E: 6 (0.74%)	#3K: 356 (43.0%) #3I: 62 (7.49%) #2A: 48 (5.8%) #5H: 38 (4.59%) #1K: 30 (3.62%) #1C: 21 (2.54%) #4J: 15 (1.81%) #10H: 15 (1.81%) #22K: 15 (1.81%) #2J: 14 (1.69%)

Table S2: Example topic inspection data, which include the c-TF-IDF description for each topic, the most distinctive terms from the search query, and the distribution of broad and focused abstracts clustered into each topic based on their original search string pathway, co-impact, and top pathway and co-impact combination. Based on these features, we generated a brief label for each topic. For instance, for 426, we generated the label “Effect of biochar on reducing methane emissions from livestock”, and for topic 637, the label “Urban forest ecosystem services”.

may have been labeled as wetland restoration, ecosystem services, and biodiversity (Extended Data Table 7). These two distinct topics would share a similar NCS pathway and one similar co-impact. A topic that only focused on methods (e.g., advances in computer vision for remote sensing or biogeochemical measures) would be excluded because it did not clearly pertain to

an NCS pathway. A topic solely focused on climate change mitigation (e.g., quantifying carbon sequestration) or a benefit type (e.g., economic measures), but not both, would also be excluded. All relevant topics therefore were categorized to at least one NCS pathway and co-impact. The team identified 400 topic clusters that contained information on NCS co-impacts.

We then coded each of the 400 topics for NCS pathways and co-impacts and generated a short title for each topic. We also used this step to further refine the identification of relevant topics. For instance, the coding team ultimately determined that the NCS pathway had to include some aspect of land or aquatic stewardship. This condition was most salient for the improved animal husbandry pathways. We determined that a topic solely featuring veterinary medicine practices and financial or other benefits, but lacking clear measures related to environmental stewardship, would ultimately not be included. A third rater and the team reviewed any disagreements. We ultimately retained the set of NCS pathways and co-impacts with agreement across coders (n=364 relevant topics, Figure S4). These 364 topics yielded 620,656 abstracts, which we further filtered to a final set of 257,266 abstracts by only including abstracts that had a topic assignment probability > 0.5 . This final filtering step was intended to ensure a higher-quality sample that was clearly associated with a topic, i.e. the probability to belong to the given topic was higher than the total probability to belong to any other topic. These 257,266 abstracts formed the basis for mapping NCS pathways and co-impacts.

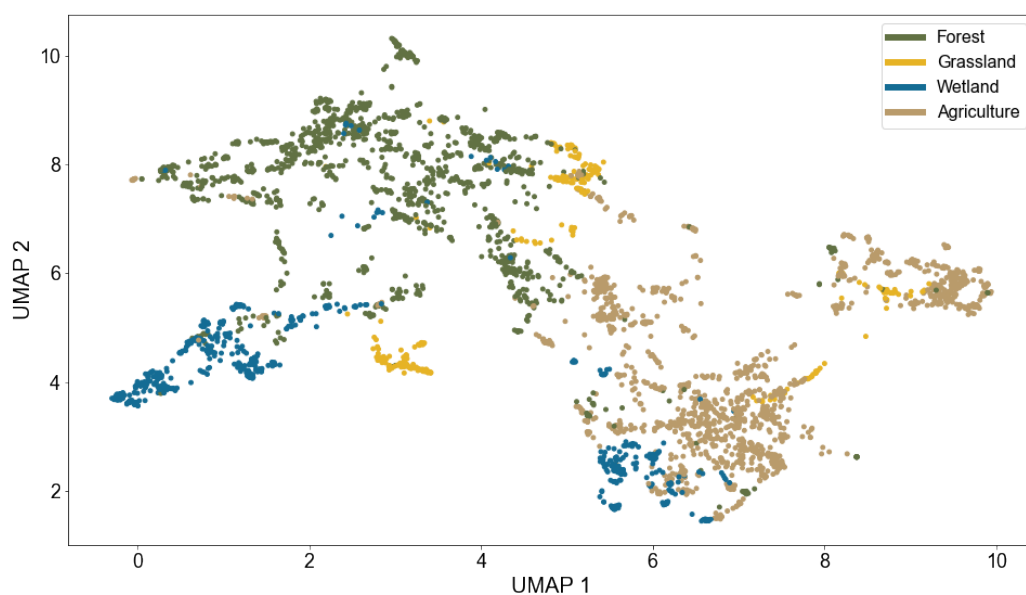


Figure S4: A depiction of the 10 most representative abstracts for each of the 364 final topics, colored based on habitat type.

3.4. Comparison with external manually curated dataset

We compared our dataset at different stages to an external sample of articles that were manually screened using the following inclusion criteria: discussing one or more NCS pathways with a clear

Table S3: The number and proportion of papers included at different stages of our machine learning pipeline as well as the counts and degree of overlap between our dataset and the external, manually curated dataset from Petry et al. The first row displays the number of papers that Petry et al. independently found. From the second row onward, we present the counts and percentages for the numbers of papers in their included or excluded samples that overlap with the papers at different stages in our pipeline. The horizontal lines delimit different stages in this comparison process: the full external dataset, our search procedure, and our topic modeling procedure.

	Number of papers	Pipeline %	Included n	Included %	Excluded n	Excluded %
External search			703	100%	17,989	100%
All papers	2,287,019	100.00%	697	99.2%	14,736	81.9%
Distance thresholding	1,275,471	55.77%	651	92.6%	12,855	71.5%
Topic modeling	620,656	27.14%	537	76.4%	8,916	49.6%
$p_{topic} > 0.5$ filtering	257,266	11.25%	287	40.8%	3,725	20.7%

geographic location and a discernible, extractable effect size for biodiversity whether that was reported in the main text or provided privately by study authors [35]. These articles come from focused expert assessments [35] outside of the current study. Our study was focused on discovering categories of NCS co-impacts; in contrast, the external, focused expert assessments emphasized the biodiversity co-benefits of natural climate solutions [35]. If our process is comparable and captures the disparate literature of NCS co-impacts compared to manual efforts, we would expect sizable overlap between our initial search queries and these external datasets. However, because these external datasets had very specific objectives (e.g. a biodiversity effect size), we expected that there could be less overlap at later stages in our pipeline, as our approach focused on surfacing clusters of studies with shared linguistic patterns that could be mapped to NCS co-impacts rather than studies fulfilling very specific criteria such as quantifiable measurements or particular biomes.

Table S3 presents the share of papers included at each stage in our analytical process. We note that our search strings and distance thresholding steps resulted in nearly full overlap with comparable but constrained efforts, while our topic modeling step yielded 76% coverage for the included papers. By the final stage of our pipeline, while our overlap with the external included papers drops to about 41%, our overlap with the externally excluded papers drops to around 21%. The reduced coverage in the topic modeling step results from the fact that manual review can identify singleton papers with highly distinctive forms of writing that do not easily associate with other relevant abstracts in the 768-dimension SBERT embedding space.

We now focus on analyzing any differences between the overlapping and non-overlapping abstracts from the Petry et al. [35] sample at the final stage of our pipeline ($n = 587$ in total with $n = 287$ overlapping at the final step and $n = 250$ non-overlapping at the final step). We observed that the overlapping and non-overlapping abstracts were strikingly similar in terms of

Table S4: Disciplinary counts for the external Petry et al. dataset. The proportion columns present either the proportion of abstracts in the non-overlapping or overlapping samples that are assigned to each category by the Web of Science.

Category	Non-overlapping	Proportion	Overlapping	Proportion
Ecology	35	0.15	43	0.16
Biodiversity Conservation; Ecology; Environmental Sciences	30	0.13	29	0.11
Forestry	26	0.11	15	0.05
Agriculture, Multidisciplinary; Ecology; Environmental Sciences	15	0.06	14	0.05
Biodiversity Conservation; Ecology	14	0.06	14	0.05
Ecology; Environmental Sciences	10	0.04	15	0.05
Plant Sciences; Ecology; Forestry	7	0.03	17	0.06
Multidisciplinary Sciences	9	0.04	13	0.05
Entomology	7	0.03	10	0.04
Environmental Sciences	8	0.03	9	0.03
Soil Science	8	0.03	6	0.02
Biodiversity Conservation; Entomology	8	0.03	4	0.01
Plant Sciences	4	0.02	7	0.03
Agronomy; Forestry	3	0.01	5	0.02
Environmental Sciences; Soil Science	4	0.02	4	0.01
Biodiversity Conservation	4	0.02	3	0.01
Agronomy; Biotechnology & Applied Microbiology; Energy & Fuels	4	0.02	2	0.01
Ecology; Engineering, Environmental; Environmental Sciences	3	0.01	3	0.01
Ecology; Zoology	1	0.00	5	0.02
Zoology	2	0.01	3	0.01

their disciplinary composition (Table S4) or NCS pathway distribution (Table S5). By focusing on the most distinctive unigrams, bigrams, and trigrams, we saw that the overlapping abstracts at the final stage exhibited a higher rate of using terms consistent with measuring outcomes, such as “higher”, “different”, “increased”, or “results”, none of which were among the top terms for the non-overlapping sample or the 587 abstracts at the previous topic modeling stage (Table S6). Additionally, the overlapping abstracts occupied a more central position in the relevant topics, and had a higher dominant topic assignment probability (Figure S5).

4. Variable extraction

4.1. Geolocating articles

We used the package Mordecai to geolocate articles [36]. Mordecai extracts locations using word2vec [37], a skip-gram model that also generates numeric embeddings of language, to conduct

Table S5: Pathway distribution for the external Petry et al. dataset. The columns correspond to the counts of the 587 abstracts that are assigned to each pathway by the topic model, which can assign more than one pathway per topic. The non-overlapping or overlapping columns present the difference in the proportions observed for each pathway relative to the 587 abstracts as a whole.

Pathway	Count	Proportion	Non-overlapping	Overlapping
Avoided forest conversion	125	0.099	0.022	-0.019
Avoided grassland conversion	190	0.151	-0.038	0.035
Avoided coastal wetland impacts	33	0.026	-0.008	0.007
Natural forest management	182	0.145	0.020	-0.018
Improved plantations	55	0.044	-0.002	0.002
Fire management	16	0.013	-0.006	0.005
Biochar	6	0.005	0.002	-0.002
Cropland nutrient management	40	0.032	0.017	-0.015
Conservation agriculture	98	0.078	0.016	-0.014
Trees in croplands & agroforestry	28	0.022	-0.004	0.003
Improved rice cultivation	6	0.005	0.004	-0.003
Forest restoration	119	0.095	0.011	-0.010
Afforestation	40	0.032	0.005	-0.005
Grassland restoration	213	0.169	-0.037	0.033
Coastal wetlands restoration	54	0.043	-0.001	0.001
Freshwater wetlands restoration	54	0.043	-0.001	0.001

Table S6: The most distinctive n-grams among the overlapping (n=287 with $p_{topic} > 0.5$), non-overlapping (n=250), and all papers (n=537) at the topic modeling stage as determined by term frequency-inverse document frequency (TF-IDF).

Rank	Overlap n-gram	TF-IDF	Non-overlap n-gram	TF-IDF	All n-gram	TF-IDF
1	species	0.012279	species	0.011751	species	0.012035
2	restoration	0.007913	forest	0.007706	restoration	0.007107
3	soil	0.006334	soil	0.007085	soil	0.006681
4	grassland	0.006158	restoration	0.006168	forest	0.006186
5	diversity	0.005743	diversity	0.005963	diversity	0.005844
6	plant	0.005183	plantations	0.004602	grassland	0.005018
7	native	0.004889	bird	0.004574	plant	0.004757
8	forest	0.004882	vegetation	0.004472	vegetation	0.004512
9	richness	0.004714	community	0.004357	native	0.004424
10	sites	0.004557	habitat	0.004310	richness	0.004392
11	vegetation	0.004546	land	0.004281	community	0.004374
12	community	0.004388	plant	0.004261	land	0.004078
13	cover	0.004028	abundance	0.004026	sites	0.004076
14	grasslands	0.003955	plots	0.004026	habitat	0.003892
15	land	0.003904	richness	0.004017	abundance	0.003823
16	seed	0.003891	communities	0.003895	communities	0.003716
17	abundance	0.003649	native	0.003882	plots	0.003661
18	restored	0.003636	forests	0.003821	grasslands	0.003533
19	species richness	0.003591	grassland	0.003689	plantations	0.003528
20	natural	0.003578	biodiversity	0.003607	cover	0.003507
21	communities	0.003563	biomass	0.003597	composition	0.003481
22	composition	0.003557	sites	0.003515	species richness	0.003393
23	habitat	0.003533	composition	0.003392	natural	0.003350
24	grazing	0.003446	tree	0.003331	bird	0.003341
25	management	0.003432	habitats	0.003285	use	0.003175
26	plots	0.003348	areas	0.003219	seed	0.003174
27	years	0.003252	species richness	0.003163	restored	0.003047
28	use	0.003238	use	0.003101	management	0.003031
29	prairie	0.003153	natural	0.003084	years	0.002989
30	systems	0.002818	afforestation	0.003054	biodiversity	0.002953
31	treatments	0.002787	grasslands	0.003042	biomass	0.002942
32	higher	0.002757	study	0.002974	habitats	0.002866
33	study	0.002678	removal	0.002901	tree	0.002854
34	different	0.002652	cover	0.002899	grazing	0.002821
35	land use	0.002634	conservation	0.002884	study	0.002815
36	increased	0.002633	effects	0.002854	areas	0.002733
37	plantations	0.002607	land use	0.002786	systems	0.002711
38	fields	0.002546	pine	0.002731	land use	0.002704
39	results	0.002516	years	0.002683	forests	0.002686
40	habitats	0.002506	field	0.002645	effects	0.002653

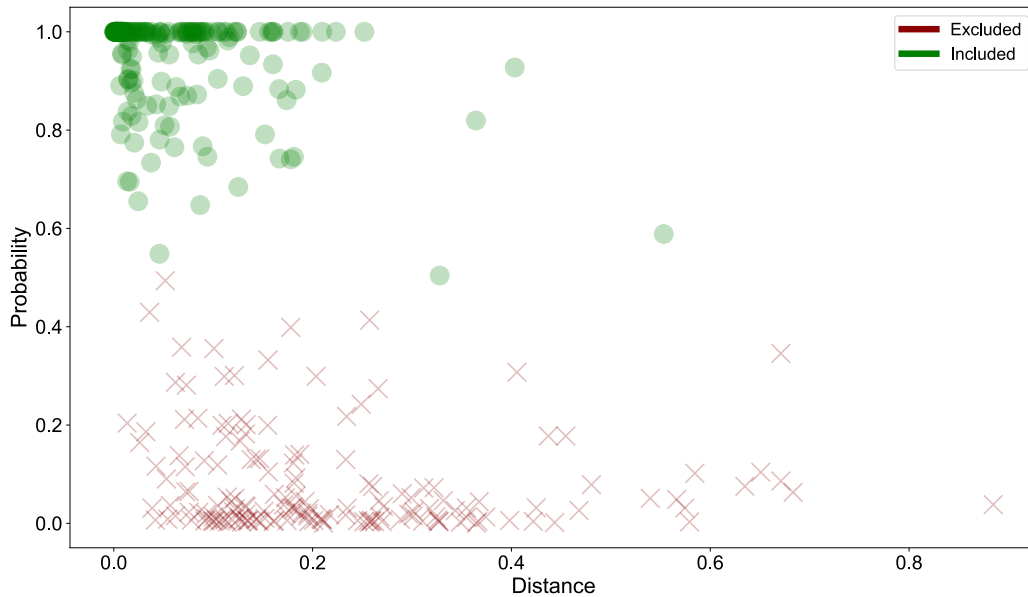


Figure S5: Visualization of the differences between the overlapping (Included) and non-overlapping (Excluded) abstracts at the final stage in our pipeline in terms of topic probability and distance to abstracts in their topic cluster, as calculated by the HDBSCAN algorithm.

named entity recognition and infer which parts of speech are place names. The place names in the abstracts are then matched against a gazetteer database. If there was a match, then the latitude, longitude, and spatial resolution (e.g., country, province, place) were recorded. Mordecai has also been used in recent ML climate change impacts evidence mapping studies [2].

To maximize the success of geolocating articles, we applied several pre-processing steps to the abstract text. We removed words that were only one character in length, numbers, and special characters. We also augmented the gazetteer database (which we will also call a vocabulary) to detect text relating to directions or abbreviations of place names. For instance, Mordecai would not be able to resolve ‘south-eastern Australia’ as a place name because there is no equivalent gazetteer entry. However, our text pre-processing would note that ‘south-eastern’ is a cardinal and ordinal direction, and would convert this information into a format that Mordecai can resolve. Our expansions to the vocabulary sought to ensure that when confronted with a cardinal and/or ordinal direction, the Mordecai package would resolve the place name to a region within a country, rather than the best matching gazetteer entry, which could be inaccurate (e.g., “North Germany” should point to the northern region of Germany rather than the “Township of North Germany”). Similarly, Mordecai would not be able to resolve ‘U.S.’ or ‘U.S.A’ due to the fact that these terms were not included in the gazetteer database. However, our text pre-processing would change this abbreviation to the United States, which can be resolved.

Mordecai can return multiple locations from an abstract. We performed additional processing on the resolved location data, which would come in the form of a vector of values. We removed any resolved locations (i) if the location was a duplicate against other resolved locations for the same

abstract, (ii) if the first character of the first word was lowercase and it was not a cardinal or ordinal direction, (iii) if the resolved location was a higher granularity equivalent of another resolved location and they were in close proximity (5-word radius) inside the abstract (e.g., in case of “London, England” our algorithm would drop “England” because it corresponds to “London”, and therefore would constitute a duplication to include both entries). This yielded a final set of resolved locations for abstracts. For the final set of locations, we used a Python library, [Locationtagger](#) (v 0.0.1), to categorize each location into three levels of granularity: city, region, and country.

4.2. Cost information

We extracted cost information from the abstracts using a Python package, LexNLP [38], which extends common natural language processing packages to provide specialized functions and data for regulatory and policy documents. We specifically used a money detector that uses regular expressions to detect cost information. This detection uses the following features:

- trigger words—terms associated with monetary mentions such as cost or price (this includes terms such as “USD” or “GBP”; Extended Data Table 8);
- currency symbols such as \$ or €;
- standardized currency prefixes such as USD or EUR or RMB;
- typical currency names such as dollar, euro, or dinar.

We extended the set of symbols, currency prefixes, and currency names from an additional Python package, [price-parser](#) (v 0.3.4). We only included additional currencies that were unambiguous. When we detected cost information using trigger words, we ran a secondary regular expression to search for patterns to ensure that there was numeric cost information; if there was no numeric information, then no cost information was ultimately extracted.

To identify abstracts with content related to economic analysis, we generated a comprehensive set of search terms based on topics in [39]. The Boolean search string for economic analysis includes the following:

“additionality” OR “adjusted net savings” OR “average cost” OR “average revenue” OR “average-cost pricing” OR “auction” “avoided costs” OR “backstop resource” OR “benefit transfer” OR “benefit ratio” OR “cost ratio” “bequest value” “Better Life Index” OR “cap and trade” OR “capital depreciation” OR “capital formation” OR “capital shallowing” OR “capital stock” OR “carbon tax” OR “choke price” “Coase theorem” OR “comparative advantage” OR “compliance costs” OR “computable general equilibrium” OR “constant dollars” OR “constant return to scale” OR “consumer surplus” OR “consumption externalities” OR “contingent ranking” OR “conservation payments” OR “conservation-based payments” OR “contingent valuation” OR “cost of illness” OR “cost-benefit analysis” OR “cost-effectiveness” OR OR “crop value index” OR “defensive expenditures” OR “demand-side management” OR “diminishing returns” OR “direct-use value” OR “discount rate” OR “distortionary subsidies” OR “ecological economics” OR “economic efficiency” OR “economic optimum” OR “economic

reserves” OR “economic value” OR “economies of scale” OR “ecosystem service valuation” OR “ecosystem service costs” OR “efficiency labeling” OR “efficiency standards” OR “elasticity of demand” OR “elasticity of supply” OR “empty-world economics” OR “full-world economics” OR “endowment effect” OR “energy demand-side management” OR “environmental asset accounts” OR “environmental economics” OR “Kuznets curve” OR “equilibrium price” OR “equimarginal principle” OR “existence value” OR “expected value” OR “exponential reserve index” OR “external costs” OR “externality, externalities” OR “feed-in tariffs” OR “free market” OR “free-rider” OR “future costs” OR “future benefits” OR “gains from trade” OR “gross domestic product” OR “GDP” OR “genuine progress indicator” OR “GPI” OR “green economy” OR “green taxes” OR “gross national happiness” OR “GNH”, OR “habitat equivalency analysis” OR “HEA” OR “Hartwick Rule: OR “hedonic pricing” OR “Hotelling’s Rule” OR “Hubbert curve” OR “Human Development Index” OR “HDI” OR “income” OR “income inequality” OR “indirect-use value” OR “individual transferable quotas” OR “ITQs” OR “information asymmetry” OR “inherent value” OR “internalizing external costs” OR “internalizing externalities” OR “law of demand” OR “law of diminishing returns” OR “law of supply” OR “leakage” OR “least-cost options” OR “levelized costs” OR “license fee” OR “macroeconomic” OR “macroeconomic scale” OR “manufactured capital” OR “marginal abatement costs” OR “marginal benefit” OR “marginal cost” OR “marginal net benefit” OR “marginal physical product” OR “marginal revenue” OR “marginal revenue product” OR “market equilibrium” OR “market failure” OR “market-based pollution control” OR “materials substitution” OR “maximum sustainable yield” OR “MSY” OR “mean annual increment” OR “natural capital” OR “natural resource limitations” OR “negative externality” OR “net benefits” OR “net domestic product” OR “NDP” OR “net domestic saving” OR “net investment” OR “net disinvestment” OR “net present value” OR “net price” OR “nominal GDP” OR “nonexcludable good” OR “nonmarket benefits” OR “nonrival good” OR “nonuse values” OR “normal good” OR “open -access equilibrium” OR “open-access resources” OR “optimal depletion rate” OR “optimal level of pollution” OR “optimal macroeconomic scale” OR “optimum rotation period” OR “option value” OR “payments for ecosystem services” OR “PES” OR “per capita GDP” OR “per capita GDP growth rate” OR “per capita output” OR “permit auction” OR “physical accounting” OR “Pigovian” OR “polluter pays principle” OR “pollution tax” OR “Porter hypothesis” OR “positional analysis” OR “positive externality” OR “post-growth economy” OR “present value” OR “price elasticity” OR “price elasticity of demand” OR “price elasticity of supply” OR “price path” OR “price taker” OR “price volatility” OR “producer surplus” OR “production externalities” OR “profits” OR “progressive tax” OR “property” OR “property rights” OR “protest bid” OR “public goods” OR “purchasing power parity” OR “PPP” OR “pure rate of time preference” OR “quota system” OR “race to the bottom” OR “real GDP” OR “real dollars” OR “inflation adjusted dollars” OR “regressive tax” OR “regulated monopolies” OR “monopoly” OR “replacement cost” OR “replacement cost methods” OR “resource curse hypothesis” OR “resource depletion tax” OR “substitutability” OR “resource substitution” OR “good substitution” OR “substitute good” OR “revealed preference” OR “revealed preference method” OR “revenue-neutral tax” OR “rival good” OR “scarcity rent” OR “social benefits” OR “social cost of carbon” OR “social discount rate” OR “social rate of time

preference” OR “social marginal cost curve” OR “socially efficient” OR “stated preference” OR “stated preference methods” OR “structural adjustment” OR “subeconomic resources” OR “subsidy” OR “substitutability” OR “supply constraint” OR “surplus” OR “sustainable development” OR “economic development” OR “sustainable yield” OR “technological lock-in” OR “total cost” OR “total economic value” OR “total net benefit” OR “total product” OR “total revenue” OR “tragedy of the commons” OR “transaction costs” OR “transferable permits” OR “tradable permits” OR “travel cost models” OR “upstream tax” OR “use values” OR “user costs” OR “value-added methods” OR “value of a statistical life” OR “VSL” OR “wage-risk analysis” OR “water footprint” OR “water markets” OR “water pricing” OR “welfare analysis” OR “willingness to accept” OR “willingness to pay”

We conducted two search queries within our database to identify papers with information on equity considerations. Following [40] and [41], we first conducted a search to identify abstracts that include terminology broadly related to equity. However, we expand this search from previous reviews by including antonyms for equity, justice, and fairness. The Boolean search string for this search includes the following:

“equit*” OR “inequit*” OR “justice*” OR “injustice*” OR “justness” OR “unjustness” OR “*fairness” OR “fair” OR “unfair” OR “*equality” OR “*equalities”

Within the set of abstracts we included language related to equity considerations, we conducted a second search to identify papers that further include a focus on human dimensions of NCS. We base the Boolean search string for this more specific search on previous work from [40–42]. The search string that identifies abstracts that contain language related to equity considerations as well as human dimensions of NCS takes the following form:

[1] “equit*” OR “inequit*” OR “justice*” OR “injustice*” OR “justness” OR “unjustness” OR “*fairness” OR “fair” OR “unfair” OR “*equality” OR “*equalities” AND

[2] “wellbeing” OR “well-being” OR “livelihood*” OR “poverty” OR “basic need*” OR “quality of life” OR “buen vivir” OR “human right*” OR “social impact*” OR “social outcome*” OR “welfare” OR

[3] “institution*” OR “subsistence” OR “coproduction” OR “co-production” OR “tenure” OR “recognition” OR “participation” OR “stakeholder engagement” OR “community engagement” OR “customary” OR “distribution of benefits” OR “access” OR “entitlement*” OR “territor*” OR “attitude*” OR “local support” OR “cooperat*” OR “conflict*” OR “collaborat*” OR “trust” OR “steward*” OR “guardian*” OR “defend*” OR “custodian*” OR “enforcement” OR “regulation*” OR “rule*” OR “incentiv*” OR “motivat*” OR “social feedback*” OR “perception*” OR “perceive*” OR “governance” OR “govern” OR “governing” OR “decision-making” OR “decision making” OR “legitima*” OR “comanage*” OR “co-manage*” OR “human behaviour*” OR “livelihood*” OR “conservation and development” OR “social development” OR “human development”) OR

[4] “wealth” OR “income” OR “cost*” OR “benefit*” OR “representation” OR “political power” OR “inclus*”

We selected words and terms from previous literature on equity and inclusion that identify human dimensions of NCS related to livelihoods and wellbeing [2], institutions and governance [3], as well as wealth and power [4]. These terms do not represent a complete union of search terms from previous literature, but draw upon the terms from these previous searches to focus on specific elements of equity and social justice relevant to human dimensions of NCS.

4.3. Indigenous People and Local Communities (IPLC)

Indigenous Peoples and Local Communities (IPLC) are recognized as having a central role in the conservation and sustainable use of ecosystems and biodiversity [43]. At the same time, NCS have become an important set of actions to reduce GHG emissions. Yet it is unclear how IPLC knowledge and management contribute to our collective knowledge of how to implement and manage natural climate solutions, or how NCS recognize or contend with Indigenous rights.

To assess whether our evidence base contains literature that relates to these topics, we scanned our database of literature for papers that deal with IPLC-related issues and topics. Search terms were derived from a scan of past reviews that survey the literature on IPLC-related topics [e.g., 44–47] as well as intergovernmental documents that discuss IPLC rights and issues (e.g., [UNFCCC](#), [World Bank, Rights & Resources Initiative](#), [IUCN](#), [IPBES](#)). The search terms used to scan our dataset include:

"Indigenous People(s)" OR "Indigenous Peoples and Local Communities" OR "IPLCs" OR "IPLC" OR "Local and Indigenous communit*" OR "Indigenous and Local Knowledge" OR "Local and Indigenous Knowledge" OR "ILK" OR "Local Ecological Knowledge" OR "LEK" OR "Local Environmental Knowledge" OR "Indigenous knowledge" OR "local knowledge" OR "local community" OR "local communities" OR "local wisdom" OR "ecological wisdom" OR "rural knowledge" OR "traditional practic*" OR "traditional medicine" OR "traditional management" OR "traditional agriculture" OR "Traditional Knowledge" OR "TK" OR "traditional wisdom" OR "Traditional Ecological Knowledge" OR "TEK" OR "Traditional Ecological Knowledge and Wisdom" OR "TEKW" OR "Customary Knowledge" OR "Customary Ecological Knowledge" OR "Customary Environmental Knowledge" OR "customary management" OR "place-based knowledge" OR "cultural practice" OR "cultural tradition" OR "cultural belief" OR "biocultural practic*" OR "bio-cultural practic*" OR "socio-cultural practic*" OR "cultural practice*" OR "cultural traditions" OR "biocultural practic*" OR "bio-cultural practic*" OR "socio-cultural practic*" OR "ethnobotany" OR "ethnoecology" OR "medicinal plant"

4.4. Biome

We used the abstract's location data (Section 4.1) and performed a spatial intersection with the IUCN function-based typology of global ecosystems to determine the biomes associated with each study [48]. We subset our data to only those abstracts that had a granularity that was finer than country (e.g., city or region) based on the `Locationtagger` threshold discussed above.

For each study where we could find an intersection, we then identified a set of ecosystem functional groups ("EFGs"). As the EFGs were at a finer scale than biomes, we then aggregated the filtered EFGs to the biome level. Ultimately, this yielded a total of 25 biomes from the unfiltered EFG data.

441 **4.5.Biodiversity**

442 We used the Open Tree of Life (“OTL”, version 13.4, [49, 50]) to identify species mentioned in
443 the abstracts in our database. We extracted all of the taxa included in the Open Tree Reference
444 Taxonomy, which was used to build the OTL v. 13.4 product [49, 50]. This taxonomy totals 4.5
445 million taxa.

446 Following the guidelines from OTL, we pruned nodes at the level of genus or species that had
447 attributes such as being extinct or barren. We then checked and filtered out any taxa that were
448 duplicated. Ultimately, the number of remaining entries was 2.5 million, at the same scale at the
449 OTL v. 13.4 product, which presents 2.4 million taxa.

450 We then queried the U.S. National Center for Biotechnology Information to find common
451 names for the 2.5 million taxa. We found common name information for roughly 59,000 taxa. We
452 then constructed Elasticsearch queries to search through all 2.56 million taxa (2.5 million Latin
453 binomial names and 59,000 common names) across all of the abstracts in our database.

454 **5.Descriptive Analysis**

455 **5.1.Need versus action countries for the manage and restore pathways**

456 Figure S6 displays threatened biodiversity, human development index, and climate mitigation
457 potential from NCS manage and restore pathways across countries in our dataset.

458 **5.2.Measuring associations**

459 To measure association between NCS evidence and country-level variables, we calculated two-
460 tailed Pearson’s correlation coefficients and p-values, applying a Bonferroni correction to account
461 for multiple statistical tests. For each NCS category (i.e., protect, manage, or restore) we calculated
462 correlation coefficients between NCS evidence (i.e. total papers in our dataset), the human
463 development index (HDI), and threatened species richness (Table S7).

Table S7: Correlation coefficients between NCS evidence, human well-being, or threatened biodiversity. All correlation coefficients were calculated using a two-sided Pearson’s r ($df=180$). All p-values have been adjusted using the Bonferroni correction to account for multiple statistical tests for each variable of interest (potential carbon storage, 1-HDI, and Threatened Species Richness), and all confidence intervals are estimated at 95% confidence. We reverse the scale of the HDI (by calculating 1-HDI) to reflect our figure in the main text and maintain the same directionality as Threatened Species Richness.

		Protect Evidence	Manage Evidence	Restore Evidence
Potential from protection	C	0.31 ($p = 7.4 * 10^{-5}$, CI = (0.17, 0.43)		
Potential from management	C		0.77 ($p = 2.90 * 10^{-36}$, CI = (0.70, 0.82))	

Potential C from restora- tion			0.41 ($p = 2.38 * 10^{-8}$, CI = (0.28, 0.53))
1-HDI	-0.19 ($p = 0.00943$, CI = (-0.33, -0.048))	-0.18 ($p=0.016$, CI = (-0.32, -0.035))	-0.195 ($p=0.0083$, CI = (-0.33, -0.051))
Threatened Species Rich- ness	0.428 ($p = 4.89 * 10^{-9}$, CI = 0.30, 0.54))	0.42 ($p = 1.69 * 10^{-8}$, CI = (0.29, 0.53))	0.38 ($p = 3.93 * 10^{-7}$, CI = (0.25, 0.497))

5.3.Cumulative Rank Indexing and Analysis

To describe country-level data across multiple pathway strategies and potential co-impacts, we generate several cumulative rank indices. We first add together variables with the same units, including the number of papers in our dataset that focus on protect, manage, or restore NCS pathways (evidence), as well as potential carbon storage potential from protect, manage, and restore NCS pathways (potential carbon storage). We then rank countries from least to most evidence, potential carbon storage, threatened species richness, and 1-HDI. Ranking assigns each country a number of 1 through 182 to generate an ordinal variable that represents a country's relative position for a given numeric variable. We combine rank variables for potential carbon mitigation, threatened species richness, and 1-HDI to generate an equally weighted cumulative rank index for potential co-impacts from NCS. Figure S7 visualizes the total evidence for each country by the equally weighted cumulative rank index, and Table S8 provides the original country-level data, rank variables, and cumulative rank indices.

Table S8: Country-level data for combined evidence and potential benefit index.

Alpha ISO	IUCN name	Combined Benefit Rank	Potential	Combined Evidence	Combined Rank Index Categories
SLE	Sierra Leone	125.5556		22.5	NEED
COG	Congo	126.5556		32.5	NEED
GNB	Guinea-Bissau	93.22222		46	NEED
ERI	Eritrea	92.27778		48.5	NEED
BDI	Burundi	113.5		54	NEED
SLB	Solomon Islands	115.9444		100	NEED
TCD	Chad	89.5		104	NEED
HTI	Haiti	125.8333		104	NEED
SOM	Somalia	118.6667		105	NEED
TGO	Togo	94.66667		105.5	NEED
MLI	Mali	96.77778		107.5	NEED
YEM	Yemen	108.3889		120	NEED
SLV	El Salvador	100		126	NEED
LBR	Liberia	128.4444		130	NEED
CIV	Côte d'Ivoire	141.5556		160	NEED
DOM	Dominican Republic	103.1667		162.5	NEED
GIN	Guinea	139.6667		165.5	NEED

Table S8: Country-level data for combined evidence and potential benefit index.

Alpha ISO	IUCN name	Combined Potential Benefit Rank	Combined Evidence	Combined Rank Index Categories
GNQ	Equatorial Guinea	110.8889	172	NEED
RWA	Rwanda	103.7222	191.5	NEED
PRY	Paraguay	94.5	199	NEED
SDN	Sudan	116.4444	201.5	NEED
GUY	Guyana	97.11111	211	NEED
BEN	Benin	96.22222	218	NEED
ZMB	Zambia	111.9444	222.5	NEED
GAB	Gabon	127.0556	227	NEED
JAM	Jamaica	102.6111	233	NEED
AGO	Angola	125.3333	240	NEED
BLZ	Belize	98.72222	242.5	NEED
SYR	Syrian Arab Republic	100.5556	243	NEED
MWI	Malawi	108.3333	269.5	ACTION
SEN	Senegal	106	283	ACTION
LAO	Lao People's Democratic Republic	131.7778	294	ACTION
HND	Honduras	131.1667	295.5	ACTION
NIC	Nicaragua	122.5	307	ACTION
CUB	Cuba	112.6667	313	ACTION
DZA	Algeria	93.55556	318.5	ACTION
PNG	Papua New Guinea	149.6111	336	ACTION
MOZ	Mozambique	147.5556	338	ACTION
MMR	Myanmar	148	360	ACTION
KHM	Cambodia	135.7222	377	ACTION
UKR	Ukraine	96.44444	381	ACTION
VEN	Venezuela, Bolivarian Republic of	139.2222	381.5	ACTION
GTM	Guatemala	138.0556	384	ACTION
PAN	Panama	104.4444	426.5	ACTION
CAF	Central African Republic	112.5556	433.5	ACTION
BOL	Bolivia, Plurinational States of	131.3889	441	ACTION
MAR	Morocco	111.8333	467	ACTION
LKA	Sri Lanka	106.4444	475.5	ACTION
ZWE	Zimbabwe	99.77778	477	ACTION
NGA	Nigeria	149.8333	509	ACTION
GHA	Ghana	127.6667	531.5	ACTION
SSD	South Sudan	87.27778	550	ACTION
CMR	Cameroon	148.5556	552	ACTION

Table S8: Country-level data for combined evidence and potential benefit index.

Alpha ISO	IUCN name	Combined Benefit Rank	Potential	Combined Evidence	Combined Rank Index Categories
COD	Congo, The Democratic Republic of the	163.5		572	ACTION
MDG	Madagascar	156.3333		578.5	ACTION
ETH	Ethiopia	140.5556		587	ACTION
UGA	Uganda	139.7222		608	ACTION
ECU	Ecuador	134.4444		609.5	ACTION
PAK	Pakistan	124.1111		614	ACTION
PHL	Philippines	142.8889		631.5	ACTION
PER	Peru	124.7778		639	ACTION
MEDIAN		126.2778		680.5	ACTION
CRI	Costa Rica	107.2778		682	ACTION
TUR	Turkey	112.4444		683	ACTION
PRT	Portugal	91.33333		704	ACTION
CHL	Chile	96.27778		747	ACTION
ZAF	South Africa	133.1111		758	ACTION
BGD	Bangladesh	111.4444		759	ACTION
GRC	Greece	94.88889		914.5	ACTION
KEN	Kenya	138.6667		920	ACTION
VNM	Viet Nam	143.7778		965	ACTION
COL	Colombia	139.3333		968	ACTION
TZA	Tanzania, United Republic of	155.7778		984	ACTION
ARG	Argentina	115.4444		1006	ACTION
IRN	Iran, Islamic Republic of	92		1025	ACTION
NPL	Nepal	99.11111		1042	ACTION
THA	Thailand	127.8889		1070	ACTION
RUS	Russian Federation	115.7222		1104	ACTION
MYS	Malaysia	127.5556		1260	ACTION
JPN	Japan	95.83333		1415	ACTION
FRA	France	105.3333		1752	ACTION
ESP	Spain	107.8333		1864	ACTION
ITA	Italy	99.55556		2191	ACTION
MEX	Mexico	142.7778		2636	ACTION
IDN	Indonesia	153.2222		3602	ACTION
AUS	Australia	109		4181	ACTION
CAN	Canada	88.94444		4259	ACTION
IND	India	153.1111		4301	ACTION
BRA	Brazil	144.9444		5215	ACTION

Table S8: Country-level data for combined evidence and potential benefit index.

Alpha ISO	IUCN name	Combined Benefit Rank	Potential	Combined Evidence	Combined Rank Index Categories
CHN	China	140.2222		7434	ACTION
USA	United States	121.7778		21141	ACTION
FRO	Faroe Islands	5.222222		6	OTHER
CPV	Cabo Verde	66.33333		6	OTHER
WSM	Samoa	51.66667		8.5	OTHER
VUT	Vanuatu	77.77778		11.5	OTHER
DJI	Djibouti	76.61111		13.5	OTHER
COM	Comoros	78.16667		22.5	OTHER
STP	Sao Tome and Principe	66.55556		27.5	OTHER
NCL	New Caledonia	82.05556		29	OTHER
GLP	Guadeloupe	35.16667		36	OTHER
GUF	French Guiana	58.22222		40	OTHER
GMB	Gambia	79.61111		45.5	OTHER
TKM	Turkmenistan	50.66667		50.5	OTHER
PRK	Korea, Democratic People's Republic of	75.66667		56	OTHER
MTQ	Martinique	27.72222		57	OTHER
FLK	Falkland Islands (Malvinas)	21.11111		57.5	OTHER
REU	Réunion	60.88889		65	OTHER
ARM	Armenia	59.94444		67.5	OTHER
SUR	Suriname	76.61111		70.5	OTHER
LUX	Luxembourg	8.611111		71	OTHER
MNE	Montenegro	60.55556		74	OTHER
QAT	Qatar	23.11111		74.5	OTHER
NER	Niger	83.72222		75	OTHER
TJK	Tajikistan	58.72222		76.5	OTHER
MDA	Moldova	48.11111		78	OTHER
MUS	Mauritius	62.55556		80	OTHER
SWZ	Eswatini	68.27778		84.5	OTHER
KGZ	Kyrgyzstan	63.27778		86	OTHER
TTO	Trinidad and Tobago	58.44444		87.5	OTHER
LSO	Lesotho	60		90	OTHER
GRL	Greenland	24.88889		92.5	OTHER
KWT	Kuwait	26.11111		99.5	OTHER
ESH	Western Sahara	68.55556		101	OTHER
LBY	Libya	58.27778		104	OTHER
AZE	Azerbaijan	65.88889		106.5	OTHER
ALB	Albania	70.33333		110	OTHER
BLR	Belarus	64.94444		118.5	OTHER

Table S8: Country-level data for combined evidence and potential benefit index.

Alpha ISO	IUCN name	Combined Potential Benefit Rank	Combined Evidence	Combined Rank Index Categories
MRT	Mauritania	81.11111	118.5	OTHER
PRI	Puerto Rico	56.5	124	OTHER
PYF	French Polynesia	64.55556	136.5	OTHER
MKD	North Macedonia	69.11111	141	OTHER
BRN	Brunei Darussalam	77.5	143	OTHER
LBN	Lebanon	80.16667	143	OTHER
UZB	Uzbekistan	67.55556	153.5	OTHER
OMN	Oman	46.16667	157	OTHER
TLS	Timor-Leste	70.05556	170.5	OTHER
AFG	Afghanistan	81.61111	181.5	OTHER
KAZ	Kazakhstan	71.22222	188.5	OTHER
ARE	United Arab Emirates	22.5	190	OTHER
BTN	Bhutan	76.05556	194	OTHER
ISL	Iceland	27.11111	210.5	OTHER
CYP	Cyprus	30.16667	231	OTHER
BIH	Bosnia and Herzegovina	64.55556	232	OTHER
IRQ	Iraq	84.77778	233.5	OTHER
BHS	Bahamas	53.22222	236.5	OTHER
URY	Uruguay	73.61111	242.5	OTHER
LVA	Latvia	40.5	246.5	OTHER
SAU	Saudi Arabia	47.72222	256	OTHER
BFA	Burkina Faso	82.05556	257.5	OTHER
FJI	Fiji	86.66667	258	OTHER
SVN	Slovenia	56	264.5	OTHER
BGR	Bulgaria	77.88889	264.5	OTHER
SRB	Serbia	67.16667	266.5	OTHER
JOR	Jordan	59.16667	267	OTHER
LTU	Lithuania	47.16667	294.5	OTHER
MNG	Mongolia	71.61111	327.5	OTHER
NAM	Namibia	79.16667	341	OTHER
TUN	Tunisia	70.61111	351	OTHER
BWA	Botswana	51.5	354.5	OTHER
SVK	Slovakia	56.94444	396	OTHER
AUT	Austria	67.77778	409.5	OTHER
HRV	Croatia	75.66667	436	OTHER
EGY	Egypt	84.05556	436	OTHER
DNK	Denmark	38.11111	442.5	OTHER
ISR	Israel	56.77778	450	OTHER
CZE	Czechia	55.77778	460	OTHER

Table S8: Country-level data for combined evidence and potential benefit index.

Alpha ISO	IUCN name	Combined Benefit Rank	Potential	Combined Evidence	Combined Rank Index Categories
GEO	Georgia	67.33333		488	OTHER
BEL	Belgium	34.38889		547	OTHER
ROU	Romania	83.66667		570	OTHER
KOR	Korea, Republic of	55.72222		595	OTHER
HUN	Hungary	65.83333		615	OTHER
EST	Estonia	36.77778		701.5	OTHER
NLD	Netherlands	35.94444		707	OTHER
IRL	Ireland	48.38889		771	OTHER
CHE	Switzerland	47.05556		812.5	OTHER
FIN	Finland	53.16667		881	OTHER
POL	Poland	66.88889		933	OTHER
NOR	Norway	50.61111		1133	OTHER
NZL	New Zealand	74.38889		1184	OTHER
SWE	Sweden	50.22222		1270	OTHER
DEU	Germany	82.33333		1613	OTHER
GBR	United Kingdom	85.55556		1983	OTHER

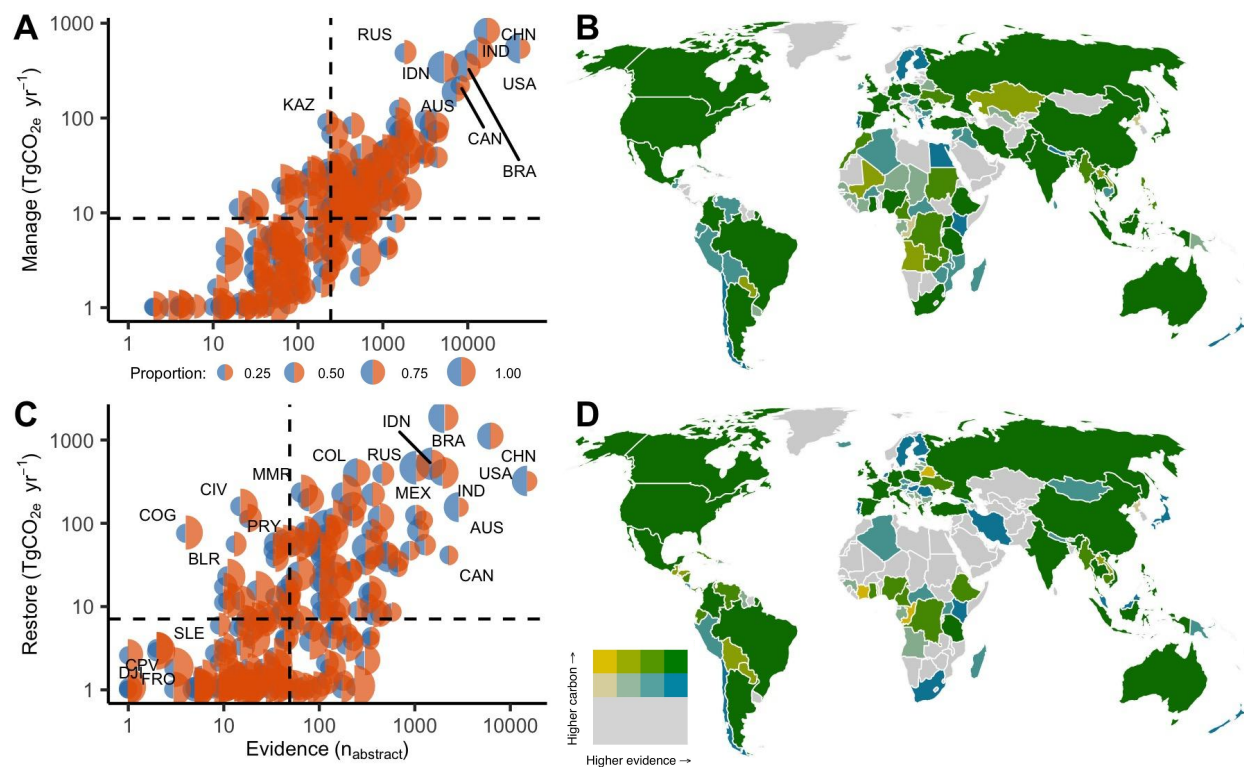


Figure S6: The volume of evidence for NCS “Manage” (first row) and “Restore” (second row) strategies across countries versus their maximum climate mitigation potential through NCS and threatened biodiversity. The maximum value for threatened biodiversity is 3,747 species while for the human development index (HDI) it is a minimum of 0.361. **A** and **C** show semi-circles on the left (blue) for threatened biodiversity and on the right (orange) for the national HDI for the manage and restore pathways, respectively. Larger semi-circles correspond to a country having higher threatened biodiversity or lower human development. The dashed vertical line corresponds to the country-median quantity of evidence, while the dashed horizontal line marks the country-median climate mitigation value for each strategy. **B** and **D** show maps colored based on the degree of climate mitigation potential for each pathway as well as the paucity of evidence. Countries that are more intensely colored in gold are those that have high climate mitigation potential but limited evidence.

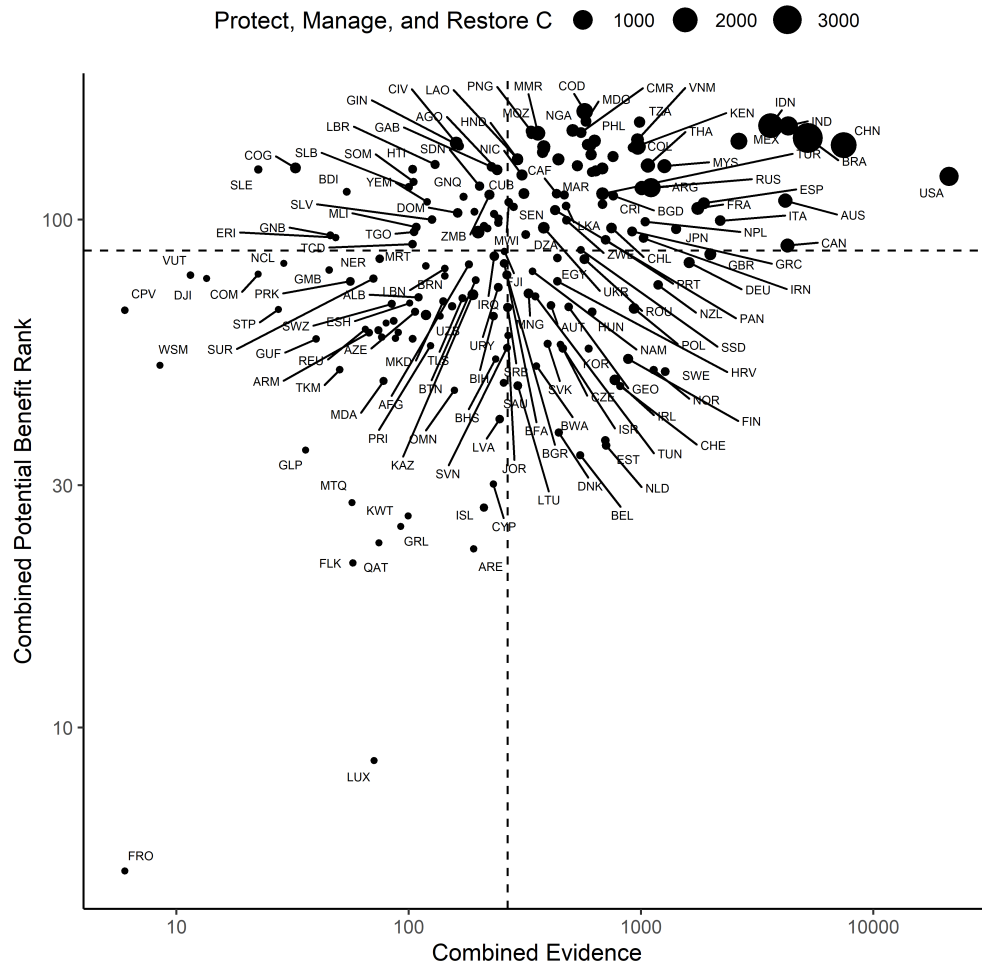


Figure S7: Combined Evidence by Combined Potential Benefit Rank by Protect, Manage, and Restore C. Combined Evidence represents the average number of papers per strategy (protect, manage, and restore) that contain NCS and co-impact information on a specific country. The Combined Potential Benefit Rank is a cumulative rank index that weights equally country-level rank orders for carbon storage across all strategies, threatened species richness, and 1-HDI. Protect, manage, and restore C represents the combined total potential carbon storage across all pathway strategies. As with figures from the main text, dashed lines represent median values for Combined Evidence and Combined Potential Benefit Rank. Countries above the median for Combined Potential Benefit Rank and below the median for Combined Evidence are referred to as Need Countries. Countries above the median for Combined Potential Benefit Rank and above the median for Combined Evidence are referred to as “Action Countries.” Countries below the median for Combined Potential Benefit Rank are referred to as “Other Countries.”

6. References

1. Boyd-Graber, J., Hu, Y., Mimno, D., *et al.* Applications of topic models. *Foundations and Trends® in Information Retrieval* **11**, 143–296 (2017).
2. Callaghan, M. *et al.* Machine-learning-based evidence and attribution mapping of 100,000 climate impact studies. *Nature Climate Change* **11**, 966–972 (2021).
3. Berrang-Ford, L. *et al.* Systematic mapping of global research on climate and health: a machine learning review. *The Lancet Planetary Health* **5**, e514–e525 (2021).
4. Farrell, J. Corporate funding and ideological polarization about climate change. *Proceedings of the National Academy of Sciences* **113**, 92–97 (2016).
5. Marlow, T., Miller, S. & Roberts, J. T. Bots and online climate discourses: Twitter discourse on President Trump’s announcement of US withdrawal from the Paris Agreement. *Climate Policy* **21**, 765–777 (2021).
6. Falkenberg, M. *et al.* Growing polarization around climate change on social media. *Nature Climate Change*, 1–8 (2022).
7. Chang, C. H., Armsworth, P. R. & Masuda, Y. J. Environmental Discourse Exhibits Consistency and Variation across Spatial Scales on Twitter. *BioScience* **72**, 789–797 (2022).
8. Chang, C. H., Armsworth, P. R. & Masuda, Y. J. Twitter data reveal six distinct environmental personas. *Frontiers in Ecology and the Environment* **20**, 481–487 (2022).
9. Westgate, M. J., Barton, P. S., Pierson, J. C. & Lindenmayer, D. B. Text analysis tools for identification of emerging topics and research gaps in conservation science. *Conservation Biology* **29**, 1606–1614 (2015).
10. Weng, M.-H., Wu, S.-C. & Dyer, M. Identification and Visualization of Key Topics in Scientific Publications with Transformer-Based Language Models and Document Clustering Methods. *Applied Sciences* (2022).
11. Hristova, G. & Netov, N. Media Coverage and Public Perception of Distance Learning During the COVID-19 Pandemic: A Topic Modeling Approach Based on BERTopic. *2022 IEEE International Conference on Big Data (Big Data)*, 2259–2264 (2022).
12. Munger, K., Bonneau, R., Nagler, J. & Tucker, J. A. Elites tweet to get feet off the streets: Measuring regime social media strategies during protest. *Political Science Research and Methods* **7**, 815–834 (2019).
13. Liebman, B. L., Roberts, M. E., Stern, R. E. & Wang, A. Z. Mass digitization of Chinese court decisions: How to use text as data in the field of Chinese law. *Journal of Law and Courts* **8**, 177–201 (2020).
14. Horowitz, M. *et al.* What makes foreign policy teams tick: Explaining variation in group performance at geopolitical forecasting. *The Journal of Politics* **81**, 1388–1404 (2019).
15. Hopkins, D. J. & King, G. A Method of Automated Nonparametric Content Analysis for Social Science. *American Journal of Political Science* **54**, 229–247 (2010).
16. DiMaggio, P. Adapting computational text analysis to social science (and vice versa). *Big Data & Society* **2**, 2053951715602908 (2015).

17. Griscom, B. W. *et al.* Natural climate solutions. *Proceedings of the National Academy of Sciences* **114**, 11645–11650 (2017).
18. IUCN. *Global standard for Nature-based Solutions. A user-friendly framework for the verification, design and scaling up of NbS* (IUCN, 2020).
19. McKinnon, M. C. *et al.* What are the effects of nature conservation on human well-being? A systematic map of empirical evidence from developing countries. *Environmental Evidence* **5**, 1–25 (2016).
20. On Biodiversity, I. S.-P. P. & (IPBES), E. S. *Global assessment report on biodiversity and ecosystem services of the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services* tech. rep. (IPBES, 2019).
21. Vera-Baceta, M.-A., Thelwall, M. & Kousha, K. Web of Science and Scopus language coverage. *Scientometrics* **121**, 1803–1813 (2019).
22. Konno, K. & Pullin, A. S. Assessing the risk of bias in choice of search sources for environmental meta-analyses. *Research Synthesis Methods* **11**, 698–713 (2020).
23. Snilstveit, B., Vojtkova, M., Bhavsar, A., Stevenson, J. & Gaarder, M. Evidence & Gap Maps: A tool for promoting evidence informed policy and strategic research agendas. *Journal of clinical epidemiology* **79**, 120–129 (2016).
24. Blevins, T. & Zettlemoyer, L. *Language Contamination Helps Explains the Cross-lingual Capabilities of English Pretrained Models* in *Proceedings of the 2022 Conference on Empirical Methods in Natural Language Processing* (2022), 3563–3574.
25. Huang, H. *et al.* Not All Languages Are Created Equal in LLMs: Improving Multilingual Capability by Cross-Lingual-Thought Prompting. *arXiv preprint arXiv:2305.07004* (2023).
26. Bang, Y. *et al.* A multitask, multilingual, multimodal evaluation of ChatGPT on reasoning, hallucination, and interactivity. *arXiv preprint arXiv:2302.04023* (2023).
27. Hendy, A. *et al.* How good are GPT models at machine translation? A comprehensive evaluation. *arXiv preprint arXiv:2302.09210* (2023).
28. Amano, T., González-Varo, J. P. & Sutherland, W. J. Languages are still a major barrier to global science. *PLoS biology* **14**, e2000933 (2016).
29. Amano, T. *et al.* Tapping into non-English-language science for the conservation of global biodiversity. *PLoS Biology* **19**, e3001296 (2021).
30. Grootendorst, M. R. BERTopic: Neural topic modeling with a class-based TF-IDF procedure. *ArXiv* **abs/2203.05794** (2022).
31. Devlin, J., Chang, M.-W., Lee, K. & Toutanova, K. *BERT: Pre-training of Deep Bidirectional Transformers for Language Understanding* in *Proceedings of the 2019 Conference of the North American Chapter of the Association for Computational Linguistics: Human Language Technologies, Volume 1 (Long and Short Papers)* (Association for Computational Linguistics, Minneapolis, Minnesota, June 2019), 4171–4186. <https://aclanthology.org/N19-1423>.

32. Reimers, N. & Gurevych, I. *Sentence-BERT: Sentence Embeddings using Siamese BERT-Networks in Proceedings of the 2019 Conference on Empirical Methods in Natural Language Processing and the 9th International Joint Conference on Natural Language Processing (EMNLP-IJCNLP)* (2019), 3982–3992.
33. McInnes, L. & Healy, J. UMAP: Uniform Manifold Approximation and Projection for Dimension Reduction. *ArXiv* **abs/1802.03426** (2018).
34. McInnes, L., Healy, J. & Astels, S. hdbscan: Hierarchical density based clustering. *J. Open Source Softw.* **2**, 205 (2017).
35. Petry, W. K. & Levine, J. M. A meta-analysis of the biodiversity co-benefits of NCS (2023).
36. Halterman, A. Mordecai: Full Text Geoparsing and Event Geocoding. *The Journal of Open Source Software* **2** (2017).
37. Mikolov, T., Chen, K., Corrado, G. S. & Dean, J. *Efficient Estimation of Word Representations in Vector Space in International Conference on Learning Representations* (2013).
38. Bommarito, M. J., Katz, D. M. & Detterman, E. M. LexNLP: Natural Language Processing and Information Extraction For Legal and Regulatory Texts. *InfoSciRN: Legal Informatics (Topic)* (2018).
39. Harris, J. M. & Roach, B. *Environmental and natural resource economics: A contemporary approach* (Routledge, 2017).
40. Friedman, R. S. *et al.* Analyzing procedural equity in government-led community-based forest management. *Ecology and Society* **25** (2020).
41. Kato-Huerta, J. & Geneletti, D. Environmental justice implications of nature-based solutions in urban areas: A systematic review of approaches, indicators, and outcomes. *Environmental Science & Policy* **138**, 122–133 (2022).
42. Dawson, N. M. *et al.* The role of Indigenous peoples and local communities in effective and equitable conservation (2021).
43. Garnett, S. T. *et al.* A spatial overview of the global importance of Indigenous lands for conservation. *Nature Sustainability* **1**, 369–374 (2018).
44. Blanco, G. D. *et al.* The impacts of mining on the food sovereignty and security of Indigenous Peoples and local communities: A global review. *Science of the Total Environment* **855**, 158803 (2023).
45. Hill, R. *et al.* Working with indigenous, local and scientific knowledge in assessments of nature and nature’s linkages with people. *Current Opinion in Environmental Sustainability* **43**, 8–20 (2020).
46. McElwee, P. *et al.* Working with Indigenous and local knowledge (ILK) in large-scale ecological assessments: Reviewing the experience of the IPBES Global Assessment. *Journal of Applied Ecology* **57**, 1666–1676 (2020).
47. Schlingmann, A. *et al.* Global patterns of adaptation to climate change by Indigenous Peoples and local communities. A systematic review. *Current Opinion in Environmental Sustainability* **51**, 55–64 (2021).

48. Keith, D. A. *et al.* A function-based typology for Earth's ecosystems. *Nature* **610**, 513–518 (2022).
49. Rees, J. A. & Cranston, K. Automated assembly of a reference taxonomy for phylogenetic data synthesis. *Biodiversity Data Journal* (2017).
50. OpenTreeofLife *et al.* *Open tree of life taxonomy* (v. 13.4) tech. rep. (Open Tree of Life, 2021). <https://doi.org/10.5281/zenodo.3937750>.

Table S9. Description of the 22 NCS pathways

Pathway	Pathway description (derived from Griscom et al. 2017, Nature4Climate 2023)
Path # 1 Avoided Forest Conversion	Avoided forest conversion, disturbance, degradation, fragmentation, and deforestation of any kind of forest (i.e., rainforests) and natural woodland, including within and close to urban areas.
Path # 2 Reforestation and forest rehabilitation/restoration	Reforestation, rehabilitation or ecological restoration of any kind of forest and natural woodland, including within riparian and urban areas. Includes forest landscape restoration and promotion and enhancement of the protection of riverine forests to reduce soil erosion and promote biodiversity conservation.
Path # 3 Natural Forest Management	Any silvicultural or community forestry practice associated with the sustainable management of natural forests. Includes the management of natural forests for sustainable wood production and provision of subsistence materials for Indigenous Peoples and Local Communities.
Path # 4 Improved Plantations	Carbon sequestration from adopting biologically optimal yield rotation lengths in intensively managed wood production forests
Path # 5 Fire Management	Management of fires occurring naturally in forested areas, savanna, and grasslands.
Path # 6 Sustainable/Avoided Woodfuel Harvest	Improvement of management practices to harvest woodfuel for cooking, heating and as biofuel. Includes regulated small-scale woodfuel harvesting, improvement of cooking and heating devices using woodfuel, zoning of forests to determine woodfuel production zones, and promotion of agroforestry systems that consider sustainable woodfuel production.
Path # 7 Avoided Grassland, Savannas and Shrublands Conversion	Avoided conversion, disturbance, and deforestation of natural grasslands, savannas and shrublands.
Path # 8 Biochar	Enhancing organic soil carbon sequestration and soil health in agricultural land by converting crop residue and other organic matter sources obtained sustainably through pyrolysis to biochar amendments.

Path # 9 Cropland Nutrient Management	Avoided and reduced N ₂ O emissions by reducing the use of chemical and synthetic fertilizers. Ensuring yields through the adequate use of mineral N fertilizers, such as ammonium nitrate to reduce emissions during wet conditions. Alternating the source of fertilizer between dry and wet conditions to reduce N ₂ O emissions. Use of ammonium-based fertilizers with nitrification inhibitors or urea. Soil nutrient management considering economic, environmental and social components. Improved management of livestock manure to reduce methane and N ₂ O emissions.
Path # 10 Conservation Agriculture	Conservation agriculture refers to the use of holistic farming systems that maintain the productivity of agricultural land and their regeneration through sustainable practices, such as year-round crop cover to maintain healthy soils and ecosystems and the diversification of crops. Includes practices such as improved water irrigation management, soil-protective management systems (e.g. cover cropping), nutrient use efficiency, mainly from organic sources, biological pest control, and practices that enhance biodiversity and ecosystem function above- and below-ground.
Path # 11 Agroforestry (Trees in Croplands)	Promotion of traditional, ancient, and modern agroforestry systems that combine the management of trees, crops and/or animal production systems based on ecologically sound practices and sustainable natural resource management systems. Includes agroforestry practiced with both permanent and annual crops.
Path # 12 Grazing - Optimal Intensity	Improved grazing management on rangelands, planted pastures and agroforestry systems considering optimal intensity based on local socio-ecological conditions. Practices include promoting grazing time-control rotation.
Path # 13 Grazing - Legumes in Pastures	Addition of diversified legume plants in pastures to enhance grass growth, soil retention and enriched and better quality pasture.
Path # 14 Grazing - Improved Feed	Improved feed for livestock to reduce enteric fermentation, such as the use of legumes, energy-rich and bloat-free food. Use of locally available natural and sustainable feedstock sources, already adapted to local conditions mainly in tropical and subtropical regions.
Path # 15 Grazing - Animal Management	Improved animal management techniques include choosing improved livestock breeds, increased reproductive performance, lower mortality and increased weight gains. By implementing these animal management techniques, livestock will feed growing populations more efficiently.
Path # 16 Improved Rice Cultivation	Improved rice cultivation through the amelioration and/or removal of water and residual plant material management to prevent/reduce methane and N ₂ O emissions.

Path # 17 Avoided Coastal Wetland Impacts and Conversion	Avoided coastal wetlands conversion, disturbance, degradation, fragmentation, and deforestation, including mangroves, seagrass and salt-marshes.
Path # 18 Avoided Peatland, Bog, Fen and freshwater wetlands Impacts and Conversion	Avoided non-tidal freshwater wetlands conversion, disturbance, fragmentation, degradation, and deforestation, including, peatlands, bogs, and fens, and forested freshwater wetlands..
Path # 19 Coastal Wetland Restoration, Reforestation and Rehabilitation	Protecting and restoring coastal wetlands. Practices include mangrove reforestation in ecologically appropriate areas, enhancement and promotion of sustainable mangrove forest management, restoration and hydrological rehabilitation of water flows within mangrove and salt marshes considering a watershed approach, and restoration and replanting of seagrass.
Path # 20 Peatlands, Bogs, Fens and Wetlands Restoration and Rehabilitation	Restoration of global non-tidal freshwater forested and non-forested wetlands. Includes practices such as the removal of dams and dikes obstructing the natural hydrological flow within peatlands, bogs and fens and other wetlands or management of water flows considering a watershed approach.
Path # 21 Grassland Restoration, Rehabilitation	Reforestation, rehabilitation or ecological restoration of grasslands, savannas, and rangelands.
Path # 22 Afforestation	Afforestation, forestation or reafforestation restricted only to areas considered ecologically appropriate, or corresponding to abandoned agricultural lands previously covered by trees. This pathway would exclude afforestation on current or past agricultural lands which historically would be grassland habitat or wetland habitat.

Table S10. Description of the 11 co-impacts

Co-impact	Co-impact description (derived from McKinnon et al. 2016 and Pörtner et al. 2021)
1. General human well-being	Well-being, prosperity, empowerment, resilience, survival development, and social improvement of humans and diverse communities
2. Economic living standards	Economic benefits including income, employment, opportunities for employment payments for ecosystem services, livelihoods, poverty, savings, and loans.
3. Material living standards	Material well-being and benefits including assets owned, access to food, fiber, fuel, and basic infrastructure such as timber, construction materials, subsistence well-being, and shelter.
4. Health	Attributes pertaining to physical and mental health, nutrition, life expectancy and health span, access to health care, disease occurrence, and mental health.
5. Education	Institutions and infrastructure relating to education including access to elementary to university-level education, capacity building, skills development, traditional knowledge systems, and metrics of educational attainment.
6. Social relations	Attributes and metrics pertaining to community interaction, participation, inter-personal conflict, social connection, trust, welfare, equity, equality, and resilience.
7. Security & Safety	Includes physical security, land tenure security and resource security, human rights, environmental and social justice, vulnerability, resilience, and adaptive capacity.
8. Subjective well-being	Perceived quality of life, happiness measures, satisfaction with life, perceptions of living standard, and perceived physiological, emotional, social, spiritual, or intellectual well-being tied to some value of ecosystem(s) and/or resources
9. Culture & spirituality	Traditional values and practices related to natural resources, sense of place or attachment to land, spiritual and religious beliefs and values, cultural identity and heritage
10. Environmental co-benefits	Reduction of environmental harms such as air, water, or soil pollution, increased environmental quality, provisioning, supporting, and regulating ecosystem services.
11. Biodiversity co-benefits	Attributes relating to the abundance and diversity of biological populations and species, metrics of biological or ecosystem diversity, ecosystem connectivity and function

Table S11. Co-impacts broad search queries.

Co-impact	Broad search query
General well-being	((human* OR communit* OR people* OR rural) AND (wellbeing OR "well being" OR well-being OR wellness OR welfare OR prosperity OR empower* OR vulnera* OR resilien* OR survival OR develop*)) OR wellbeing OR "well being" OR well-being OR "social condition" OR "social improvement*" OR welfare OR "positive welfare" OR wellness OR ((animal OR livestock OR ruminant* OR cattle OR cow* OR sheep OR lamb* OR goat* OR horse* OR ungulate OR deer* OR herd* OR pig OR herbivore) AND (health* OR performance OR "optim* grass* use*" OR behavior OR "positive interaction*" OR wellness))
Economic living standards	((econom* OR financ* OR socio-economic OR socioeconomic) AND (security OR resource* OR *benefit* OR wellbeing OR well-being OR "well being" OR return* OR remunerat* OR revenue* OR incentive* OR saving* OR cost* OR impact* OR capital OR value* OR optim* OR condition* OR outcome* OR indicator* OR loss* OR support OR fair* OR equit* OR equal* OR resilien* OR stability)) OR (poverty AND (avoid* OR prevent* OR reduc* OR alleviat* OR line OR dynamic* OR polic* OR eradicat* OR impact* OR rate* OR level* OR class* OR mitigat* OR tackl* OR impact* OR effect* OR rural OR distribution)) OR income OR wage OR salar* OR livelihood* OR "economic livelihood*" OR "livelihood resilience" OR "sust* livelihood*" OR job OR wealth OR employ* OR compensat* OR earn* OR pay* OR remunerat* OR incentive* OR stipend* OR revenue* OR reward* OR saving* OR loan* OR rural OR labor OR poverty OR cash-flow* OR cost-effective* OR cost-efficien* OR (reduce*, cost*) OR low-cost* OR "cost* saving*" OR "opportunity cost*" OR "cost* opportunity" OR economy OR "natural capital" OR "positive welfare effect*" OR price* OR (fair*, equit*, distribution, *benefit*) OR (improv*, business, practice*) OR (improv*, business)
Material living standards	(material AND (wellbeing OR well-being OR "well being" OR *benefit* OR welfare OR wellness OR "living standard*" OR asset* OR cost* OR value* OR optim* OR condition* OR outcome* OR indicator* OR loss* OR gain* OR support OR construction)) OR (security AND (food OR fiber OR fibre OR water OR shelter OR transport* OR house*)) OR (food AND (security OR sovereignty OR safety OR "sust* production" OR health* OR slow OR local OR organic OR nutritious OR economic*)) OR (crop* AND (quality OR sust* OR yield OR local OR organic)) OR (livelihood* AND (timber OR wood OR lumber OR agricultur* OR *forest* OR wetland OR graz* OR livestock OR people* OR depend* OR relay* OR reliance*)) OR (water AND (potable OR drinking OR tap)) OR "living standard*" OR asset* OR food OR fiber OR fibre OR fuel OR house* OR shelter OR water OR transport OR communication OR "resource access" OR transport* OR house* OR (avoid*, deprivation) OR "sust* food production" OR (sust*, wood, production) OR (sust*, timber, production) OR (increas*, sust*, yield*) OR "global food security"
Health	(health* AND (*benefit* OR physical OR mental OR emotional OR maternal OR infant OR child OR human OR care OR public OR pollution OR contamination OR noise OR communit* OR occupation* OR cost* OR value* OR optim* OR condition* OR outcome* OR effect* OR improv* OR impact*)) OR (wellness AND (physical OR mental OR emotional OR psychol* OR intellectual OR spiritual OR social)) ((avoid* OR prevent* OR tackl* OR reduc* OR mitigat*) NEAR/3 (disease* OR illness* OR "infectious disease*" OR infectious OR malaria OR dengue OR infection* OR zoonos* OR zoonotic OR respiratory OR cardiovascular OR communicable OR stress OR heat OR warming OR famine OR starvat* OR hunger OR anxiety OR depression OR "impact on health" OR unhealthy OR harmful OR pollution OR contaminat* OR noise OR *creased OR burden)) OR (medicin* AND (traditional OR ancestral)) OR healthcare OR (social, care) OR nutrition OR diet OR longevity OR "life expectancy" OR health OR lifestyle OR "*creased illness" OR "*creased disease*" OR nutrition OR (human, nutrition) OR (better, nutrition) OR stress OR heat OR warming OR illness* OR famine OR starvation OR hunger OR infection OR anxiety OR depression OR health OR lifestyle OR (avoid*, infectious, disease*) OR (impact, health) OR (*creased, illness) OR (avoid*, zoonos*) OR (avoid*, zoonotic)
Education	(knowledge AND (scientific OR science-based OR observat* OR empirical OR experimental OR traditional OR Indigenous OR local OR transfer OR gain* OR exchang* OR access*)) OR (capacit* AND (building OR build* OR local OR develop* OR strengthen* OR framer* OR agricultur* OR harvester* OR forester* OR manager* OR technician* OR rancher* OR ranger* OR rural OR "rural stakeholder*" OR "rural small-holder*" OR "rural smallholder*" OR stakeholder* OR multiple-stakeholder* OR communit* OR peasant* OR dweller* OR fisher* OR optim* OR condition* OR outcome* OR support)) OR (skill* AND (improv* OR gain OR livelihood* OR transfer OR organiz* OR develop* OR administ* OR manag* OR framer* OR agricultur* OR harvester* OR forester* OR manager* OR technician* OR rancher* OR ranger* OR rural OR "rural stakeholder*" OR "rural small-holder*" OR "rural smallholder*" OR stakeholder* OR communit* OR peasant* OR dweller* OR fisher* OR optim* OR condition* OR outcome* OR indicator*)) OR

	educat* OR literacy OR illiteracy OR illitera* OR evidence-based OR “local ecological knowledge” OR “traditional ecological knowledge” OR (knowledge, loss*)
Social relations	(social AND (relation* OR network* OR improv* OR enhance* OR interact* OR participat* OR involv* OR cohesion OR bonding OR welfare OR “well being” OR wellbeing OR well-being OR equit* OR equal* OR inequalit* OR inequity OR network OR resilien* OR interact* OR conflict OR cost* OR value* OR optim* OR condition* OR outcome* OR indicator* OR acceptance)) OR (communit* AND (interact* OR participat* OR involv* OR cohesion OR relation* OR building)) OR (gender AND (equity OR equality OR inequalit* OR inequity)) OR togetherness OR inclus* OR equality OR equit* OR inequality OR inequity OR stakeholder* OR gender OR connectedness OR trust OR engagement OR (stakeholder*, engag*) OR (stakeholder*, partnership*) OR (stakeholder*, involv*) OR belonging OR “mutual interdependenc*” OR “synergistic opportunit*” OR cohesion OR bonding OR community-driven OR community-based OR cooperativ* OR collaborat* OR cooperat* OR co-operat* OR partnership* OR synergy OR teamwork OR coordinat* OR interaction* OR interrelation* OR participat* OR coercion OR kinship OR reciprocity OR behavior OR behaviour OR (change, behavior) OR (transformat*, change*) OR recreation OR (outdoor, recreation)
Security & Safety	((tenure OR titl* OR land* OR property OR “property right*” OR (land, tenure) OR (land, right*) OR (land*, own*) OR (human, right*) OR (Indigenous, territor*) OR (indigenous, land*) OR (ancestral, land*) OR (ancestral, territor*)) AND (tenure OR secur* OR insecur* OR right* OR land* OR territor* OR indigenous OR *forest* OR *wetland* OR farm* OR recogni* OR formal* OR stab* OR improv* OR optim* OR condition* OR outcome* OR solution* OR customary OR joint OR formal OR legal* OR commun* OR common* OR collectiv* OR ownership OR property OR long-term OR value* OR grab* OR allocation* OR acquisition* OR appropriation OR confiscat* OR expropriat* OR illicit OR requisition OR seizure OR dispossession* OR taking OR take OR women OR men OR strength*)) OR ((perceiv* OR indigenous OR ancestr* OR commun* OR rural OR “indigneous peoples” OR tribal OR farmer* OR agricultur* OR peasant* OR dweller* OR fisher OR person* OR people) AND (land* OR “land* right*” OR “land* own*” OR tenure OR secur* OR insecur* OR safety OR territor* OR right* OR tenure OR titl* OR “resource access*” OR resilien*)) OR (resource* AND (access OR secur* OR right* OR insecur* OR prohibit* OR forbid* OR limit* OR quota* OR regulat* OR collectiv*)) OR ((forest* OR land* OR environment*) AND (defender* OR guardian* OR steward* OR violence)) OR security OR vulnerab* OR “adaptive capacit*” OR right* OR rights-based OR (rights-based, conservation) OR (human*, resilien*) OR communal* OR statutory OR safety OR shelter OR (environment*, justice) OR displacement* OR landowner* OR “water security” OR (traditional, land*, manag*)
Subjective well-being	(life AND (improv* OR quality OR good OR perceiv* OR *benefit*)) OR (satisfaction AND (life OR personal OR communit* OR communal OR perceiv* OR job OR work OR labor)) OR (living AND (well OR good OR standard* OR cost*)) OR (subjective AND (well-being OR “well being” OR wellbeing OR value*)) OR (nature AND (aesthetic OR scenery OR scene* OR perceiv*)) OR (psychol* AND (well-being OR “well being” OR wellbeing OR restor* OR instorative OR health)) OR (perceiv* AND (land* OR territor* OR sea* OR forest* OR wet* OR nature OR sacred OR value*)) OR ((wellbeing OR well-being*) AND (physical OR emotional OR social OR spiritual OR intellectual OR optim* OR condition* OR outcome* OR indicator* OR resilien*)) OR “subjective well*” OR “perceived well*” OR “quality of life” OR self-esteem OR “self esteem” OR happy OR happiness OR “savoir vivre” OR creativity OR imagination OR thrive OR flourish OR lifestyle OR “well-living” OR “living-well” OR prosperity OR develop* OR empower* OR capab* OR success* OR “positive impact”
Culture & spirituality	((cultur* OR socio-cultur* OR sociocultur*) AND (practice* OR tradition* OR heritage OR revitaliz* OR preserv* OR protect* OR continu* OR identit* OR cost* OR value* OR optim* OR condition* OR outcome* OR loss*)) OR (value* AND (cultur* OR tradition* OR spiritual* OR religious OR social OR societal OR nature OR ecosystem* OR relational OR instrumental OR intrinsic OR aesthetic OR landscape OR seascape)) OR (sacred AND (plac* OR mountain* OR sea* OR land* OR forest* OR wet*)) OR (practice* AND (custom* OR wise OR tradition* OR care)) OR (belief* AND (cultur* OR spiritual* OR religious OR tradition*)) OR (sense AND (home OR place)) OR (attachment AND (place OR communit* OR land* OR territor*)) OR (nature AND (connect*)) OR spirit* OR cultur* OR identity OR belief*

Environmental co-impacts	((contamin* OR pollut* OR quality OR clean) AND (air OR water OR soil*)) OR (carbon AND (increase* OR sequest* OR stock* OR stor* OR sink* OR pool* OR reservoir* OR cycl* OR recalcitrant OR add* OR uptak* OR loss* OR maint* OR biomass)) OR (water AND (reservoir OR ground OR underground OR regulat* OR flow* OR purification OR saving OR recharg* OR replen* OR stor* OR retention OR filtration)) OR ((soil* OR water* OR forest* OR wetland* OR tree* OR ecol* OR ecosystem* OR environment* OR coast* OR greenspace*) AND (security OR protect* OR conserv* OR quality OR expos* OR improv* OR moisture OR carbon OR "organic matter" OR "organic material*" OR rehabilit* OR erosion OR pollut* OR degrad* OR contamin* OR toxic* OR health* OR fertil* OR acid* OR *divers* OR remediation OR evaporation OR ground OR underground OR cycle OR regulat* OR flow* OR purification OR eutrophication OR recharg* OR replen* OR stor* OR restor* OR retention OR filtration OR resilien* OR manag* OR maint* OR recover* OR regener* OR benefit* OR wellbeing OR well-being OR risk* OR quality OR remediation OR sust* OR cover)) OR ((avoid* OR prevent* OR reduc* OR mitigat* OR decreas* OR offset OR remediati*) AND (emission* OR "greenhouse gas*" OR methan* OR carbon OR "nitrous oxide" OR N2O OR CO2* OR fertiliz* OR ammon* OR nitr* OR denitr* OR pollution OR soil* OR water OR urea* OR NH3 OR manure OR desiccat* OR eutrophication OR erosion OR contamin* OR conver* OR deforest* OR disaster* OR flood* OR drought* OR pest OR acid*)) OR "nat* regener*" OR "nutrient cycl*" OR (flood*, control) OR (erosion, control) OR pollination OR (pest, suppression) OR (land, degradation) OR "water security"
Biodiversity co-impacts	*divers* OR "bio-divers*" OR species OR (increas*, rich*) OR (function*, group*) OR bird* OR mammal* OR insect* OR butterfl* OR fish* OR amphibian* OR reptile* OR arthropod* OR vertebrat* OR invertebrat* OR herbivore* OR pollinator* OR wildlife OR *organism* OR flora OR fauna* OR vegetation OR understory OR upperstory OR floristic OR *forest* OR wetland* OR plant* OR herb* OR fern* OR moss* OR tree* OR shrub* OR seedling* OR seed* OR fungi OR fungus OR *bacteria* OR (habitat AND (creat* OR quality OR availab* OR loss* OR value* OR optim* OR condition* OR outcome* OR avoid* OR prevent* OR tackl* OR reduc* OR mitigat* OR conver* OR chang* OR impact* OR amount OR use OR manag* OR patch* OR fragment* OR connect* OR cover OR age* OR recolon* OR modif* OR degrad* OR disturb* OR type OR suitable OR increas* OR protect* OR conserv* OR preserv*)) OR ((connectiv* OR corridor) AND (ecosystem* OR ecolog* OR forest* OR wet* OR woodland* OR maint* OR increas* OR protect* OR conserv* OR preserv*))
NCS	((natur* OR nature-based) AND (solution* OR "climate solution*" OR approach* OR strateg*))

Table S12. Co-impacts focused search queries.

Co-impact	Focused search query
General human well-being	(human* OR communit* OR people* OR rural) NEAR/3 (wellbeing OR "well being" OR well-being OR wellness OR welfare OR prosperity OR empower* OR vulnera* OR resilien* OR survival OR develop*) OR wellbeing OR "well being" OR well-being OR "social condition" OR "social improvement*" OR welfare OR "positive welfare"
Economic living standards	(economic* OR financ* OR socio-economic* OR socioeconomic*) NEAR/3 (security OR resource* OR benefit* OR wellbeing OR well-being OR "well being" OR return* OR remunerat* OR revenue* OR incentive* OR saving* OR cost* OR impact* OR capital OR value* OR optim* OR condition* OR outcome* OR indicator* OR fair* OR equit* OR equal* OR resilien* OR stability) OR (income NEAR/3 (low* OR high* OR mid* OR economic* OR benefit* OR optim* OR condition* OR outcome* OR increas* OR rural OR local)) OR (poverty NEAR/3 (reduc* OR alleviat* OR eradicat* OR mitigat* OR tackl* OR prevent* OR avoid*)) OR (improv* OR increase*) NEAR/3 (income OR porfit* OR yield* OR productiv* OR high-yield) OR (avoid* OR prevent* OR tackl* OR reduc* OR mitigat*) NEAR/3 ("economic* hurdle*" OR high-cost) OR income OR wage OR salar* OR livelihood* OR "economic* livelihood*" OR "sust* livelihood*" OR job OR wealth OR employ* OR compensat* OR earn* OR pay* OR remunerat* OR incentiv* OR revenue* OR saving* OR labor OR cash-flow* OR cost-effectiv* OR cost-efficien* OR (reduce*, cost*) OR low-cost* OR "cost* saving*" OR "opportunity cost*" OR "cost* opportunity" OR "positive welfare effect*" OR "fair* and equit* distribution* of benefits" OR (fair*, equit*, distribution, benefit*) OR (improv*, business, practice*) OR (improv*, business)
Material living standards	(material NEAR/3 (wellbeing OR well-being OR "well being" OR benefit* OR welfare OR wellness OR "living standard*" OR asset* OR cost* OR value* OR optim* OR condition* OR outcome* OR indicator*)) OR (security NEAR/3 (food OR fiber OR fibre OR water OR shelter OR transport* OR house*)) OR (food NEAR/3 (security OR sovereignty OR safety OR "sust* production" OR health* OR slow OR local OR organic OR nutritious OR economic*)) OR (crop* NEAR/3 (quality OR sust* OR yield OR local OR organic)) "material well-being" OR "material wellbeing" OR "material living standard*" OR "living standard*" OR food OR fiber OR fibre OR fuel OR house* OR shelter OR water OR "potable water" OR "drink* water" OR "tap water" OR transport* OR communicat* OR "resource access" OR (timber, livelihood*) OR (wood, livelihood*) OR (lumber, livelihood*) OR "construction material*" OR (avoid*, deprivation) OR "sust* food production" OR "sust* wood production" OR "sust* timber production" OR (increas*, sust*, yield*) OR "global food security"
Health	(health* NEAR/3 (benefit* OR physical OR mental OR emotional OR maternal OR infant OR child OR human OR care OR public OR communit* OR occupation* OR cost* OR value* OR optim* OR condition* OR outcome* OR improv* OR effect* OR impact*)) OR (wellness NEAR/3 (physical OR mental OR emotional OR psychol* OR intellectual OR spiritual OR social)) (medicin* NEAR/3 (traditional OR ancestral)) OR (avoid* OR prevent* OR tackl* OR reduc* OR mitigat*) NEAR/3 (disease* OR illness* OR "infectious disease*" OR infectious OR malaria OR dengue OR infection OR zoonos* OR zoonotic OR respiratory OR cardiovascular OR communicable OR stress OR heat OR warming OR famine OR starvat* OR hunger OR anxiety OR depression OR "impact on health" OR unhealthy OR harmful OR pollution OR contaminat* OR noise) OR healthcare OR "social care" OR nutrition OR diet OR "healthy diet" OR longevity OR "life expectancy" OR health OR lifestyle OR "creased illness" OR "creased disease*" OR "human nutrition" OR "better nutrition"
Education	(knowledge NEAR/3 (scientific OR science-based OR observat* OR empirical OR experimental OR traditional OR Indigenous OR local OR transfer OR exchang* OR access*)) OR (capacit* NEAR/3 (building OR build* OR local OR develop* OR strengthen* OR framer* OR agricultur* OR harvester* OR forester* OR manager* OR technician* OR rancher* OR ranger* OR rural OR "rural stakeholder*" OR "rural small-holder*" OR "rural smallholder*" OR stakeholder* OR multiple-stakeholder* OR communit* OR peasant* OR optim* OR condition* OR outcome*)) OR

	(skill* NEAR/3 (improv* OR gain OR livelihood* OR transfer OR organiz* OR develop* OR administ* OR manag* OR framer* OR agricultur* OR harvester* OR forester* OR manager* OR technician* OR rancher* OR ranger* OR rural OR "rural stakeholder*" OR "rural small-holder*" OR "rural smallholder*" OR stakeholder* OR communit* OR peasant* OR dweller* OR fisher* OR optim* OR condition* OR outcome* OR indicator*)) OR (avoid* OR prevent* OR tackl* OR reduc* OR mitigat*) NEAR/3 (illiteracy OR illitera* OR "knowledge loss") OR educati* OR literacy OR "local ecological knowledge" OR "traditional ecological knowledge" OR (improv*, manag*, practic*, educat*) OR (improv*, manag*, practic*, teach*) OR (improv*, manag*, practic*, train*) OR (access*, information) OR (technical, train*)
Social relations	(social* NEAR/3 (relation* OR network* OR improve* OR enhance* OR interact* OR participat* OR involv* OR cohesion OR bonding OR welfare OR "well being" OR wellbeing OR well-being OR equit* OR equalit* OR network OR resilien* OR interact* OR conflict OR cost* OR value* OR optim* OR condition* OR outcome* OR indicator* OR acceptance)) OR (communit* NEAR/3 (interaction* OR participat* OR involv* OR cohesion OR relation* OR building)) OR (gender NEAR/3 (equit* OR equality)) OR (avoid* OR prevent* OR tackl* OR reduc* OR mitigat*) NEAR/3 (inequalit* OR "social inequalit*" OR inequity OR "social injustice*" OR disadvantage* OR discriminat*) OR togetherness OR inclus* OR equality OR equit* OR stakeholder* OR gender OR connectedness OR trust OR engagement OR (stakeholder*, engag*) OR (stakeholder*, partnership*) OR (stakeholder*, involv*) OR belonging OR "mutual interdependenc*" OR "synergistic opportunit*" OR cohesion OR bonding OR community-driven OR community-based OR cooperativ* OR collaborat* OR cooperat* OR co-operat* OR partnership* OR synergy OR teamwork OR coordinat* OR interaction* OR interrelation* OR participat* OR coaction OR kinship OR reciprocity OR behavior OR behaviour OR (change, behavior) OR transformation OR (transformat*, change*) OR recreation OR (outdoor, recreation)
Security & Safety	(tenure NEAR/3 (secur* OR right* OR land* OR territor* OR "Indigenous territor*" OR "Indigenous land*" OR "ancestral land*" OR "ancestral territor*" OR *forest* OR *wetland* OR farm* OR recogni* OR formal* OR stab* OR improv* OR optim* OR condition* OR outcome* OR solution* OR customary OR joint OR legal* OR commun* OR common* OR collectiv*)) OR (titl* NEAR/3 (property OR tenure OR land* OR right* OR *forest* OR wetland* OR farm* OR territor* OR "Indigenous territor*" OR "Indigenous land*" OR recogni* OR secur* OR solution* OR customary OR joint OR formal OR commun* OR common* OR collectiv* OR legal*)) OR (resource* NEAR/3 (access OR secur* OR right* OR quota* OR regulat* OR collectiv*)) OR (right* NEAR/3 (ownership OR property OR *forest* OR wetland* OR farm* OR land* OR human* OR long-term OR territor* OR "Indigenous territor*" OR Indigneous OR customary OR collectiv*)) OR (communit* OR rural OR "Indigneous Peoples" OR tribal OR farmer* OR agricultor* OR peasant* OR dweller* OR fisher*) NEAR/3 (secur* OR safety OR "land* right*" OR "land* own*" OR tenure OR titl* OR "resource access") OR (Indigenous NEAR/3 (territor* OR right* OR secur* OR safety OR land*)) OR (ancestr* NEAR/3 (land* OR territor* OR right*)) OR (perceiv* NEAR/3 (land* OR tenure OR secur* OR insecur* OR safety OR value*)) OR (land* NEAR/3 (*secur* OR allocation* OR acquisition* OR own* OR common OR communal OR property OR customary OR joint OR formal OR women OR men)) OR (avoid* OR prevent* OR tackl* OR reduc* OR mitigat*) NEAR/3 ("forest-related violence" OR displacement* OR "dispossession" land*" OR "land* dispossession*" OR "land* grab*" OR "land* tak*" OR "tenure insecur*" OR insecur*) OR (formal*, land*, right*) OR (women, land*, right*) OR (men, land*, right*) OR "strengthen property right*" OR "person* safety" OR security OR vulnerab* OR "adaptive capacit*" OR (rights-based, conservation) OR (commun*, resilien*) OR (people*, resilien*) OR (human*, resilien*) OR communal* OR "communal* own*" OR "collective* land*" OR "collective* own* land*" OR (collective*, own*, land*) OR (common, right*, land*) OR (communit*, right*, land*) OR (Indigenous, right*, land*) OR statutory OR safety OR shelter OR "environmental justice" OR "environmental defender*" OR "land defender*" OR "**forest* defender*" OR "**forest* guardian*" OR "**forest* steward*" OR "land-tenure stab*" OR (stable, land-tenure) OR (strength*, tenure, security) OR (long-term, land-tenure, right*) OR landowner* OR "water security" OR (protect*, traditional, approach*, "land* manag*") OR (conserv*, traditional, approach*, "land* manag*") OR (improv*, traditional, approach*, "land* manag*") OR (avoid*, resource*, insecur*) OR (avoid*, resource*, prohibit*) OR (avoid*, resource*, forbid*) OR (avoid*, resource*, limit*) OR (land*, tenure, secur*) OR (avoid*, Indigenous, land*, tenure, insecur*) OR (avoid*, Indigenous, territor*, tenure, insecur*)

Subjective well-being	(life NEAR/3 (improv* OR quality OR good OR perceiv* OR benefit*)) OR (satisfaction NEAR/3 (life OR personal OR communit* OR communal OR perceiv* OR job OR work OR labor)) OR (living NEAR/3 (well OR good OR standard* OR cost*)) OR (subjective NEAR/3 (well-being OR "well being" OR wellbeing OR value*)) OR (nature NEAR/3 (aesthetic OR scenery OR scene* OR perceiv*)) OR (psychol* NEAR/3 (well-being OR "well being" OR wellbeing OR restor* OR instorative OR health)) OR (perceiv* NEAR/3 (land* OR territor* OR sea* OR forest* OR wet* OR nature OR sacred OR value*)) OR (wellbeing OR well-being*) NEAR/3 (physical OR emotional OR social OR spiritual OR intellectual OR optim* OR condition* OR outcome* OR indicator*) OR "subjective well*" OR "perceived well*" OR "quality of life" OR self-esteem OR "self esteem" OR happ* OR "savoir vivre" OR lifestyle OR "well-living" OR "living-well" OR prosperity OR empower*
Culture & spirituality	(cultur* OR socio-cultur* OR sociocultur*) NEAR/3 (practice* OR tradition* OR heritage OR revitaliz* OR preserv* OR protect* OR continu* OR identit* OR value* OR optim* OR condition* OR outcome*) OR (value* NEAR/3 (cultur* OR tradition* OR spiritual* OR religious OR social OR societal OR relational OR instrumental OR intrinsic OR aesthetic)) OR (sacred NEAR/3 (place* OR mountain* OR sea* OR land* OR forest* OR wet*)) OR (practice* NEAR/3 (custom* OR wise OR tradition* OR care)) OR (belief* NEAR/3 (cultur* OR spiritual* OR religious OR tradition*)) OR (sense NEAR/3 (home OR place)) OR (attachment NEAR/3 (place OR communit* OR land* OR territor*)) OR (nature NEAR/3 (connect*)) OR spirit* OR cultur* OR identit* OR "belief"
Environmental co-impacts	(quality NEAR/3 (air OR water OR soil*)) OR (clean NEAR/3 (air OR water OR soil*)) OR (soil* NEAR/3 (protect* OR conserv* OR quality OR improv* OR moisture OR "water retention" OR carbon OR "organic matter" OR "organic material*" OR rehabilitat* OR health* OR fertil* OR *divers* OR remediation OR stabilizat*)) OR (water NEAR/3 (avail* OR supply OR reservoir OR ground OR underground OR cycle OR regulat* OR flow* OR purification OR "sust* manag*" OR saving OR protect* OR conserv* OR recharg* OR replen* OR stor* OR retention OR filtration)) OR (carbon NEAR/3 (increase* OR sequest* OR stock* OR stor* OR sink* OR pool* OR reservoir* OR cycl* OR recalcitrant OR emission* OR cycl* OR emission* OR add* OR uptak* OR loss* OR mitigat* OR protect* OR conserv* OR maint* OR biomass)) OR (ecol* NEAR/3 (integrity OR function*)) OR (*forest* NEAR/3 ("water security" OR water OR "clean air" OR carbon OR habitat OR health* OR "nat* regener*" OR "stimulate regener*" OR regener* OR re-grow* OR regrow* OR resilien* OR *divers* OR rehabilit*)) OR (wetland* NEAR/3 ("water security" OR water OR "clean water" OR carbon OR habitat OR "nat* regener*" OR "stimulate regener*" OR regener* OR health* OR rehabilitat* OR regen* OR resilien* OR *divers*)) OR (plant* NEAR/3 (germination OR "nat* regener*" OR regener*)) OR (environment* NEAR/3 (benefit* OR wellbeing OR "well being" OR well-being OR risk* OR quality OR remediation OR sust* OR improv* OR cost* OR optim* OR condition* OR outcome* OR indicator*)) OR (ecosystem* NEAR/3 (health* OR resilien* OR functioning OR service* OR good* OR wellbeing OR well-being OR benefit* OR adapt*)) OR (reforest* OR restor* OR rehabilit* OR regener* OR recover* OR "increas* cover" OR "cover* increas*" OR reveget* OR re-vegetat* OR replant* OR re-plant* OR improv* OR increase* OR amount OR protect* OR preserv* OR conserv* OR maint*) NEAR/3 ("soil* fertil*" OR "soil* health*" OR "soil organic carbon" OR soil*-carbon OR carbon-soil* OR "carbon stor" OR carbon OR "carbon sequest*" OR "blue carbon" OR "brown carbon" OR "carbon sink*" OR "carbon pool*" OR biomass OR "forest sink*" OR "wetland* sink*" OR habitat OR "wildlife habitat" OR "*forest* cover" OR "wetland* cover*" OR "grassland* cover" OR ecosystem* OR "water quality" OR *forest* OR wetland* OR greenspace* OR "green space*") OR (avoid* OR prevent* OR tackl* OR reduc* OR mitigat*) NEAR/3 (eutrophication OR erosion OR "coast* erosion" OR "land erosion" OR "soil* erosion" OR "soil loss*" OR "soil degrad*" OR pollutant* OR degrad* OR pollution OR contaminat* OR toxic* OR acid* OR "NO3-N leaching" OR ammon* OR nitrite OR nitrate OR denitrification OR nitrification OR "nitrogen pollution" OR "nutrient* pollution" OR "soil* expos*" OR reactive-N OR emission* OR deforest* OR "land-use* chang*" OR "natural disaster*" OR flood* OR drought* OR landslide* OR hurricane* OR "sea-level-ris*" OR "ris*-sea-level*" OR warm* OR heat* OR

	"land degrad*" OR drain* OR disturb* OR loss* OR "habitat* loss*" OR "ecosystem* loss*" OR "grassland* loss" OR "**forest* loss*" OR "wetland* loss*" OR "land loss*" OR "loss* land" OR "water runoff" OR "greenhouse gas*" OR "pollutant gas*" OR methan* OR carbon OR "carbon loss" OR "nitrous oxide" OR GHG* OR CH4 OR N2O OR CO2* OR NH3) OR (climate* NEAR/3 (change OR regulat* OR mitigat* OR avoid* OR "reduce* impact*" OR adapt*)) OR (compet*, species, control*) OR (compet*, plants*, control*) OR (germinat*, seed*) OR (ecolog, succession) OR (increas*, "**forest* cover") OR (increas*, "**forest* biomass") OR (increas*, "tree* cover") OR (increas*, "tree* biomass") OR (increas*, "**forest* cover", carbon) OR (increas*, "**forest* biomass", carbon) OR (increas*, "tree* cover", carbon) OR (increas*, "tree* biomass", carbon) OR "nat* regener*" OR (maint*, *forest*, "carbon sequest*", capacity) OR (maint*, *forest*, "carbon stor*", capacity) OR (increas*, "green space*") OR "coastal protection" OR "nutrient cycl*" OR freshwater OR (improv*, "soil* fertil*") OR (improv*, "soil* quality") OR (improv*, "soil* health*") OR (stabil*, soil*) OR (increas*, "carbon stor*") OR (increas*, carbon, stor*, soil*) OR (increas*, carbon, sequest*) OR (increas*, carbon, sequest*, soil*) OR (increas*, carbon, stock*) OR (increas*, "carbon stock*", soil*) OR "increas* carbon uptak*" OR (high*, yield*, crop*) OR (land-based, "climate mitigat*") OR (land-based, "carbon mitigat*") OR "flood* control" OR (reduc*, water, runoff) OR (slow*, water, runoff) OR (regulat*, water, flow*) OR "erosion control" OR (prevent*, release*, carbon, *forest*) OR (prevent*, release*, emission*, *forest*) OR (prevent*, release*, GHG*, *forest*) OR (increas*, "tree* cover*") OR (increas*, "**forest* cover*") OR pollination OR "pest suppression" OR (reduc*, "nitrogen pollution", crop*) OR (reduc*, "nitrogen pollution", agricultur*) OR (reduc*, "nitrogen pollution", farm*) OR ("optim* use*", "nat* resourc*") OR "diffuse pollution" OR (protect*, pollinat*) OR (increas*, pollinat*) OR (service*, pollinat*) OR (water, remediat*) OR (soil*, remediat*) OR "pest control" OR "mitigat* climate" OR (disaster*, risk, reduc*) OR (groundwater, recharg*) OR (underground, replenish*, water) OR (underground, recharg*, water) OR (aquifer*, recharg*) OR (aquifer*, replenish*) OR (heat*, regulat*) OR (heat*, reduce*) OR (reduc*, heat*, risk*) OR (reduc*, heat*, stress*) OR (flood*, regulat*) OR (reduc*, flood*, risk*) OR (reduc*, *fire*, risk*) OR (restor*, degrad*, land*) OR (avoid*, loss*, nat*, ecosystem*) OR (avoid*, loss*, ecosystem*) OR (restor*, degrad*, land*) OR (restor*, degrad*, wetland*) OR (restor*, degrad*, ecosystem*) OR (land*, stabil*) OR (produc*, biomass) OR (protect*, living, biomass) OR (coast*, buffer*) OR (wetland*, buffer*) OR (*forest*, buffer*) OR rewild* OR (increas*, canopy, cover)
Biodiversity co-impacts	(species NEAR/3 (*divers* OR rich* OR "increas* rich*" OR "rich* increas*" OR abund* OR assemb* OR distribut* OR native OR protect* OR conser* OR maint* OR restock OR keystone)) OR (habitat NEAR/3 (creation OR quality OR availab* OR value* OR optim* OR condition* OR outcome*)) OR (tree* NEAR/3 (cover OR biomass OR divers* OR "increas* cover*)) OR (abundance* OR response* OR impact*) NEAR/3 (bird* OR mammal* OR insect* OR fish* OR amphibian* OR reptile* OR arthropod* OR vertebrat* OR invertebrat* OR herbivore* OR flora OR fauna OR plant* OR tree*) OR (*divers* NEAR/3 (bird* OR mammal* OR insect* OR fish* OR amphibian* OR reptile* OR arthropod* OR vertebrat* OR invertebrat* OR flora OR fauna OR plant* OR tree* OR "native tree*" OR "native species" OR ecosystem* OR species OR cost* OR impact* OR value* OR indicator* OR habitat*)) OR (connect* NEAR/3 (ecosystem* OR ecolog* OR forest* OR wet* OR woodland* OR maint* OR increas*)) OR (avoid* OR prevent* OR tackl* OR reduc* OR mitigat*) NEAR/3 ("habitat loss" OR "**divers* loss" OR "species loss") OR (protect* OR preserv* OR conserv* OR maint*) NEAR/3 (*divers* OR "biol* divers*" OR "function* divers*" OR "function* group*") OR "natural ecosystem*" OR biodiversity OR "biological diversity" OR "ecolog* corridor" OR organism* OR (*divers*, maint*) OR (increas*, *divers*) OR "wildlife conservation" OR (maint*, species-rich*) OR (increas*, species-rich) OR (enhanc*, commun*, species, composition) OR (increas*, commun*, species, composition) OR (enhanc*, species, composition) OR (increas*, species, composition)
NCS	"nature based solution*" OR "nature-based solution*" OR "natural climate solution*" OR "nature-based climate solution*" OR "nature-based approach*" OR "Nature-based strat*" OR "natural solution"

Table S13. NCS pathways broad search queries.

Pathway	Broad search query
Path #1 Avoided Terrestrial Forest Conversion	((forest* OR woodland*) AND (avoid* OR prevent* OR conserv* OR preserv* OR maint* OR protect* OR chang* OR conver* OR impact* OR connect* OR fragment* OR function* OR cover))
Path #2 Reforestation	((forest* OR woodland* OR tree* OR land*) AND (restor* OR rehab* OR revital* OR reveget* OR re-vegetat* OR regenerat* OR re-plant* OR replant* OR enhanc* OR renew* OR recover* OR rewild* OR "assist* nat* regenerat*" OR "direct seedling" OR "seedling planting" OR "increas* cover" OR "cover* increas*" OR grow* OR re-grow* OR remediat* OR mitigat* OR offset*)) OR reforest* OR "tree* planting" OR "non-forest *to forest"
Path #3 Natural Forest Management	(forest*, manag*) OR (forest*, sust*) OR (timber, manag*) OR (woodland*, manag*) OR (logging, manag*) OR (wood, production) OR (timber, production) OR (lumber, production) OR "production forest*" OR silvicult* OR forestry OR (non-intens*, wood, production, forest*)
Path #4 Improved Plantations	(plantation*, tree*) OR (plantation*, forest*) OR (plantation*, timber*) OR (plantation*, lumber*) OR (plantation*, wood) OR (plantation*, "pulp and paper") OR ("pulp wood", plantation*) OR (pulp, plantation*) OR (pulpwood, plantation*) OR (plantation*, manag*) OR woodlot* OR timber* OR (wood, production) OR (timber, production) OR (lumber, production) OR (forest*, stand) OR (timber*, stand) OR (lumber*, stand) OR (stand, manag*) OR "planted forest*" OR "production wood" OR (even-age*, plantation*, wood) OR (rotation, plantation*) OR (hardwood, plantation*) OR (mix*-species, plantation*) OR (slow-grow*, plantation*) OR (yield, timber*) OR (yield, wood*) OR (yield, lumber) OR woodlot*
Path #5 Fire Management	((manag* OR prescrib* OR control OR practic* OR fire* OR fuel* OR burn* OR wildfire* OR reburn* OR underburn* OR unburn*) AND (wildfire* OR forest* OR wildland* OR wild-land* OR woodland* OR grassland* OR prairie* OR shrubland* OR savannah* OR savanna* OR wetland*)) OR wildfire*
Path #6 Avoided Woodfuel Harvest	((wood-fuel OR woodfuel OR fuel-wood OR fuelwood OR firewood OR fire-wood) AND (regulate* OR sust* OR avoid* OR prevent* OR chang* OR conver* OR protect* OR impact* OR reduc* "reduc* harvest")) OR ((cookstove* OR cook-stove* OR "burning stove*" OR "wood* stove*" OR "biomass-stove*") AND (improv* OR efficien* OR wood-fuel OR woodfuel OR fuel-wood OR fuelwood OR firewood OR fire-wood))
Path #7 Avoided Grassland Conversion	((grassland* OR prairie* OR shrubland* OR savannah* OR savanna*) AND (avoid* OR prevent* OR conserv* OR preserv* OR maint* OR protect* OR chang* OR impact* OR connect* OR fragment* OR function* OR cover OR native OR natural))
Path #8 Biochar	((biochar* OR bio-char* OR charcoal OR "recalcitrant carbon" OR "non-recalcitrant carbon" OR pyrolysis) AND (soil* OR agricultur*) OR (crop*) OR (amend*, agricultur*, soils*) OR (amend*, farm*, soils*) OR (amend*, crop*, soils*) OR (crop*, residue*))
Path #9 Cropland Nutrient Management	(nutrient*, crop*) OR (nutrient*, agricultur*) OR (fertil*, crop*) OR (fertil*, agricultur*) OR (organic, crop*) OR (organic, agricultur*)
Path #10 Conservation Agriculture	(agricultur*, conserv*) OR (farm*, conserv*) OR (crop*, conserv*) OR (organic, agricultur*) OR (organic, farm*) OR (organic, crop*) OR (soil*, manag*, agricultur*) OR (soil*, manag*, farm*) OR (agricultur*, divers*) OR (farm*, divers*) OR (crop*, divers*) OR (no-till, agricultur*) OR (no-till, farm*) OR (no-till, crop*) OR (reduced-till*, agricultur*) OR (reduced-till*, farm*) OR (reduced-till*, crop*) OR (minimum-till*, agricultur*) OR (minimum-till*, farm*) OR (minimum-till*, crop*) OR (zero-till*, agricultur*) OR (zero-till*, farm*) OR (zero-till*, crop*) OR ("conservation till*", farm*) OR ("conservation till*", crop*)
Path #11 Trees in Croplands & Agroforestry	((agricultur* OR crop* OR farm*) AND tree*) OR agroforest* OR agro-forest* OR agrisilvicultur* OR agri-silvicultur* OR agrosilvicultur* OR agro-silvicultur* OR windbreak* OR shelterbelts OR "alley cop*" OR (farm*, manag*, "nat* regenerat*")
Path #12 Grazing - Optimal Intensity	((graz*, optim*) OR (graz*, manag*) OR (graz*, animal) OR (graz*, improv*) OR (graz*, better) OR (graz*, regenerat*) OR (planted, pasture*) OR (planted, forage) AND (graz* OR pastur* OR rangeland* OR grass* OR sust* OR optim* OR rotat* OR low-intensity OR "stocking rate"))
Path #13 Grazing - Legumes in Pastures	((legum*, graz*) OR (legum*, pasture*, graz*) OR (legum*, planted, pasture*) OR (legum*, planted, graz*) OR (legum*, forage*, graz*) OR (legum*-grass*) OR (sowing, legum*, crop*) OR (sowing, legum*, agricultur*) OR (sowing, legum*, farm*) OR (sowing, legum*, graz*) AND (livestock OR cattle OR ruminant* OR ungulate* OR cow* OR sheep OR lamb* OR goat* OR horse* OR herd* OR graz* OR legume* OR protein* OR pea* OR soy OR soybean OR clover OR "red clover" OR "sweet clover" OR alfalfa OR bloat-free)) OR ((reduc*, enteric*, ferment*) OR (reduc*, rumen, ferment*) AND (cereal OR grain* OR pasture* OR forage OR fodder))
Path #14 Grazing - Improved Feed	((livestock OR cattle OR ruminant* OR ungulate* OR cow* OR sheep OR lamb* OR goat* OR horse* OR herd* OR graz*) AND (feed* OR grain* OR cereal* OR forage OR fodder OR corn OR maize OR pumpkin* OR carrot* OR seed* OR root* OR potato* OR barley OR oat* OR cabbage* OR sorghum OR "winter wheat" OR wheat OR Acacia OR Ailanthus OR Albizia OR Atriplex OR Artemisia OR Artocarpus OR Azadirachta OR Bassia OR Bauhinia OR Brosimum OR Budleja OR Calliandra OR Cajanus OR Caribbean OR Castanopsis OR Centrosema OR Enterolobium OR Erythrina OR Dalbergia OR Desmodium OR Ficus OR Gliricidia OR Grewia OR Hardwickia OR Litsea OR Leucaena OR Macroptilium OR Morus OR Moringa OR Neustanthus OR Pithecellobium OR Prosopis OR Pueraria OR Quercus OR Salix OR Salsola OR Sesbania OR Suaeda OR Stylosanthes OR Tamarix OR Trichantera OR Ziziphus OR alfalfa OR bean* OR breadnut OR "butterfly pea" OR clover OR ipil-ipil OR jumbay OR pea* OR "pigeon pea" OR "purple bush-bean" OR ramon OR "river tamarind" OR siratro OR soy OR soybean OR "tan tan" OR "white leadtrees" OR "white popinac" OR bloat-free OR antifoam* OR supplement* OR "vegetable oil*" OR peanut OR "bloat free" OR bloat* OR non-bloat OR milk OR digestion OR antibloat OR anti-bloat OR digest*))
Path #15 Grazing - Animal Management	((graz*, manag*) AND (animal OR livestock OR cattle OR ruminant* OR sheep OR goat* OR ungulate* OR cow* OR lamb* OR horse*)) OR ((graz*, animal) AND (manag* OR improv* OR sust*)) OR ((livestock OR cattle OR ruminant* OR ungulate* OR cow* OR sheep OR lamb* OR goat* OR horse* OR herd* OR graz*) AND (manag* OR grazing OR pastoral OR methan* OR "breed*" OR "reproductive performance" OR sust* OR rearing OR emission* OR "greenhouse

	gas* OR methan* OR carbon OR "nitrous oxide" OR GHG* OR CH4 OR N2O OR CO2*)) OR ((enhanc*, animal, perform*, graz*) OR (increas*, animal, perform*, graz*) OR (increas*, weight, gain*, graz*) OR (improv*, livestock, breed) OR (improv*, ruminant*, breed) AND (reduc*, rumen, ferment*) OR (reduc*, enteric, ferment*))
Path #16 Improved Rice Cultivation	((rice*, cultivation) OR (rice*, production) AND (improv* OR water OR manag* OR conserv* OR irrigat* OR dry* OR *wet* OR *flood* OR emission* OR "greenhouse gas*" OR methan* OR carbon OR "nitrous oxide" OR GHG* OR CH4 OR N2O OR CO2*))
Path #17 Avoided Coastal Wetlands Impacts	((("coastal wetland*" OR "tidal wetland*" OR mangrov* OR salt-marsh* OR saltmarsh* OR tidal-marsh* OR seagrass* OR sea-grass* OR "shrimp farm*" OR "kelp farm*" OR "seaweed farm*") AND (avoid* OR prevent* OR conserv* OR preserv* OR maint* OR protect* OR chang* OR convers* OR impact* OR connect* OR fragment* OR function* OR cover OR natural))
Path #18 Avoided Freshwater Wetlands	((peat* OR bog OR fen OR marsh* OR wetland* OR swamp*) AND (avoid* OR prevent* OR conserv* OR preserv* OR maint* OR protect* OR chang* OR convers* OR impact* OR connect* OR fragment* OR function* OR cover OR natural))
Path #19 Coastal Wetland Restoration & Rehabilitation	((("coastal wetland*" OR "tidal wetland*" OR mangrov* OR salt-marsh* OR saltmarsh* OR tidal-marsh* OR seagrass* OR sea-grass* OR "shrimp farm*" OR "kelp farm*" OR "seaweed farm*") AND (reforest* OR restor* OR rehab* OR revital* OR reveget* OR re-vegetat* OR regenerat* OR re-plant* OR replant* OR enhanc* OR renew* OR recover* OR rewild* OR "assist* nat* regenerat*" OR "direct seedling" OR "seedling planting" OR "increas* cover" OR "cover* increas*" OR grow* OR re-grow* OR rewet* OR re-wet* OR reflood* OR wet* OR hydro* OR road* OR construction* OR degrad* OR drain* OR dry* OR disturb* OR loss* OR soil OR carbon OR "soil carbon" OR redox OR manag* OR oxi* OR methan* OR condition* OR waterlog* OR *water OR flow OR low-oxygen OR acid* OR road* OR construction* OR nutrient* OR fertiliz* OR remediat* OR mitigat* OR offset* OR emission* OR "greenhouse gas*" OR methan* OR carbon OR "nitrous oxide" OR GHG* OR CH4 OR N2O OR CO2*))
Path #20 Freshwater Wetlands Restoration & Rehabilitation	((peat* OR bog OR fen OR marsh* OR wetland* OR swamp*) AND (non-tidal OR freshwater OR fresh-water OR forested OR reforest* OR restor* OR rehab* OR revital* OR reveget* OR re-vegetat* OR regenerat* OR re-plant* OR replant* OR enhanc* OR renew* OR recover* OR rewild* OR "assist* nat* regenerat*" OR "direct seedling" OR "seedling planting" OR "increas* cover" OR "cover* increas*" OR grow* OR re-grow* OR rewet* OR re-wet* OR reflood* OR dry* OR disturb* OR loss* OR soil OR carbon OR "soil carbon" OR redox OR manag* OR oxi* OR methan* OR condition* OR waterlog* OR *water OR flow OR low-oxygen OR acid* OR road* OR construction* OR nutrient OR fertiliz* OR moss OR remediat* OR mitigat* OR offset* OR emission* OR "greenhouse gas*" OR methan* OR carbon OR "nitrous oxide" OR GHG* CH4 OR N2O OR CO2*))
Path #21 Grassland Restoration & Rehabilitation	((grassland* OR prairie* OR shrubland* OR shrub-land* OR savannah* OR savanna*) AND (reforest* OR restor* OR rehab* OR revital* OR reveget* OR re-vegetat* OR regenerat* OR re-plant* OR replant* OR enhanc* OR renew* OR recover* OR rewild* OR "assist* nat* regenerat*" OR "direct seedling" OR "seedling planting" OR "increas* cover" OR "cover* increas*" OR grow* OR re-grow* OR remediat* OR mitigat* OR offset*))
Path #22 Afforestation	afforestation OR forestation OR reafforestation OR re-afforestation OR "farm* into *forest*" OR "crop* into *forest*" OR ("available land", restor*, *forest*) OR (abandon*, agricultur*, *forest*) OR (abandon*, land, *forest*) OR (abandon*, farm*, *forest*) OR (abandon*, aquiculture, *forest*) OR (abandon*, aquaculture, *forest*) OR (abandon*, pisciculture, *forest*)

Table S14. NCS pathway focused search queries.

Pathway	Focused search query
Path #1 Avoided Terrestrial Forest Conversion	("tropical forest*" OR *forest* OR woodland* OR rainforest*) NEAR/3 ("carbon sequest*" OR "carbon stor*" OR "carbon reservoir*" OR "carbon mitigat*" OR "carbon-rich" OR "cover* increas*" OR "protect* cover*" OR "conserv* cover*" OR "conserv* OR protect* OR preserv*" OR "connect* OR maint*" OR "avoid*" OR "gain*" OR "old-grow*" OR "primary" OR "primeval" OR "climax" OR "evergreen" OR "native" OR "nat*" OR "ecological function" OR "CO2") OR (old-grow*, *forest*, conserv*) OR (old-grow*, *forest*, protect*) OR (old-grow*, *forest*, preserv*) OR (old-grow*, *forest*, maint*) OR (primary, *forest*, conserv*) OR (primary, *forest*, protect*) OR (primary, *forest*, preserv*) OR (primary, *forest*, maint*) OR (primeval *forest*, conserv*) OR (primeval, *forest*, protect*) OR (primeval, *forest*, preserv*) OR (primeval, *forest*, maint*) OR (*forest*, maint*, "ecological function") OR (woodland*, maint*, "ecological function") OR (avoid*, deforest*) OR "revers* deforest*" OR (avoid*, *forest*, degrad*) OR "revers* *forest* degrad*" OR (avoid*, *forest*, "land-use* change*") OR (avoid*, *forest*, disturb*) OR (avoid*, *forest*, loss*) OR (avoid*, *forest*, conver*) OR (avoid*, *forest*, reduc*) OR (avoid*, *forest*, disappear*) OR (avoid*, *forest*, deplet*) OR ("avoid* logg*", *forest*) OR (avoid*, nat*, *forest*, fragment*) OR (avoid*, old-growth, *forest*, conver*) OR (avoid*, old-grow*, *forest*, loss*) OR (avoid*, old-grow*, *forest*, logg*) OR (avoid*, old-grow*, *forest*, degrad*) OR (avoid*, old-grow*, *forest*, disturb*) OR (avoid*, old-grow*, *forest*, disappear*) OR (avoid*, old-grow*, *forest*, reduc*) OR (avoid*, old-grow*, *forest*, fragment*) OR (avoid*, woodland*, degrad*) OR (avoid*, woodland*, "land-use* change*") OR (avoid*, woodland*, disturb*) OR (avoid*, woodland*, loss*) OR (avoid*, woodland*, conver*) OR (avoid*, woodland*, reduc*) OR (avoid*, woodland*, disappear*) OR (avoid*, woodland*, deplet*) OR (avoid*, woodland*, logg*) OR (avoid*, nat*, *woodland*, fragment*) OR (avoid*, old-growth, woodland*, conver*) OR (avoid*, old-grow*, woodland*, loss*) OR (avoid*, old-grow*, woodland*, logg*) OR (avoid*, old-grow*, woodland*, degrad*) OR (avoid*, old-grow*, woodland*, disturb*) OR (avoid*, old-grow*, woodland*, disappear*) OR (avoid*, old-grow*, woodland*, reduc*) OR "tropical *forest* conver*" OR (avoid*, unsust*, *forest*, conver*) OR (avoid*, unsust*, *forest*, "land-use* chang*") OR (prevent*, deforest*) OR (prevent*, *forest*, degrad*) OR (prevent*, *forest*, "land-use* change*") OR (prevent*, *forest*, disturb*) OR (prevent*, *forest*, loss*) OR (prevent*, *forest*, conver*) OR (prevent*, *forest*, reduc*) OR (prevent*, *forest*, disappear*) OR (prevent*, *forest*, deplet*) OR (prevent*, nat*, *forest*, fragment*) OR (prevent*, old-growth, *forest*, conver*) OR (prevent*, old-grow*, *forest*, loss*) OR (prevent*, old-grow*, *forest*, logg*) OR (prevent*, old-grow*, *forest*, degrad*) OR (prevent*, old-grow*, *forest*, disturb*) OR (prevent*, old-grow*, *forest*, disappear*) OR (prevent*, old-grow*, *forest*, reduc*) OR (prevent*, old-grow*, *forest*, fragment*) OR (prevent*, *forest*, conver*) OR (prevent*, woodland*, degrad*) OR (prevent*, woodland*, "land-use* change*") OR (prevent*, woodland*, disturb*) OR (prevent*, woodland*, loss*) OR (prevent*, woodland*, conver*) OR (prevent*, woodland*, reduc*) OR (prevent*, woodland*, disappear*) OR (prevent*, woodland*, deplet*) OR (prevent*, "nat* *woodland*", fragment*) OR (prevent*, old-grow*, woodland*, conver*) OR (prevent*, old-grow*, woodland*, loss*) OR (prevent*, old-grow*, woodland*, logg*) OR (prevent*, old-grow*, woodland*, degrad*) OR (prevent*, old-grow*, woodland*, disturb*) OR (prevent*, old-grow*, woodland*, disappear*) OR (prevent*, old-grow*, woodland*, reduc*) OR (sust*, land*, manag*)
Path #2 Reforestation	("tropical forest*" OR *forest* OR woodland* OR rainforest*) NEAR/3 ("carbon sequest*" OR "carbon stor*" OR "carbon reservoir*" OR "carbon mitigat*" OR "carbon-rich" OR "increas* cover" OR "cover* increas*" OR "restor*" OR "reforest*" OR "rehabilit*" OR "recover*" OR "regener*" OR "reveget*" OR "re-vegetat*" OR "replant*" OR "re-plant*" OR "establish*" OR "re-establish*" OR "enhanc*" OR "regrow*" OR "re-grow*" OR "renew*" OR "rewild*" OR "mitigat*" OR "offset*" OR "remediat*" OR "nat* regener*" OR "assist* nat* regener*" OR "seeding" OR "carbon" OR "CO2") OR reforest* OR "forest* nat* regener*" OR "forest* land* restor*" OR (FLR, forest*) OR (landscape, restor*) OR "enrichment planting" OR "second* forest*" OR "tree* planting" (tree*, planting) OR "forest*-cover increas*" OR "tree*-cover increas*" OR (tree*, cover, increas*) OR (increase*, "carbon sequest*", *forest*) OR (increase*, "carbon stor*", *forest*) OR (increase*, "carbon reservoir*", *forest*) OR (*forest*, "nat* regener*") OR (*forest*, "assist* nat* regener*") OR (*forest*, second*, regener*) OR (restor*, *forest*, cover) OR (restor*, *forest*, "native species") OR (restor*, *forest*, "native tree* species") OR (reforest*, *forest*, "native species") OR (reforest*, *forest*, "native tree* species") OR "non-*forest* to *forest*" OR ("right species", reforest*) OR ("native species", reforest*)
Path #3 Natural Forest Management	("tropical forest*" OR *forest* OR woodland* OR rainforest* OR logg* OR wood* OR wood*-harvest* OR timber-harvest* OR lumber-harvest* OR wood OR timber OR lumber OR wood-production OR timber-production OR lumber-production OR "production *forest*" OR stand OR "nat* *forest*" OR "nat* woodland*") NEAR/3 (manag* OR "sound manag*" OR "manag* practic*" OR "adapt* manag*" OR "practice*" OR "silviculture" OR "sust*" OR "improv*" OR "enhanc*" OR "select* harvest*" OR "select* cut*" OR "select* logg*" OR "select* system*" OR "directional felling" OR "rotation*" OR "optim* rotation*" OR "long*-rotation*" OR "prolong* rotation*" OR "extend* rotation*" OR "prolong* harvest*" OR "extend* harvest*" OR "long*-harvest*" OR "coppic*" OR "coppic* system" OR grow* OR regener* OR low-impact OR low-intensity OR reduce*-impact OR small-scale OR small-sized OR "harvest* cycle*" OR even-age* OR multiage* OR multi-age* OR "tree* biomass" OR "forest* biomass" OR "increas* carbon" OR "increas* cover" OR "cover* increas*" OR "add* carbon*" OR "nat* forest*" OR "nat* woodland*") OR (non-intens*, *forest*, harvest*) OR (non-intens*, *forest*, manag*) OR (non-intens*, manag*, wood, production) OR (non-intens*, manag*, timber, production) OR (non-intens*, manag*, *forest*) OR (directional, felling, *forest*) OR (improv*, skidding, timber) OR (improv*, harvest*, timber) OR (improv*, harvest*, wood) OR (improv*, harvest*, lumber) OR (improv*, logg*, timber) OR (improv*, logg*, wood*) OR (low-impact, logg*) OR (low-impact, timber, harvest*) OR (low-impact, wood, harvest*) OR (low-impact, timber, production) OR (low-impact, wood, production) OR (low-impact, timber, extraction*) OR (low-impact, wood, extraction) OR (low-intensity, thinning, timber) OR (low-intensity, thinning, *forest*) OR (small-scale, harvest*, timber) OR (small-scale, harvest*, wood) OR (select*, harvest*, *forest*) OR ("select* harvest*", timber) OR ("select* system*", *forest*) OR ("select* system*", timber) OR ("select* cut*", *forest*) OR ("small-scale harvest*", *forest*) OR "selective logging" OR silviculture OR "natural forest* manag*" OR (sust*, harvest*, nat*, woodland*) OR (sust*, lumber*, woodland*) OR "sust* timber production" OR "sust* forest* manag*" OR "sust* woodland* manag*" OR "small-scale logging" OR (sust*, harvest*, lumber*) OR (sust*, extraction*, timber) OR (sust*, extraction*, wood) OR "sust* timber production" OR "sust* wood production" OR "sust* lumber production" OR "sust* forestry" OR "woodland* manag* practic*" OR (improv*, nat*, woodland*, manag*) OR (improv*, logg*, nat*, woodland*) OR (improv*, "forest* manag* practic*") OR (improv*, "nat* forest*", manag*) OR (wood-production, *forests*, improv*, "manag* practice*") OR ("nat* forest*", "nat* regener*", manag*) OR (*forest*, "nat* regener*", manag*) OR "improv* forest* manag*" OR "improv* nat* forest* manag*" OR ("improv* logging", "road construction") OR (improv*, logging, "road construction") OR "improv* forestry" OR "improv* forestry practic*" OR "improv* forestry techniq*" OR (improv*, forestry, techniq*)

	OR (efficien*, forestry, techniq*) OR (sound, forestry, techniq*) OR (reduc*, damag*, woodland*, manag*) OR (reduc*, damag*, *forest*, manag*) OR (reduc*, damag*, logg*, manag*) OR (reduc*, damag*, timber, manag*) OR (reduc*, damag*, timber-production, manag*) OR (reduc*, damag*, wood-production, manag*) OR (reduce*, "wood waste") OR (reduc*, "collateral damage", *forest*) OR (harvest*, rotation*, woodland*) OR (small-scale, "forest* harvest") OR (enhanc*, woodland*, grow*) OR (enhanc*, woodland*, regener*) OR "*forest* manag* practic*" OR (improv*, "forest* practic*") OR (climate-smart, forestry) OR "sust* community forestry" OR "community forestry" OR ("sust* harvest*", timber) OR ("sust* harvest*", wood) OR (improv*, "wood production") OR (extend*, "harvest* cycle*", timber) OR (extend*, "harvest cycle*", wood) OR (extend*, rotation*, *forest*) OR (extend*, harvest*, rotation*, *forest*) OR (extend*, harvest*, cycle*, *forest*) OR (extend*, harvest*, cut*, *forest*) OR "conservation forestry" OR "liberation thinning" OR (limited, extension, harvest*, cycle*, *forest*) OR (limited, extension, harvest*, *forest*) OR (improv*, "nat* *forest*", manag*) OR (enhanc*, *forest*, grow*) OR (enhanc*, *forest*, regener*) OR (enhanc*, manag*, *forest*) OR ("second* grow*", *forest*) OR "seed-tree system" OR shelterwood* OR ("nat* regeneration*", *forest*) OR ("assist* nat* regener*", *forest*) OR (sust*, forestry, techniq*) OR (even-age*, *forest*) OR (even-age*, *forest*, manag*) OR (even-age*, stand) OR (multiage*, stand, manag*) OR (uneven-age*, *forest*, improv*, manag*) OR ("all size class*", *forest*) OR (even-age*, stand) OR (uneven-age*, stand, improv*) OR (optim*, rotation*, age, *forest*) OR (optim*, harvest*, age, *forest*) OR (stand, regener*) OR (stand, regener*, timber) OR (stand, regener*, wood) OR (improv*, timber, quality, manag*) OR (improv*, wood, quality, manag*) OR (improv*, lumber, quality, manag*) OR (improv*, stand, productivity, *forest*) OR (old-grow*, *forest*, conserv*) OR (old-grow*, *forest*, protect*) OR (old-grow*, *forest*, manag*) OR (old-grow*, set-aside*, *forest*) OR (continuous, cover, *forest*) OR (maint*, *forest*, cover) OR (increas*, *forest*, cover) OR (increas*, *forest*, cover, forestry) OR (increas*, *forest*, cover, manag*) OR (increas*, "tree* density") OR (increas*, "tree* biomass") OR (increas*, "forest* biomass") OR (increas*, stem*, density*) OR (increas*, canopy, cover) OR (below-ground, tree*, biomass, increase*) OR (above-ground, tree*, biomass, increase*) OR (belowground, tree*, biomass, increase*) OR (aboveground, tree*, biomass, increase*) OR (below-ground, *forest*, biomass, increase*) OR (above-ground, *forest*, biomass, increase*) OR (belowground, *forest*, biomass, increase*) OR (aboveground, *forest*, biomass, increase*) OR (*forest*, age, structure) OR (*forest*, structure, manag*) OR (increas*, *forest*, grow*, rate*)
Path #4 Improved Plantations	("planted forest*" OR plantation* OR woodlot* OR timber* OR lumber* OR wood* OR wood*-harvest* OR timber-harvest* OR lumber-harvest* OR wood-production OR timber-production OR lumber-production OR stand) NEAR/3 (logg* OR improv* OR perform* OR optim* OR rotation* OR "long*-rotation*" OR "prolong* rotation*" OR "extend* rotation*" OR "prolong* harvest*" OR "extended harvest*" OR "long*-harvest*" OR thinnin* OR "yield rotation*" OR "increas* yield" OR "increas* production" OR sust* OR "production wood" OR intens* OR manag* OR cultivar OR mixed-species OR "native species" OR enrich* OR forestry OR resilien* OR carbon OR CO2*) OR (increase, timber, production) OR (increase, lumber*, production) OR (increase, wood, production) OR (increase, pulp, production, plantation*) OR (increase, timber, production, sust*) OR (increase, lumber*, production, sust*) OR (increase, wood, production, sust*) OR (increase, pulp, production, sust*, plantation*) OR (increase, timber, production, manag*) OR (increase, lumber*, production, manag*) OR (increase, wood, production, manag*) OR (increase, pulp, production, manag*) OR (increase, pulp, production, manag*) OR ("production forest*", intens*, manag*) OR ("production forest*", intens*, manag*, improv*) OR "intensive plantation forestry" OR (intens*, plantation*, forestry) OR (intens*, plantation*, forestry, improv*) OR (intens*, plantation*, forestry, manag*) OR (intens*, plantation*, forestry, sust*) OR (even-age*, stand, manag*, plantation*) OR (even-age*, intens*, manag*, plantation*) OR (even-age*, intens*, manag*, wood, production) OR (even-age*, intens*, manag*, timber, production) OR (even-age*, intens*, manag*, pulp, plantation*) OR (timber, plantation*, improv*, quality) OR (lumber*, plantation*, improv*, quality) OR (wood, plantation*, improv*, quality) OR ("pulp wood", plantation*) OR (pulpwood, plantation*) OR (pulp, plantation*, improv*, quality) OR (pulp, plantation*, improv*) OR ("pulp and paper", plantation*, improv*) OR (timber, plantation*, manag*) OR (timber, plantation*, improv*) OR (timber, plantation*, sust*) OR (timber, plantation*, long*-rotation*) OR (timber, plantation*, manag*, long*, rotation*) OR (timber, plantation*, "prolong* rotation*") OR (timber, plantation*, "extend* rotation*") OR (timber, plantation*, "prolong* harvest*") OR (timber, plantation*, prolong*, harvest*) OR (timber, plantation*, optim*, harvest*) OR (timber, plantation*, optim*, rotation*) OR (optim*, rotation*, age, plantation*, timber) OR (timber, plantation*, optim*, thinnin*) OR (timber, plantation*, optim*, extend*, rotation*) OR ("optim* rotation*", age, plantation*, timber) OR (timber, plantation*, extend*, harvest*) OR (timber, plantation*, extend*, harvest*, cycle*) OR (timber, plantation*, long*-harvest*) OR (timber, plantation*, long*, harvest*) OR (timber, plantation*, long*, harvest*, cycle*) OR (extend*, harvest*, cycle*, timber) OR (extend*, harvest*, rotation*, cycle*, timber) OR (extend*, harvest*, rotation*, timber) OR (timber, plantation*, sust*, production) OR (hardwood, plantation*) OR (timber, "hardwood* plantation*") OR (slow-grow, tree*, plantation*) OR (timber, plantation*, slow-grow*) OR (timber, plantation*, slow-grow*, tree*) OR (mix*-species, plantation*) OR (mix*-species, hardwood, plantation*) OR (mix*-species, slow-grow*, plantation*) OR (small-scale, hardwood, plantation*) OR (sust*, "plantation forestry") OR (optim*, rotation*, plantation*, lumber*) OR (optim*, rotation*, age, plantation*, lumber*) OR (optimal, yield, plantation*) OR (optimal, yield, lumber*) OR (optimal, yield, wood*) OR (optimal, yield, timber*) OR (optimal, yield, pulp) OR (optimal, yield, rotation*, plantation*) OR (optimal, yield, rotation*, "planted forest*") OR (optim*, yield, rotation*, timber) OR (optim*, yield, rotation*, lumber*) OR (optim*, yield, rotation*, wood) OR (extend*, rotation*, lumber*) OR ("increas* yield*", improv*, timber) OR ("increas* yield*", improv*, lumber*) OR ("increas* yield*", improv*, wood) OR ("increas* yield*", improv*, plantation*) OR ("increas* yield*", improv*, "planted forest*") OR (increas*, yield*, lumber*) OR (increas*, yield*, wood) OR (increas*, yield*, plantation*) OR (increas*, yield*, "planted forest*") OR (long*, rotation*, lumber*) OR (long*, age, rotation*, lumber*) OR (woodlot*, sust*, manag*, timber) OR (woodlot*, timber) OR (woodlot*, lumber*) OR (woodlot*, manag*, "native species") OR (woodlot*, "biomass production") OR (improv*, woodlot*, manag*) OR (climate-smart, plantation*) OR (climate-smart, plantation*, hardwood) OR (climate-smart, plantation*, slow-grow*)
Path #5 Fire Management	("peat* fire*" OR wildfire* OR "*forest* fire*" OR "wildland* fire*" OR "wild-land* fire*" OR "woodland* fire*" OR "grassland* fire*" OR "prairie* fire*" OR "shrubland* fire*" OR "savannah* fire*" OR "savanna* fire*" OR "wetland* fire*") NEAR/3 (avoid* OR "carbon sequest*" OR "carbon stor*" OR "carbon reservoir*" OR "carbon mitigat*" OR reduce* OR prevent* OR regime* OR impact* OR effect* OR intens* OR frequen* OR infrequent OR sever* OR natural OR pattern* OR extent OR patch* OR unburn* OR time OR timing OR season* OR seed* OR "disturb* OR control*" OR "control* practic*" OR low-tech* OR contain* OR manag* OR "manag* practic*" OR fuel* OR prescrib* OR plan* OR break* OR carbon OR CO2*) OR ("*forest* fuel*" OR "wildland* fuel*" OR "wild-land* fuel*" OR "woodland* fuel*" OR "grassland* fuel*" OR "prairie* fuel*" OR "shrubland* fuel*" OR "savannah* fuel*" OR "savanna* fuel*") NEAR/3 (load* OR avoid* OR amount* OR availab* OR "climat* condition*" OR "carbon sequest*" OR "carbon stor*" OR "carbon reservoir*" OR "carbon mitigat*" OR reduce* OR prevent* OR control* OR "control* practic*" OR burn* OR fire* OR low-tech* OR contain* OR manag* OR "manag* practic*" OR prescrib* OR plan* OR wildfire* OR wood OR aerial OR branch* OR twig* OR cone* OR dead OR debri* OR leaf OR leaves OR slash OR grass* OR litter OR bed OR treatment* OR CO2*) OR

	("peat* burn*" OR "forest* burn*" OR "wildland* burn*" OR "wild-land* burn*" OR "woodland* burn*" OR "grassland* burn*" OR "prairie* burn*" OR "shrubland* burn*" OR "savannah* burn*" OR "savanna* burn*") NEAR/3 (avoid* OR "carbon sequest*" OR "carbon stor*" OR "carbon reservoir*" OR "carbon mitigat*" OR reduce* OR prevent* OR control* OR "control* practic" OR fire* OR fuel* OR low-tech* OR contain* OR manag* OR "manag* practic" OR prescrib* OR plan* OR recurring OR debri* OR wildfire* OR carbon OR CO2*) OR "fire* break*" OR "prescrib* burn*" OR "prescrib* fire*" OR "reduc* *forest* fuel*" OR (reduc*, wildfire*, intens*) OR (wildfire*, fire*, manag*) OR (wildfire*, intens*, manag*) OR (wildfire*, frequen*, manag*) OR (wildfire*, reduce*, frequen*, manag*) OR (wildfire*, reduce*, severity, manag*) OR (wildland*, fire*, manag*) OR (wild-land*, fire*, manag*) OR (*forest*, fire*, manag*) OR (*forest*, fire*, intens*, manag*) OR (*forest*, fire*, frequen*, manag*) OR (*forest*, fire*, reduce*, frequen*, manag*) OR (*forest*, fire*, reduce*, severity, manag*) OR (wetland*, fire*, manag*) OR (wetland*, fire*, intens*, manag*) OR (wetland*, fire*, frequen*, manag*) OR (wetland*, fire*, reduce*, frequen*, manag*) OR (wetland*, fire*, reduce*, severity, manag*) OR (wildfire*, species, composition, divers*) OR (fire*, species, composition, divers*) OR (burn*, germination, plant*) OR (*fire*, germination, plant*) OR (burn*, seed*, regener*) OR (*fire*, seed*, regener*) OR ("regeneration burn*", *forest*) OR ("regeneration burn*", wetland*) OR (peat*, fire*, manag*) OR (peat*, fire*, avoid*) OR (peat*, fire*, intens*) OR (wetland*, fire*, intens*)
Path #6 Avoided Woodfuel Harvest	(avoid*, wood-fuel, harvest*) OR (avoid*, woodfuel, harvest*) OR (avoid*, fuel-wood, harvest*) OR (avoid*, fuelwood, harvest*) OR (avoid*, firewood, harvest*) OR (avoid*, fire-wood, harvest*) OR (avoid*, wood-fuel, collect*) OR (avoid*, woodfuel, collect*) OR (avoid*, fuel-wood, collect*) OR (avoid*, fuelwood, collect*) OR (avoid*, fire-wood, collect*) OR ("wood for cook*" AND sust*) OR ("wood for heat*" AND sust*) OR "sust* wood-fuel harvest*" OR "sust* fuel-wood harvest*" OR "sust* fuelwood harvest*" OR "sust* collection of fuelwood" OR "sust* firewood collection" OR "wood collection for firewood" OR "sust* wood-fuel" OR "sust* wood-fuel cookstove*" OR (collect*, wood-fuel, sust*) OR (collect*, woodfuel, sust*) OR (collect*, fuel-wood, sust*) OR (collect*, fuelwood, sust*) OR (collect*, firewood, sust*) OR (collect*, fire-wood, sust*) OR (wood-fuel, cookstove*, perform*) OR (wood-fuel, cook-stove*, perform*) OR (wood-fuel, wood-stove*, perform*) OR (wood-fuel, burning-stove*, perform*) OR (wood-fuel, biomass-stove*, perform*) OR (woodfuel, cookstove*, perform*) OR (woodfuel, cook-stove*, perform*) OR (woodfuel, wood-stove*, perform*) OR (woodfuel, burning-stove*, perform*) OR (fuel-wood, cookstove*, perform*) OR (fuel-wood, cook-stove*, perform*) OR (fuel-wood, wood-stove*, perform*) OR (fuel-wood, burning-stove*, perform*) OR (fuel-wood, biomass-stove*, perform*) OR (fuelwood, cookstove*, perform*) OR (fuelwood, cook-stove*, perform*) OR (fuelwood, wood-stove*, perform*) OR (fuelwood, burning-stove*, perform*) OR (fuelwood, biomass-stove*, perform*) OR (wood-fuel, cookstove*, sust*) OR (wood-fuel, cook-stove*, sust*) OR (wood-fuel, wood-stove*, sust*) OR (wood-fuel, burning-stove*, sust*) OR (woodfuel, cookstove*, sust*) OR (woodfuel, cook-stove*, sust*) OR (woodfuel, wood-stove*, sust*) OR (woodfuel, burning-stove*, sust*) OR (fuel-wood, cookstove*, sust*) OR (fuel-wood, cook-stove*, sust*) OR (fuel-wood, wood-stove*, sust*) OR (fuel-wood, burning-stove*, sust*) OR (improv*, cookstove*, *wood*) OR (improv*, cook-stove*, *wood*) OR (improv*, "burning stove*", *wood*) OR (improv*, "wood* stove*", *wood*)
Path #7 Avoided Grassland Conversion	(grassland* OR prairie* OR shrubland* OR shrub-land* OR savannah* OR savanna*) NEAR/3 (avoid* OR "carbon sequest*" OR "carbon stor*" OR "carbon reservoir*" OR "carbon mitigat*" OR protect* OR conserv* OR preserv* OR manag* OR maint* OR intact OR healthy OR native OR natural OR perennial OR "ecological function maint*" OR connect* OR cover OR CO2*) OR ("soil conserv*", grassland*) OR ("soil carbon", conserv*, grassland*) OR ("soil conserv*", prairie*) OR ("soil carbon", conserv*, prairie*) OR ("soil conserv*", shrubland*) OR ("soil carbon", conserv*, shrubland*) OR ("soil conserv*", shrub-land*) OR ("soil carbon", conserv*, shrub-land*) OR ("soil conserv*", savannah*) OR ("soil conserv*", savanna*) OR (avoid*, conver*, grassland*) OR (avoid*, conver*, native, grassland*) OR (avoid*, conver*, prairie*) OR (avoid*, conver*, shrubland*) OR (avoid*, conver*, native, shrubland*) OR (avoid*, conver*, shrub-land*) OR (avoid*, conver*, savannah*) OR (avoid*, loss*, grassland*) OR (avoid*, loss*, prairie*) OR (avoid*, loss*, shrubland*) OR (avoid*, loss*, shrub-land*) OR (avoid*, loss*, savannah*) OR (avoid*, loss*, savanna*) OR (avoid*, disturb*, grassland*) OR (avoid*, disturb*, prairie*) OR (avoid*, disturb*, shrubland*) OR (avoid*, disturb*, shrub-land*) OR (avoid*, disturb*, savannah*) OR (avoid*, disturb*, savanna*) OR (avoid*, degrad*, grassland*) OR (avoid*, degrad*, prairie*) OR (avoid*, degrad*, shrubland*) OR (avoid*, degrad*, shrub-land*) OR (avoid*, degrad*, savannah*) OR (avoid*, degrad*, savanna*) OR (avoid*, "land-use* change*", grassland*) OR (avoid*, "land-use* change*", prairie*) OR (avoid*, "land-use* change*", shrubland*) OR (avoid*, "land-use* change*", shrub-land*) OR (avoid*, "land-use* change*", savannah*) OR (avoid*, "land-use* change*", savanna*) OR (avoid*, grassland*, fragment*) OR (avoid*, prairie*, fragment*) OR (avoid*, shrubland*, fragment*) OR (avoid*, shrub-land*, fragment*) OR (avoid*, savannah*, fragment*) OR (avoid*, savanna*, fragment*) OR (prevent*, conver*, grassland*) OR (prevent*, conver*, prairie*) OR (prevent*, conver*, shrubland*) OR (prevent*, conver*, savannah*) OR (prevent*, conver*, savanna*) OR (prevent*, loss*, grassland*) OR (prevent*, loss*, prairie*) OR (prevent*, loss*, shrubland*) OR (prevent*, loss*, shrub-land*) OR (prevent*, loss*, savannah*) OR (prevent*, loss*, savanna*) OR (prevent*, disturb*, grassland*) OR (prevent*, disturb*, prairie*) OR (prevent*, disturb*, shrubland*) OR (prevent*, disturb*, shrub-land*) OR (prevent*, disturb*, savannah*) OR (prevent*, disturb*, savanna*) OR (prevent*, degrad*, grassland*) OR (prevent*, degrad*, prairie*) OR (prevent*, degrad*, shrubland*) OR (prevent*, degrad*, shrub-land*) OR (prevent*, degrad*, savannah*) OR (prevent*, degrad*, savanna*) OR (prevent*, "land-use* change*", grassland*) OR (prevent*, "land-use* change*", prairie*) OR (prevent*, "land-use* change*", shrubland*) OR (prevent*, "land-use* change*", shrub-land*) OR (prevent*, "land-use* change*", savannah*) OR (prevent*, "land-use* change*", savanna*)
Path #8 Biochar	(biochar OR bio-char OR charcoal OR "recalcitrant carbon") NEAR/3 (production OR "crop* residue*" OR "crop* waste" OR "plant material" OR "organic material" OR "decaying biomass" OR "forest* waste" OR twig* OR cone* OR debri* OR leaf OR leaves OR slash OR stalks OR root* OR seed* OR husk* OR grass* OR stem* OR "tree* trimm*" OR "wood chip*" OR litter OR "amend* soil*" OR "soil* amend*" OR "enrich soil" OR "soil* health*" OR "improv* soil health*" OR "increase* soil* carbon" OR "increase* carbon sequest*" OR "soil* carbon" OR "crop* residue*" OR "crop* residue*" OR agricultur* OR crop* OR grain* OR farm* OR fertil* OR "soil fertil*") OR (burn*, "crop* residue*", soil*, biochar) OR (sust*, "crop residue*", manag*, biochar) OR (burn*, "crop* waste", biochar) OR ("crop* waste", biochar) OR ("crop* waste", biochar, soil*) OR (pyrolysis, "crop* waste") OR (pyrolysis, crop*, waste) OR (pyrolysis, agricultur*, waste, soil*) OR (biochar, "agriculture* residue") OR (pyrolysis, "agriculture* residue", soil*) OR (pyrolysis, "crop* residue", soil*) OR (pyrolysis, "crop* residue*", soil*) OR "slash-and-char" OR ("biomass burning", biochar, agricultur*) OR ("biomass burning", biochar, crop*) OR ("biomass burning", biochar, farm*) OR ("forest* waste", biochar) OR ("agricultur* waste", biochar) OR "amend* agricultur* soil*" OR (pyrolysis, biochar, amend*, agricultur*, soil*) OR (biochar, amend*, agricultur*, soil*) OR (bio-char, amend*, agricultur*, soil*) OR (charcoal, amend*, agricultur*, soil*) OR ("recalcitrant carbon", amend*, agricultur*, soil*) OR (biochar, amend*, crop*, soil*) OR (bio-char, amend*, crop*, soil*) OR (charcoal, amend*, crop*, soil*) OR ("recalcitrant carbon", amend*, crop*, soil*) OR (biochar, amend*, farm*, soil*) OR (bio-char, amend*, farm*, soil*) OR (charcoal, amend*, farm*, soil*) OR ("recalcitrant carbon", amend*, farm*, soil*) OR ("organic mat*", biochar, agricultur*) OR ("crop* residue*", biochar, agricultur*) OR (improv*, soil*, health*, biochar) OR (biochar, restor*, degrad*, soil*) OR (biochar, rehabilit*, degrad*, soil*) OR (biochar, improv*, plant*, productivity*) OR (biochar,

	improv*, crop*, productivity*) OR (biochar, alleviat*, soil*, toxic*) OR (biochar, alleviat*, soil*, pollution) OR (biochar, alleviat*, soil*, contamination) OR (biochar, improv*, soil*) OR (biochar, amend*, soil*) OR (biochar, "plant* biomass", soil*)
Path #9 Cropland Nutrient Management	(crop* OR "crop* soil" OR agricultur* OR farm* OR "arable land*" OR "organic crop*" OR "organic agricultur*" OR "organic farm*" OR "crop* development" OR "crop grow*") NEAR/3 ("carbon sequest*" OR "carbon mitigat*" OR nutrient* OR fertil* OR manag* OR "nitrogen use efficien*" OR "nutrient manag*" OR "4R-Nutrient" OR "best practices" OR "right source*" OR "right rate*" OR "right tim*" OR "right place*" OR "soil nutrient*" OR "soil fertil*" OR "soil manag*" OR "healthy soil*" OR "soil mineral" OR nitrogen OR calcium OR potassium OR sulphate* OR calcium OR boron OR magnesium OR phosphorus OR NPK OR "nitrogen manag*" OR "optim* N-fertil*" OR urea OR fertil* OR "organic nitrogen* fertil*" OR "organic fertil*" OR organic OR compost* OR manure OR polyhalite OR polysulphate OR "potassium sulphat*" OR "sulphate of potash" OR polysulphat* OR "monocalcium phosphate" OR "magnesium sulphat*" OR "phosphate fertil*" OR "phosphoric fertil*" OR "phosphoric acid" OR kieserite OR superphosphat* OR super-phosphat* OR "calcium sulphate dihydrate" OR gypsum OR "livestock manure" OR "fish manure" OR "organic manure" OR oil-cake* OR "phosphoric acid" OR potash OR "potassic fertil*" OR "compound fertil*" OR "mixed fertil" OR "complete fertil*" OR P2O5 OR K2O OR mineral OR "mineral fertil*" OR "nitrate fertil*" OR ammon* OR denitri* OR nitrifier* OR "livestock slurry" OR "urease inhibitor" OR mulch* OR macro-nutrient* OR micro-nutrient* OR "nitrification inhibitor*" OR nitrifier OR carbon OR CO2*) OR (manag* NEAR/3 ("agricultur* nutrient*" OR "soil nutrient*" OR "crop* nutrient*" OR "soil fertil*" OR "nutrient crop*")) OR (efficien*, crop*, fertil*, manag*) OR (efficien*, agricultur*, fertil*, manag*) OR (efficien*, farm*, fertil*, manag*) OR (efficien*, crop*, nutrient, manag*) OR (efficien*, agricultur*, nutrient, manag*) OR (efficien*, farm*, nutrient, manag*) OR (crop*, nutrient, manag*) OR (agricultur*, nutrient, manag*) OR (farm*, nutrient, manag*) OR (reduc*, fertiliz*, use, agricultur*) OR (reduc*, fertiliz*, use, farm*) OR (reduc*, fertiliz*, use, crop*) OR (crop*, improv*, application, fertiliz*) OR (farm*, improv*, application, fertiliz*) OR (agricultur*, improv*, application, fertiliz*) OR (enhanc*, nutrient*, manag*, agricultur*) OR (enhanc*, nutrient*, manag*, farm*) OR (enhanc*, nutrient*, manag*, crop*) OR (agricultur*, sust*, nutrient) OR (farm*, sust*, nutrient) OR (crop*, sust*, nutrient) OR "precis* fert*" OR "precision agricultur*" OR "precision farm*" OR ("reduc* fertil* use", crop*) OR ("reduc* fertil* use", agricultur*) OR "crop* nutrient* manag*" OR (right source*, right rate*, right tim*, right place*, crop*) OR (right source*, right rate*, right tim*, right place*, crop*) OR (right source*, right rate, right rim*, right place*, nutrient*, agricultur*) OR (right source, right rate, right time, right place, fertil*) OR ("best timing", fertil*, agricultur*) OR ("best timing", fertil*, crop*) OR (4R, nutrient*, "best practice") OR (improv*, tim*, fertil*, agricultur*) OR (improv*, tim*, fertil*, crop*) OR (improv*, tim*, fertil*, farm*) OR (improv*, placement, fertil*, agricultur*) OR (improv*, placement, fertil*, crop*) OR (improv*, placement, fertil*, farm*) OR (improv*, form, fertil*, agricultur*) OR (improv*, form, fertil*, crop*) OR (improv*, form, fertil*, farm*) OR (tim*, nitrogen, crop*) OR (manag*, timing, nitrogen, applicat*) OR (manag*, rate, nitrogen, fertil*) OR (manag*, rate, nitrogen, concentration*) OR (low*, nitrogen, applicat*, frequen*) OR (optim*, nitrogen, applicat*, frequen*) OR (optim*, nitrogen, applicat*, dose*) OR (optim*, nitrogen, applicat*, tim*) OR (optim*, nitrogen, applicat*, schedule*) OR (low*, fertil*, applicat*, frequen*) OR (optim*, fertil*, applicat*, frequen*) OR (optim*, fertil*, applicat*, dose*) OR (optim*, fertil*, applicat*, tim*) OR (optim*, fertil*, applicat*, schedule*) OR (crop*, nutrient*, manag*, "best practic*") OR (crop*, nutrient, manag*, best, principle*) OR (nutrient*, manag*, sust*, crop*, production) OR (N-output, N-input, improv*, agricultur*) OR (N-output, N-input, improv*, grain*, product*) OR (N-manag*, efficien*, agricultur*) OR (nitrogen, manag*, "efficien* use", fertil*, agricultur*) OR (soil-N*, crop*) OR (manag*, plant*-N-demand, crop*) OR (manag*, plant*-N, crop*) OR "sust*-N-manag*" OR "sust* nitrogen manag*" OR (reduce-N-pollution, sust*, crop*) OR (sust*, "efficien* crop* system*") OR ("minimiz* nutrient loss*", crop*) OR (soil-N-availab*, manag*, crop*) OR ("catch crop*", nutrient*, soil*) OR ("low NO3-N leaching", crop*) OR ("reduc* NO3-N leaching", crop*) OR ("reduc* NO3-N leaching", agricultur*) OR ("reduc* NO3-N leaching", farm*) OR (N-balance, crop*, sust*, manag*) OR (nitrogen-balance, crop*, sust*, manag*) OR "agronom* efficien*" OR "nitrogen agronom* efficien*" OR ("optim* agronom* manag*", crop*) OR ("optim* agronom* manag*", grain*) OR (optim*, agronom*, manag*, crop*) OR (efficien*, agronom*, manag*, crop*) OR (nitrogen, "physio* efficien*", crop*) OR (N-use*, efficien*, crop*) OR (N-use*, photosynt*, efficien*, crop*) OR (improv*, N-utilizat*, efficien*, crop*) OR (N-uptake*, optim*, crop*) OR (N-uptake*, efficien*, crop*) OR (N-product*, optim*, crop*) OR (N-deriv*, fertil*, efficien*, crop*) OR (N-deriv*, fertil*, optim*, crop*) OR (N-product*, efficien*, crop*) OR (N-harvest*, Index, crop*) OR (N-harvest*, Index, grain*) OR (improv*, N-cycl*, crop*) OR (optim*, N-cycl*, crop*) OR (efficien*, N-cycl*, crop*) OR (improv*, N-cycl*, agricultur*) OR (optim*, N-cycl*, agricultur*) OR (efficien*, N-cycl*, agricultur*) OR (fertil*-based, NUE, crop*) OR (improv*, N-uptak*, mycorr*, crop*) OR (N-uptak*, mycorr*, crop*) OR (improv*, root-N, crop*) OR (organic*, mulch*, agricultur*) OR (organic*, mulch*, farm*) OR (compost, organic, fertil*, crop*) OR (compost, organic, fertil*, agricultur*) OR (compost, organic, fertil*, farm*) OR ("soil nutrient*", monitor*, agricultur*) OR (crop*, nutrient*, manag*) OR (well-mineralized, soil*, agricultur*) OR (well-mineralized, soil*, crop*) OR (well-mineralized, soil*, farm*) OR (increas*, nutrient*, absorption, crop*) OR (optim*, nutrient*, manag*, increas*, crop*, yield*) OR (optim*, nutrient*, manag*, increas*, crop*, product*) OR (better, nutrient*, manag*, nutrition*, quality, crop*) OR (manag*, pathogen*, nutrient*, crop*) OR (nutrient*, neutrality, agricultur*) OR (nutrient*, neutrality, farm*) OR (nutrient*, neutrality, agricultur*) OR (run-off, manag*, nutrient*, agricultur*) OR (regulat*, flow*, nutrient*, agricultur*) OR ("soil mineral content", crop*) OR ("soil mineral content", farm*) OR ("soil mineral content", agricultur*) OR (soil*, nitrogen, agricultur*) OR ("organic manure", grass*, nutrient*, crop*) OR (soil, nitrogen, manag*, crop*) OR (nitrogen, manag*, crop*) OR (avoid, nitrite, crop*) OR (avoid, nitrite, agricultur*) OR (avoid, nitrite, grass*, crop*) OR ("livestock slurry", crop*) OR ("livestock slurry", agricultur*) OR ("arable land", nitr*) OR ("ammonium nitrate", calcium, fertiliz*) OR ("urease inhibitor", agricultur*) OR "sustainable agrifood system*" OR "cover crop*" OR "cash crop" OR (organic, manure, "soil nutrient", crop*) OR (organic, manure, "soil nutrient", agricultur*) OR (avoid*, "nitrous oxide", grass*, crop*) OR (mulch*, "soil moist*", agricultur*) OR (mulch*, "soil moist*", farm*) OR (mulch*, "soil moist*", crop*) OR (legum*, fix*, nitrogen, soil*, crop*) OR (reduc*, "nitrogen fertil*", add*, legum*) OR (reduc*, "nitrogen fertil*", legum*, crop*) OR (reduc*, "nitrogen fertil*", incorporat*, legum*, crop*) OR (reduc*, need, fertiliz*, legum*)
Path #10 Conservation Agriculture	(crop* OR "crop* soil" OR agricultur* OR farm* OR "arable land*" NEAR/3 ("integrated pest management" OR IPM OR "organic weed-killer" OR "natural weed-killer" OR "clove oil" OR "peppermint oil" OR "citronella oil" OR "soybean oil" OR "pine oil" OR "natural acid*" OR "citric acid*" OR "corn gluten" OR "salt-based herbicid*" OR "iron-based herbicid" OR "herbicid, soap*" OR "organic pesticide*" OR "organic herbicide*" OR "organic insecticide*" OR mulch* OR integrated OR holistic OR regenerative OR sust*) OR (avoid* OR prevent* OR reduc* OR mitigat* OR decreas*) NEAR/3 (insecticides OR pesticides OR herbicide OR fungicides OR weed-killers OR glyphosate OR "pollut* soil*" OR "pollut* water" OR "contaminat* soil*" OR "contaminat* water" OR "harmful chemicals") OR "organic agricultur*" OR "organic crop*" OR "conservation agriculture" OR (pollinator-depend*, crop*) OR (protect*, pollinat*, agricultur*) OR "sust* agroecosystem*" OR "sust* agro-ecosystem*" OR (integrated, manag*, agricultur*) OR "agricultur* sust*" OR "ecofriendly agricultur*" OR

	"eco-friendly agricultur*" OR "ecofriendly crop*" OR "eco-friendly crop*" OR "ecofriendly farm*" OR "eco-friendly farm*" OR (eco*-efficient, sust*, agricultur*) OR (eco*-efficient, sust*, crop*) OR (eco*-efficient, sust*, farm*) OR "improv* crop* production" OR (climate-smart, agricultur*) OR (climate-smart, farm*) OR (climate-smart, crop*) OR (climate-smart, permacultur*) OR (climate-smart, horticultur*) OR "conservation agricultur*" OR "adaptive agricultur*" OR "regenerat* agricultur*" OR "regenerat* farm*" OR (holistic, farm*, crop*, practic*) OR "organic agricultur*" OR "organic farm*" OR ("organic farm*", crop*) OR "adaptive farm*" OR ("adaptive farm*", crop*) OR (sust*, farm*, waste, manag*) OR (sust*, crop*, waste, manag*) OR (sust*, agricultur*, waste, manag*) OR (sust*, farm*, residue*, manag*) OR (sust*, crop*, residue*, manag*) OR (sust*, agricultur*, residue*, manag*) OR permaculture OR (sust*, "horticultur* system") OR "traditional alley crop*" OR ("increas* yield*", "cover crop") OR ("soil* moisture", "cover crop") OR (retain*, "soil* moisture", "cover crop") OR (mitigat*, drought, "cover crop") OR (organic, "cover crop") OR (sust*, "cash crop") OR "subsistence crop*" OR "reduced-till*" OR "minimum-till*" OR "no-till*" OR "zero-till*" OR "conservation till*" OR (improv*, "fertiliz* manag*", crop*) OR (improv*, "fertiliz* manag*", crop*, N2O, mitigat*) OR ("fertiliz* manag*", crop*, N2O, mitigat*) OR (improv*, "fertilizer manag*", agricultur*) OR ("fertilizer manag*", agricultur*, N2O, mitigat*) OR ("optim* fertiliz* use*", crop*) OR ("optim* fertiliz* use*", agricultur*) OR ("optim* fertiliz* use*", farm*) OR ("natural fertiliz*", crop*) OR ("natural fertiliz*", agricultur*) OR ("organic fertiliz*", crop*) OR ("organic fertiliz*", agricultur*) OR ("organic fertiliz*", agricultur*, enhanc*, "crop* grow") OR "4R nutrient" OR "4R nutrient manag*" OR ("soil fertility manag*", crop*) OR ("soil fertility manag*", agricultur*) OR ("soil fertility manag*", farm*) OR ("sustainable intensification", crop*) OR (improv*, "water manag*", crop*) OR (improv*, "water manag*", agricultur*) OR (improv*, "water manag*", farm*) OR ("water conservation", agricultur*) OR ("water conservation", crop*) OR ("water conservation", farm*) OR "agricultur* water conservation" OR ("alternate wetting and drying", crop*) OR ("alternate wetting and drying", farm*) OR ("alternate wetting and drying", agricultur*) OR (water-saving, agricultur*) OR (water-saving, crop*) OR (water-saving, farm*) OR ("alternative irrigation", crop*) OR ("alternative irrigation", agricultur*) OR ("alternative irrigation", farm*) OR ("cover cropping", crop*) OR ("cover cropping", increas*, yield) OR ("permanent soil cover", crop*) OR ("permanent soil cover", agricultur*) OR "intercropping" OR (agricultur*, conserv*, *divers*) OR (farm*, conserv*, *divers*) OR (crop*, conserv*, *divers*) OR (agricultur*, protect*, *divers*) OR (farm*, protect*, *divers*) OR (crop*, protect*, *divers*) OR sequential-cropping OR ("irrigation scheduling", crop*) OR ("irrigation scheduling", agricultur*) OR ("diverse crop*", rotation*) OR "diverse crop* system" OR "crop* diversity" OR ("nat* weed control", agricultur*) OR ("nat* pest* control", agricultur*) OR (maint*, "soil fertility", farm*) OR (maint*, "soil fertility", agricultur*) OR (maint*, "soil fertility", crop*) OR (resilient, "climate change", agricultur*) OR (resilient, "climate change", farm*) OR (resilient, "climate change", crop*) OR (increase*, "soil organic matter", agricultur*) OR (increase*, "soil organic matter", farm*) OR (increase*, "soil organic matter", crop*) OR (resilience, "farm* practice") OR ("filter strip", farm*) OR ("filter strip", farm*) OR ("filter strip", agricultur*) OR "traditional farming" OR (subsistence, farm*, improv*, manag*) OR (sust*, land*, manag*) OR (soil*, health*, manag*) OR (soil*, health*, regener*)
Path #11 Trees in Croplands & Agroforestry	(agricultur* OR crop* OR farm*) NEAR/3 (tree*-crop* OR crop*-shrub* OR tree* OR tree-based OR "tree garden*" OR bush OR shrub* OR woodlot* OR windbreak* OR "intercropping system" OR intercropping OR "intercropping AND tree*" OR belt* OR "tree-belt" OR alley* OR "buffer zone" OR "riparian buffer* strip*" OR "riparian buffer*" OR plantation* OR "woody species" OR "tree garden*" OR "**forest* garden*" OR "**forest* farm*" OR "live fenc*" OR shelterbelt OR "shelter belt" OR "shade system*" OR homegarden* OR home-garden* OR cocoa OR cacao OR coffee OR tea-tree* OR rubber OR palm OR banana OR manioc OR coconut OR cashew OR guava OR papaya OR acacia OR albizia OR araucaria OR cedrela OR cordia OR balfourodendron OR brosimum OR desmodium OR enterolobium OR erythrina OR gliricidia OR jacaranda OR leucaena OR ocotea OR pithecellobium OR prosopis OR nectandra OR tabebuia OR theobroma) OR (homegarden*, tree*, agricultur*) OR (home-garden*, tree*, agricultur*) OR (homegarden*, tree*, farm*) OR (home-garden*, tree*, farm*) OR (homegarden*, tree*, crop*) OR (home-garden*, tree*, crop*) OR agroforestry OR "agroforestry system*" OR (sust*, agroecosystem*, tree*) OR (improv*, agroecosystem*, tree*) OR ("agro-forest*", tree*) OR ("agroforest*", tree*) OR (improv*, agroforest*) OR (improv*, agro-forest*) OR (sust*, agroforest*) OR (sust*, agro-forest*) OR ("swidden-fallow agroforestry" OR "**forest* garden*" OR "indigenous agroforestry" OR "**forest* garden* system*" OR "tree garden*" OR silvopast* OR silvo-past* OR agrisilvicultur* OR agri-silvicultur* OR agrosilvicultur* OR agro-silvicultur* OR "silvopast* systems" OR (agro-pastur*, tree*) OR (agropastur*, tree*) OR (agro-pastor*, tree*) OR (agropastor*, tree*) OR taungya OR "tree-based intercropping" OR windbreak* OR "alley-cropping" OR alleycropping OR "avenue cropping" OR "alley farming" OR "improv* fallow" OR crop-livestock-tree* OR "integrat* of tree* into crop*" OR (integrat*, tree*, crop*) OR "tree* into crop*" OR "tree* into pasture*" OR (tree*, pasture*) OR (intercropping, tree*) OR "intercropping with food crop*" OR (intercropping, food-crop*) OR "crop-shrub* intercropping" OR (intercropping, crop-shrub*) OR "crop-tree* intercropping" OR (intercropping, cocoa) OR (intercropping, cacao) OR (agroforestry, cocoa) OR (agroforestry, cacao) OR (agroforestry, coffee) OR (agroforestry, coffee, organic) OR "coffee forest* gardens*" OR "coffee agroforestry system*" OR "coffee-based agroforestry" OR "organic coffee" OR (coffee, organic, tree*) OR "rubber agroforestry" OR (agroforestry, rubber) OR ("yerba mate", organic, agroforestry) OR (agroforestry, "yerba mate") OR "integrated tree-livestock system*" OR (integrat*, tree-livestock) OR (integrat*, tree*-crop*) OR (integrat*, tree-pastur*) OR ("sust* agricultur*", tree*) OR ("community forestry", crop*) OR hedgerow* OR hedge* OR (farmer-manag*, nat*-regener*, *forest*) OR (farmer-manag*, nat*-regener*, tree*) OR shelterbelt* OR shelter-belt* OR ("horticultural crop*", tree*) OR ("horticultural crop*", shrub*) OR ("cattle feed* system*", tree*) OR ("cattle feed* system*", shrub*) OR (integrat*, tree*, "grazing livestock") OR "adaptive agroforestry" OR (agricultur*, intercropping, tree*) OR (crop*, intercropping, tree*) OR (farm*, intercropping, tree*)
Path #12 Grazing - Optimal Intensity	((graz*, optim*) OR (graz*, manag*) OR (graz*, animal) OR (graz*, improv*) OR (graz*, better) OR (graz*, regenerat*) AND ("land-use plan*" OR "land* regenerat*" OR "land* rehabilitat*" OR sust* OR benefit* OR optim* OR manag* OR "optim* ratio*" OR "optim* intens*" OR "improv* practice*" OR frequen* OR intens* OR system* OR "stocking rate" OR rotat* OR schedule OR improv* OR alternate OR low-intensity OR light-intensity OR control*-intensity OR time-control* OR holistic OR paddock* OR bunched OR "pasture allowance" OR "pasture rotat*" OR "forage allowance" OR regenerat* OR perform* OR high-performance OR "carbon sequest*" OR "carbon mitigat*" OR "mitigat* carbon" OR forage OR pasture OR farm* OR "production system*" OR system* OR rangeland* OR grassland* OR savanna* OR savannah* OR saltmarsh OR salt-marsh OR marsh OR raygrass OR cattle OR livestock OR ruminant* OR cow* OR sheep OR lamb* OR goat* OR horse* OR ungulate* OR herbivore* OR stock OR ostrich* OR turkey* OR chicken OR quail OR emu* OR rhea* OR bison OR deer* OR elk OR caribu* OR herd* OR pig)) OR (cattle OR livestock OR ruminant* OR cow* OR sheep OR lamb* OR goat* OR horse* OR ungulate* OR herbivore* OR stock OR ostrich* OR turkey* OR chicken OR quail OR emu* OR rhea* OR bison OR deer* OR elk OR caribu* OR herd* OR beef) NEAR/3 ("land-use plan*" OR "optim* graz*" OR "graz* improv*" OR intens* OR "optim* intens*" OR impact* OR effect* OR outcome* OR "pasture allowance" OR "pasture rotat*" OR "forage allowance" OR grass*-based OR "sust* production" OR "sust* system") OR (time-control*, rotat*, grazing) OR (optim*, intens*, grazing) OR (improv*, intens*, grazing) OR (better, manag*, intens*, grazing) OR (pastoral*, grazing, improv*) OR (pastoral*, grazing, optim*) OR (improv*, timing, grazing) OR (pasture, intake, control, graz*) OR (forage, intake, control, graz*) OR (improv*, manag*, frequen*, grazing) OR (optim*, farm*, grazing) OR (improv*, farm*, grazing) OR (improv*, manag*, target*, area*, grazing) OR (optim*, grass*, use*) OR (avoid*, emission*, grazing) OR (avoid*, methan*, grazing) OR (graz*, optim*) OR (graz*, manag*) OR (graz*, animal) OR (graz*, improv*) OR (graz*, better) OR (graz*, regenerat*) OR

	(improv*, animal, farm*, grazing) OR (optim*, animal, farm*, grazing) OR (better, animal, farm*, grazing) OR (livestock, farm*, grazing, improv*) OR (livestock, farm*, grazing, optim*) OR (cattle, avoid*, emission*, grazing) OR (livestock, avoid*, emission*, grazing) OR (ruminant*, avoid*, emission*, grazing) OR (cattle, reduc*, emission*, grazing) OR (livestock, reduc*, emission*, grazing) OR (ruminant*, reduc*, emission*, grazing) OR ("rotation* grazing", crop*, livestock) OR ("rotation* grazing", crop*, cattle) OR ("rotation* grazing", crop*, ruminant*) OR ("rotational grazing", agricultur*, livestock) OR ("rotational grazing", agricultur*, cattle) OR ("rotational grazing", agricultur*, ruminant*) OR (holistic, grazing, herbivore*) OR (holistic, grazing, livestock) OR (holistic, grazing, cattle) OR (holistic, grazing, ruminant*) OR (holistic, grazing, crop*, livestock) OR (holistic, grazing, crop*, cattle) OR (holistic, grazing, crop*, ruminant*) OR (adapt*, multi-paddock, grazing) OR (multi-paddock, grazing, livestock) OR (multi-paddock, grazing, cattle) OR (multi-paddock, grazing, ruminant*) OR (avoid*, overgrazing) OR (avoid*, over-grazing) OR (avoid*, intens*, grazing) OR (reduce*, over-grazing) OR (reduce*, overgrazing) OR (reduce*, intens*, grazing) OR (manag*, forage, allowance, grazing) OR (improv*, forage, allowance, grazing) OR (manag*, pasture*, allowance, grazing) OR (improv*, pasture*, allowance, grazing) OR (regenerat*, grazing, manag*) OR (allow*, grass*, recover*, grazing) OR (grazing, manag*, land*, recover*) OR (local, monitor*, livestock, move*, grazing, manag*) OR (monitor*, move*, grazing, manag*) OR (monitor*, grazing, pattern*, manag*) OR (grazing, period*, livestock, manag*) OR (grazing, period*, cattle, manag*) OR (grazing, period*, herbivor*, manag*) OR (grazing, period*, ungulate*, manag*) OR (traditional, approach, land* manag*, grazing)
Path #13 Grazing - Legumes in Pastures	((legum*, graz*) OR (legum*, pasture*, graz*) OR (legum*, planted, pasture*) OR (legum*, planted, graz*) OR (legum*, forage*, graz*) OR (legum*-grass*) AND (graz* OR legum* OR perennial-legum* OR high-legum* OR legum*-crop OR "legume-grass mix*" OR legume*-rich OR feed* OR farm* OR grass* OR rangeland* OR savanna* OR savannah* OR cattle OR livestock OR ruminant* OR cow* OR sheep OR lamb* OR goat* OR horse* OR herd* OR pea* OR cowpea OR lablab OR bean* OR sorghum OR soy OR soybean* OR clover OR "red clover" OR "sweet clover" OR alfalfa OR pasture OR forage* OR system* OR mix* OR "frost seeding" OR high-performance OR bloat-free OR sowing OR dibbling OR drilling OR disease-free OR seed* OR "plant* seed*" OR "seed drop*" OR "traditional method*" OR "direct seeding" OR "cover crop*" OR manag* OR sust* OR broadcast* OR inter-seeding OR rejuvenation)) OR ("frost seeding", legum*, graz*) OR (legum*, rangeland*, grazing) OR (cattle, grazing, grass*, legume-pasture) OR (bloat-free, legume*, pasture*) OR (bloat-free, legume*, grazing) OR (rotat*, grazing, system*, legume*) OR (legume*, strengthen, pasture*) OR ("cover crop*", legum*, grazing) OR (crop*, legum, grazing) OR (legum*/grass*, forage*) OR (legum*, avoid*, emission*, cattle) OR (legum*, avoid*, emission*, livestock) OR (legum*, avoid*, emission*, ruminant*) OR (legume-grass, grazing, avoid*, emission*) OR (pasture-crop*, grazing, avoid*, emission*) OR "crop-livestock system*" OR (crop-livestock, grazing, avoid*, emission*) OR "rotational grazing system*" OR ("broadcast seeding", pasture*, avoid*, emission*) OR ("inter-seeding", pasture*, avoid*, emission*) OR ("pasture rejuvenation", legum*, grazing) OR (legum*/grass*, forage*) OR (manag*, pasture*, legum*) OR (manag*, planted, pasture*, incorporat*, legum*) OR (improv*, forage, productivity, legum*) OR (improv*, grazing, native, legum*) OR (improv*, grazing, annual, legum*) OR (seed*, planted, pasture, legum*) OR (native, legum*, grazing)
Path #14 Grazing - Improved Feed	(cattle OR livestock OR ruminant* OR ungulate* OR cow* OR sheep OR lamb* OR goat* OR herbivore* OR horse* OR graz* OR "feed* system* AND livestock" OR "feed* system* AND ruminant*") NEAR/3 ("high-quality feed*" OR "feed* system*" OR feed* OR "feed* improv*" OR "improv* feed*" OR "improv* pastur*" OR fodder OR pasture-crop OR crop-livestock OR "improv diet" OR nutrient-rich OR "nutrient-rich feed*" OR energy-rich OR energy-dense OR "feed-crop*" OR "feed-rich-crop*" OR "feed quality" OR "feed additiv*" OR "protein feed*" OR protein* OR forage* OR "forage* crop*" OR grain* OR cereal* OR corn OR maize OR legum* OR pumpkin* OR carrot* OR seed* OR root* OR potato* OR barley OR oat* OR pea* OR cabbage* OR "orchard grass*" OR grass* OR sorghum OR soy OR soybean OR "winter wheat" OR wheat OR clover OR "red clover" OR "sweet clover" OR alfalfa OR graz* OR legume* OR bloat-free OR antifoam* OR "vegetable oil*" OR peanut OR "bloat free" OR bloat* OR non-bloat OR digest* OR "byproduct AND digest*" OR antibloat OR anti-bloat OR byproduct OR "enteric methan*" OR econo* OR carbon OR CO2*) OR (avoid*, methan*, cattle) OR (avoid*, "greenhouse gas", cattle) OR (avoid*, GHG*, cattle) OR (avoid*, methan*, livestock) OR (avoid*, "greenhouse gas", livestock) OR (avoid*, GHG*, livestock) OR (avoid*, "methan*-emission*", ruminant*) OR (avoid*, "greenhouse gas", ruminant*) OR (avoid*, GHG*, ruminant*) OR (avoid*, methan* emission*, graz*, legum*) OR (avoid*, methan*, "feeding system*", graz*) OR (reduc*, hindgut, fermentation, livestock, graz*) OR (bloat-free, sheep, graz*) OR (bloat-free, goat, graz*) OR (bloat-free, legum*, cow*) OR (bloat-free, legum*, cattle) OR (bloat-free, legum*, livestock) OR (bloat-free, legum*, ruminant*) OR (bloat-free, legum*, graz*) OR (non-bloat*, legum*, graz*) OR ("cereal grain*", graz*) OR "improv* pastur*" OR "cut and carry forage*" OR (improv*, feed*, graz*) OR (high-quality, livestock, feed*, graz*) OR (high-nutrient, livestock, feed*, graz*) OR (nutrient-rich, livestock, feed*, graz*) OR (improv*, cattle, feed*, graz*) OR (high-quality, cattle, feed*, graz*) OR (high-nutrient, cattle, feed*, graz*) OR (nutrient-rich, cattle, feed*, graz*) OR (energy-dense, cattle, feed*, graz*) OR (improv*, ruminant*, feed*, graz*) OR (improv*, ruminant*, feed*, graz*) OR (high-quality, cattle, ruminant*, graz*) OR (high-nutrient, ruminant*, feed*, graz*) OR (nutrient-rich, ruminant*, feed*, graz*) OR (improv*, cattle, "feeding system*") OR (improv*, livestock, "feeding system*") OR (improv*, ruminant*, "feeding system*") OR "legum* fodder tree*" OR "crop-livestock system*" OR crop-livestock OR (legum*, fodder, livestock) OR (feed*-crop*, livestock, graz*) OR (root-crop*, livestock, graz*) OR (reduc*, "pasture bloat", livestock, graz*) OR (feed*, hay, livestock, graz*) OR (legum*, fodder, cattle) OR (feed*-crop*, cattle, graz*) OR (root-crop*, cattle, graz*) OR (reduc*, "pasture bloat", cattle, graz*) OR (feed*, hay, cattle, graz*) OR (legum*, fodder, ruminant*) OR (feed*-crop*, ruminant*, graz*) OR (root-crop*, ruminant*, graz*) OR (reduc*, "pasture bloat", ruminant*, graz*) OR (feed*, hay, ruminant*, graz*) OR (feed*-crop*, ungulat*, graz*) OR (root-crop*, ungulat*, graz*) OR (reduc*, "pasture bloat", ungulat*, graz*) OR (feed*, hay, ungulat*, graz*) OR (bloat-free, legum*, graz*) OR (non-bloat*, legum*, graz*) OR (cereal*-grain*, graz*) OR (improv*, pasture*, legum*, graz*) OR (improv*, feed*, legum*, graz*) OR "cut and carry forage*" OR (improv*, digestion, legum*, graz*) OR (improv*, digestion, legum*-grass*) OR (treat*, livestock, feed, enteric, methan*) OR (improv*, livestock, feed, enteric, methan*) OR (improv*, livestock, feed) OR (improv*, livestock, feed, quality) OR (improv*, livestock, feed, additive) OR (improv*, livestock, feed, avoid*, methan*) OR (improv*, livestock, feed, avoid*, emission*) OR (improv*, livestock, feed, avoid*, carbon) OR (improv*, livestock, feed, avoid*, CO2*) OR (reduc*, enteric, methan*, emission*, improv*, feed) OR (reduc*, enteric, methan*, emission*, treat*) OR (increas*, pasture*, yield*, milk, legum*) OR (increas*, pasture*, yield*, milk, legum*-grass*) OR (improv*, feed*, practice*, cattle) OR (feed*, improv*, techniq*, cattle) OR (improv*, feed*, practice*, livestock) OR (feed*, improv*, techniq*, livestock) OR (improv*, feed*, practice*, ruminant*) OR (feed*, improv*, techniq*, ruminant*) OR (feed, improv*, tool*, ruminant*) OR (legum*, fodder, tree*, livestock) OR (legum*, fodder, tree*, *nutrient*, livestock) OR (legum*, fodder, tree*, nutritious, livestock) OR (legum*, tree*, livestock, pasture*) OR (avoid*, low-quality, feed*, graz*) OR (avoid*, poor-quality, feed*, graz*) OR (easy, grow*, legum*, pasture*) OR (fast, grow*, legum*, pasture*) OR (easy, grow*, legum*, graz*) OR (fast, grow*, legum*, graz*) OR (high-performance, graz*)
Path #15 Grazing - Animal Management	((animal, graz*) OR (animal, manag*) OR (manag*, graz*) OR graz* AND (improv* OR "improv* practice*" OR "improv* water quality" OR "improv* manag*" OR mix* OR optim* OR welfare OR health* OR farm* OR "production system*" OR sust* OR rearing OR husbandry OR rotat* OR move* OR water OR shelter OR livestock OR ruminant* OR cattle OR cow* OR sheep OR lamb* OR goat* OR horse* OR ungulate OR deer* OR pig OR herbivore OR stock OR animal OR "nat* regenerat*" OR "group size*" OR dens* OR weight OR rest* OR strategic-rest)) OR agroecosystem* OR agro-forest* OR agroforest* OR silvopastur* OR silvo-pastur* OR agrisilvicultur* OR agri-silvicultur* OR agrosilvicultur* OR

	agro-silvicultur* OR silvopastoral systems OR (reduc*, enteric, ferment*, breed) OR (reduc*, rumen, ferment*, breed) OR (effect*, grass*, graz*, positiv*, cattle) OR (effect*, grass*, graz*, positiv*, livestock) OR (shelter*, graz*, tree*) OR (shelter*, graz*, bush*) OR (pastoral*, graz*, improv*) OR (pastoral*, graz*, optim*) OR (breed*, graz*, improv*) OR (health, graz*, improv*) OR (health, graz*, optim*) OR (reduc*, mortality, graz*, improv*) OR (improv*, weight, graz*, manag*) OR (optim*, weight, graz*, manag*) OR (optim*, weight, graz*) OR (improv*, water quality, graz*) OR (optim*, water, quality, graz*) OR (improv*, animal, welfare, graz*) OR (improv*, husbandry, graz*) OR (optim*, husbandry, graz*) OR (improv*, handling, graz*) OR (optim*, handling, graz*) OR (improv*, production, system*, graz*) OR (optim*, production, system*, graz*) OR (improv*, rearing, graz*) OR (optim*, rearing, graz*) OR (graz*, "group size*", cattle, manag*) OR (graz*, dens*, cattle, manag*) OR (graz*, improv*, dens*, cattle, manag*) OR (improv*, manag*, plant*, graz*) OR (improv*, graz*, manag*, practic*) OR (strategic-rest, graz*) OR (period*, rest*, graz*) OR (pastoral*, improv*, manag*) OR (subsistence, farm*, improv*, graz*, manag*) OR (graz*, animal, manag*) OR (improv*, livestock, rearing, graz*) OR (improv*, pastoral*, cattle, graz*, manag*) OR (pastoral*, cattle, graz*, manag*) OR (optim*, cattle, graz*) OR (optim*, livestock, graz*) OR (optim*, ruminant*, graz*) OR (period*, non-graz*) OR (period*, ungraz*) OR (dens*, graz*, cattle) OR (dens*, graz*, livestock) OR (dens*, graz*, ruminant*) OR (dens*, graz*, cow*) OR (dens*, graz*, sheep) OR (dens*, graz*, lamb*) OR (dens*, graz*, goat*) OR (dens*, graz*, horse*) OR (reduc*, emission*, animal, manag*) OR (optim*, livestock, manag*, graz*) OR (improv*, livestock, breed*, graz*) OR (improv*, cattle, breed*, graz*) OR (improv*, ruminant*, breed*, graz*) OR (increas*, reproduct*, livestock, graz*) OR (animal, health*, livestock, avoid*, methan*) OR (improv*, animal, weight, manag*, graz*) OR (livestock, weight, manag*, graz*) OR (improv*, water, livestock, graz*) OR (welfare, livestock, graz*) OR (improv*, animal, farm*, graz*) OR (optim*, animal, farm*, graz*) OR (livestock, farm*, graz*, improv*) OR (livestock, farm*, graz*, optim*) OR (livestock, husbandry, graz*) OR (livestock, handling, graz*) OR ("subsistence farm*", graz*, improv*) OR ("subsistence farm*", graz*, optim*) OR (sust*, livestock, "production system*", graz*) OR (livestock-rearing, graz*) OR (reduc*, densit*, livestock, graz*) OR (reduc*, densit*, cattle, graz*) OR (reduc*, densit*, ruminant*, graz*) OR (regener*, ranching) OR ((enhanc*, animal, perform*) OR (increas*, animal, perform*) OR (increas*, weight, gain*) OR (improv*, livestock, breed) OR (improv*, ruminant*, breed) AND (reduc*, rumen, ferment*) OR (reduc*, enteric, ferment*))
Path #16 Improved Rice Cultivation	"improv* rice cultivation" OR (improv*, rice, cultivation) OR (water-saving, rice, irrigation) OR (water-saving, rice, technolog*) OR (water-saving, tech*, rice) OR (water-saving, practic*, rice) OR (water-saving, method*, rice) OR (water-saving, irrigation, practic*, rice) OR (water-saving, irrigation, rice) OR ("alternate wetting and drying", rice) OR (alternate, wet*, dry*, rice) OR "water-saving rice production system*" OR (water-saving, rice, production, system*) OR (water, manag*, rice) OR (improv*, rice, production, system*) OR (improv*, rice, production) OR (improv*, rice, cultivation) OR (optim*, rice, production, system*) OR (optim*, rice, production) OR (optim*, rice, cultivation) OR (eco-efficien*, rice, production) OR (climate-smart, rice, production) OR "intermit* flood" rice" OR (intermit*, flood*, rice) OR (intermit*, wet*, rice) OR ("organic mat*", manag*, rice) OR (rice-wheat, rotation) OR (rice-wheat, alternat*) OR "rice water manag*" OR (rice, water, conserv*) OR (water-saving, rice) OR "rice-wheat rotation" OR "water-saving rice" OR (avoid*, methan*, rice) OR (avoid*, "nitrous oxide", rice) OR (avoid*, emission*, rice) OR (water-saving, rice, reduc*, methan*) OR (rice, reduc*, methan*) OR (rice, reduc*, CH4) OR (rice, reduc*, "nitrous oxide") OR (rice, reduc*, NO2) OR (rice, reduc*, emission*) OR (rice, reduc*, CO2) OR (water-saving, rice, reduc*, methan*) OR (water-saving, rice, reduc*, emission*)
Path #17 Avoided Coastal Wetlands Impacts	("coastal wetland*" OR "tidal wetland*" OR mangrov* OR salt-marsh* OR saltmarsh* OR tidal-marsh* OR seagrass* OR "sea grass*") NEAR/3 ("carbon sequest*" OR "carbon stor*" OR "carbon reservoir*" OR "carbon mitigat*" OR carbon-rich OR conserv* OR protect* OR preserv* OR "maint* cover*" OR "protect* cover*" OR "conserv* cover*" OR unfragment* OR health OR avoid* OR sust* OR natural OR "ecological function*" OR "ecological integrity" OR manag* OR sediment* OR "water flow" OR "flow of water" OR "soil carbon" OR carbon OR CO2*) OR (maint*, connect*, "coastal wetland*") OR (maint*, connect*, "tidal wetland*") OR (maint*, connect*, mangrov*) OR (maint*, connect*, salt-marsh*) OR (maint*, connect*, saltmarsh*) OR (maint*, connect*, tidal-marsh*) OR (preserv*, "ecological function*", "coastal wetland*") OR (preserv*, "ecological function*", "tidal wetland*") OR (preserv*, "ecological function*", mangrov*) OR (preserv*, "ecological function*", salt-marsh*) OR (preserv*, "ecological function*", saltmarsh*) OR (preserv*, "ecological function*", tidal-marsh*) OR (preserv*, "ecological function*", seagrass*) OR (preserv*, "ecological function*", sea-grass*) OR (preserv*, "ecological integrity", "coastal wetland*") OR (preserv*, "ecological integrity", "tidal wetland*") OR (preserv*, "ecological integrity", mangrov*) OR (preserv*, "ecological integrity", salt-marsh*) OR (preserv*, "ecological integrity", saltmarsh*) OR (preserv*, "ecological integrity", tidal-marsh*) OR (preserv*, "ecological integrity", seagrass*) OR (preserv*, "ecological integrity", sea-grass*) OR (avoid*, "coastal wetland*", impact*) OR (avoid*, "tidal wetland*", impact*) OR (avoid*, mangrov*, impact*) OR (avoid*, salt-marsh*, impact*) OR (avoid*, saltmarsh*, impact*) OR (avoid*, tidal-marsh*, impact*) OR (avoid*, seagrass*, impact*) OR (avoid*, "sea grass*", impact*) OR (avoid*, "coastal wetland*", conver*) OR (avoid*, "tidal wetland*", conver*) OR (avoid*, mangrov*, conver*) OR (avoid*, salt-marsh*, conver*) OR (avoid*, saltmarsh*, conver*) OR (avoid*, "sea grass*", conver*) OR (avoid*, seagrass*, conver*) OR (avoid*, "sea grass*", conver*) OR (avoid*, "coastal wetland*", loss*) OR (avoid*, "tidal wetland*", loss*) OR (avoid*, mangrov*, loss*) OR (avoid*, salt-marsh*, loss*) OR (avoid*, saltmarsh*, loss*) OR (avoid*, tidal-marsh*, loss*) OR (avoid*, seagrass*, loss*) OR (avoid*, "sea grass*", loss*) OR (avoid*, "coastal wetland*", subsidenc*) OR (avoid*, "tidal wetland*", subsidenc*) OR (avoid*, mangrov*, subsidenc*) OR (avoid*, salt-marsh*, subsidenc*) OR (avoid*, saltmarsh*, subsidenc*) OR (avoid*, tidal-marsh*, subsidenc*) OR (avoid*, seagrass*, subsidenc*) OR (avoid*, "sea grass*", subsidenc*) OR (avoid*, "coastal wetland*", drain*) OR (avoid*, "tidal wetland*", drain*) OR (avoid*, mangrov*, drain*) OR (avoid*, salt-marsh*, drain*) OR (avoid*, saltmarsh*, drain*) OR (avoid*, tidal-marsh*, drain*) OR (seagrass*, avoid*, drag*) OR ("sea grass*", avoid*, drag*) OR (prevent*, "coastal wetland*", impact*) OR (prevent*, "tidal wetland*", impact*) OR (prevent*, mangrov*, impact*) OR (prevent*, salt-marsh*, impact*) OR (prevent*, saltmarsh*, impact*) OR (prevent*, tidal-marsh*, impact*) OR (prevent*, seagrass*, impact*) OR (prevent*, "sea grass*", impact*) OR (prevent*, "coastal wetland*", degrad*) OR (prevent*, "tidal wetland*", degrad*) OR (prevent*, mangrov*, degrad*) OR (prevent*, salt-marsh*, degrad*) OR (prevent*, saltmarsh*, degrad*) OR (prevent*, tidal-marsh*, degrad*) OR (prevent*, seagrass*, degrad*) OR (prevent*, "sea grass*", degrad*) OR (prevent*, "coastal wetland*", disturb*) OR (prevent*, "tidal wetland*", disturb*) OR (prevent*, mangrov*, disturb*) OR (prevent*, salt-marsh*, disturb*) OR (prevent*, saltmarsh*, disturb*) OR (prevent*, tidal-marsh*, disturb*) OR (prevent*, seagrass*, disturb*) OR (prevent*, "sea grass*", disturb*) OR (prevent*, conversion*, "coastal wetland*") OR (prevent*, conversion*, "tidal wetland*") OR (prevent*, conversion*, mangrov*) OR (prevent*, conversion*, salt-marsh*) OR (prevent*, conversion*, saltmarsh*) OR (prevent*, conversion*, tidal-marsh*) OR (prevent*, conversion*, seagrass*) OR (prevent*, conversion*, sea-grass*) OR (prevent*, "coastal wetland*", "land-use change*") OR (prevent*, "tidal wetland*", "land-use change*") OR (prevent*, mangrov*, "land-use change*") OR (prevent*, salt-marsh*, "land-use change*") OR (prevent*, saltmarsh*, "land-use change*") OR (prevent*, tidal-marsh*, "land-use change*") OR (avoid*, "coastal wetland*", "land-use change*") OR (avoid*, "tidal wetland*", "land-use change*") OR (avoid*, mangrov*, "land-use change*") OR (avoid*, salt-marsh*, "land-use change*") OR (avoid*, saltmarsh*, "land-use change*") OR (avoid*, tidal-marsh*, "land-use change*") OR (avoid*, "blue carbon"
Path #18 Avoided Freshwater Wetlands	(peat* OR bog OR fen OR "freshwater marsh*" OR "fresh-water marsh*" OR "freshwater *forest*" OR "fresh-water *forest* wetland*" OR "freshwater wetland*" OR "fresh-water wetland*" OR "non-tidal wetland*" OR wetland* OR "swamp forest*" OR "blue carbon") NEAR/3 ("carbon sequest*" OR "carbon stor*" OR "carbon reservoir*" OR "carbon mitigat*" OR carbon-rich OR conserv* OR protect* OR preserv* OR "maint*

	cover*" OR "protect* cover*" OR "conserv* cover*" OR unfragment* OR health OR avoid* OR "avoid* distrub*" OR sust* OR natural OR manag* OR sediment* OR "water conservation" OR "water flow" OR "flow of water" OR "soil carbon" OR carbon OR CO2*) OR (maint*, connect*, peatland*) OR (maint*, connect*, bog) OR (maint*, connect*, fen) OR (maint*, connect*, freshwater, marsh*) OR (maint*, connect*, fresh-water, marsh*) OR (maint*, connect*, "freshwater *forest*") OR (maint*, connect*, wetland*) OR (maint*, connect*, non-tidal, wetland*) OR (maint*, connect*, "swamp forest*") OR (avoid*, peat*, impact*) OR (avoid*, fen, impact*) OR (avoid*, bog, impact*) OR (avoid*, "freshwater marsh*", impact*) OR (avoid*, "fresh-water marsh*", impact*) OR ("freshwater *forest*", wetland*, avoid*, impact*) OR ("fresh-water *forest*", wetland*, avoid*, impact*) OR (freshwater, wetland*, avoid*, impact*) OR (fresh-water, wetland*, avoid*, impact*) OR (non-tidal, wetland*, avoid*, impact*) OR (avoid*, peat*, conver*) OR (avoid*, fen, conver*) OR (avoid*, bog, conver*) OR (avoid*, "freshwater marsh*", conver*) OR (avoid*, "fresh-water marsh*", conver*) OR ("freshwater *forest*", wetland*, avoid*, conver*) OR ("fresh-water *forest*", wetland*, avoid*, conver*) OR (freshwater, wetland*, avoid*, conver*) OR (fresh-water, wetland*, avoid*, conver*) OR (non-tidal, wetland*, avoid*, conver*) OR (avoid*, peat*, loss*) OR (avoid*, fen, loss*) OR (avoid*, bog, loss*) OR (avoid*, "freshwater marsh*", loss*) OR (avoid*, "fresh-water marsh*", loss*) OR ("freshwater *forest*", wetland*, avoid*, loss*) OR ("fresh-water *forest*", wetland*, avoid*, loss*) OR (freshwater, wetland*, avoid*, loss*) OR (fresh-water, wetland*, avoid*, loss*) OR (non-tidal, wetland*, avoid*, loss*) OR (avoid*, peat*, subsidenc*) OR (avoid*, fen, subsidenc*) OR (avoid*, bog, subsidenc*) OR (avoid*, "freshwater marsh*", subsidenc*) OR (avoid*, "fresh-water marsh*", subsidenc*) OR ("freshwater *forest*", wetland*, avoid*, subsidenc*) OR ("fresh-water *forest*", wetland*, avoid*, subsidenc*) OR (freshwater, wetland*, avoid*, subsidenc*) OR (fresh-water, wetland*, avoid*, subsidenc*) OR (non-tidal, wetland*, avoid*, subsidenc*) OR (avoid*, peat*, drain*) OR (avoid*, fen, drain*) OR (avoid*, bog, drain*) OR (avoid*, "freshwater marsh*", drain*) OR (avoid*, "fresh-water marsh*", drain*) OR ("freshwater *forest*", wetland*, avoid*, drain*) OR ("fresh-water *forest*", wetland*, avoid*, drain*) OR (freshwater, wetland*, avoid*, drain*) OR (fresh-water, wetland*, avoid*, drain*) OR (non-tidal, wetland*, avoid*, drain*) OR (prevent*, peat*, impact*) OR (prevent*, fen, impact*) OR (prevent*, bog, impact*) OR (prevent*, "freshwater marsh*", impact*) OR (prevent*, "fresh-water marsh*", impact*) OR ("freshwater *forest*", wetland*, prevent*, impact*) OR ("fresh-water *forest*", wetland*, prevent*, impact*) OR (freshwater, wetland*, prevent*, impact*) OR (fresh-water, wetland*, prevent*, impact*) OR (non-tidal, wetland*, prevent*, impact*) OR (prevent*, peat*, disturb*) OR (prevent*, fen, disturb*) OR (prevent*, bog, disturb*) OR (prevent*, "freshwater marsh*", disturb*) OR (prevent*, "fresh-water marsh*", disturb*) OR ("freshwater *forest*", wetland*, prevent*, disturb*) OR ("fresh-water *forest*", wetland*, prevent*, disturb*) OR (freshwater, wetland*, prevent*, disturb*) OR (fresh-water, wetland*, prevent*, disturb*) OR (non-tidal, wetland*, prevent*, disturb*) OR "brown carbon" OR (prevent*, land-use change*, peatland*) OR (prevent*, land-use change*, bog) OR (prevent*, land-use change*, fen) OR (prevent*, land-use change*, freshwater, marsh*) OR (prevent*, land-use change*, fresh-water, marsh*) OR (prevent*, land-use change*, "freshwater *forest*") OR (prevent*, land-use change*, wetland*) OR (prevent*, land-use change*, non-tidal, wetland*) OR (avoid*, land-use change*, peatland*) OR (avoid*, land-use change*, bog) OR (avoid*, land-use change*, fen) OR (avoid*, land-use change*, freshwater, marsh*) OR (avoid*, land-use change*, fresh-water, marsh*) OR (avoid*, land-use change*, "freshwater *forest*") OR (avoid*, land-use change*, wetland*) OR (avoid*, land-use change*, non-tidal, wetland*)
Path #19 Coastal Wetland Restoration & Rehabilitation	("coastal wetland*" OR "tidal wetland*" OR mangrov* OR salt-marsh* OR saltmarsh* OR tidal-marsh* OR seagrass* OR sea-grass*) NEAR/3 ("carbon sequest*" OR "carbon stor*" OR "carbon reservoir*" OR "carbon mitigat*" OR "carbon increase*" OR carbon-rich OR reforest* OR restor* OR rehabilit* OR regener* OR recover* OR gain* OR "increas* cover" OR "cover* increas*" OR reveget* OR re-vegetat* OR replant* OR re-plant* OR establish* OR planting OR re-establish* OR enhanc* OR regrow* OR re-grow* OR renew* OR rewild* OR rewet* OR re-wet* OR reflood* OR wetting OR "restor* water flow" OR "rehabilit* water flow" OR "restor* flow of water" OR "rehabilit* flow of water" OR mitigat* OR offset* OR remedi* OR "nat* regener*" OR "assist* nat* regener*" OR seeding OR "soil carbon" OR manag* OR "nutrient* manag*" OR fertiliz* OR carbon OR CO2*) OR (carbon, increas*, "coastal wetland*") OR (carbon, increas*, "tidal wetland*") OR (carbon, increas*, mangrov*) OR (carbon, increas*, salt-marsh*) OR (carbon, increas*, saltmarsh*) OR (carbon, increas*, tidal-marsh*) OR (carbon, increas*, seagrass*) OR (carbon, increas*, sea-grass*) OR (enhanc*, function, "coastal wetland*") OR (enhanc*, function, "tidal wetland*") OR (enhanc*, function, mangrov*) OR (enhanc*, function, salt-marsh*) OR (enhanc*, function, saltmarsh*) OR (enhanc*, function, tidal-marsh*) OR (enhanc*, function, seagrass*) OR (enhanc*, function, sea-grass*) OR ("coastal wetland*", restor*, CO2*) OR ("coastal wetland*", "carbon seq*", restor*) OR ("coastal wetland*", "increas* carbon seq*", restor*) OR ("coastal wetland*", hydro*, rehabilit*) OR ("coastal wetland*", hydro*, restor*) OR ("coastal wetland*", "carbon seq*", restor*) OR ("coastal wetland*", "increas* carbon seq*", restor*) OR ("coastal wetland*", restor*, CO2*) OR ("tidal wetland*", "carbon seq*", restor*) OR ("tidal wetland*", "increas* carbon seq*", restor*) OR ("tidal wetland*", hydro*, rehabilit*) OR ("tidal wetland*", hydro*, restorat*) OR ("tidal wetland*", "carbon seq*", restor*) OR ("tidal wetland*", "increas* carbon seq*", restor*) OR ("tidal wetland*", restor*, CO2*) OR (mangrov*, restor*, CO2*) OR (mangrov*, "carbon seq*", restor*) OR (mangrov*, "increas* carbon seq*", restor*) OR (mangrov*, hydro*, rehabilit*) OR (mangrov*, hydro*, restorat*) OR (mangrov*, "carbon seq*", restor*) OR (mangrov*, "increas* carbon seq*", restor*) OR (mangrov*, restor*, CO2*) OR (salt-marsh*, restor*, CO2*) OR (salt-marsh*, "carbon seq*", restor*) OR (salt-marsh*, "increas* carbon seq*", restor*) OR (salt-marsh*, hydro*, rehabilit*) OR (salt-marsh*, hydro*, restorat*) OR (salt-marsh*, "carbon seq*", restor*) OR (salt-marsh*, "increas* carbon seq*", restor*) OR (salt-marsh*, restor*, CO2*) OR (saltmarsh*, restor*, CO2*) OR (saltmarsh*, "carbon seq*", restor*) OR (saltmarsh*, "increas* carbon seq*", restor*) OR (saltmarsh*, hydro*, rehabilit*) OR (saltmarsh*, hydro*, restorat*) OR (saltmarsh*, "carbon seq*", restor*) OR (saltmarsh*, "increas* carbon seq*", restor*) OR (saltmarsh*, restor*, CO2*) OR (tidal-marsh*, restor*, CO2*) OR (tidal-marsh*, "carbon seq*", restor*) OR (tidal-marsh*, "increas* carbon seq*", restor*) OR (tidal-marsh*, hydro*, rehabilit*) OR (tidal-marsh*, hydro*, restorat*) OR (tidal-marsh*, "carbon seq*", restor*) OR (tidal-marsh*, "increas* carbon seq*", restor*) OR (tidal-marsh*, restor*, CO2*) OR (sea-grass*, restor*, CO2*) OR (sea-grass*, "carbon seq*", restor*) OR (sea-grass*, "increas* carbon seq*", restor*) OR (sea-grass*, "carbon seq*", restor*) OR (sea-grass*, "increas* carbon seq*", restor*) OR (sea-grass*, restor*, CO2*) OR (seagrass*, restor*, CO2*) OR (seagrass*, "carbon seq*", restor*) OR (seagrass*, "increas* carbon seq*", restor*) OR (seagrass*, "carbon seq*", restor*) OR (seagrass*, "increas* carbon seq*", restor*) OR (seagrass*, restor*, CO2*) OR ("coastal wetland*", reduc*, emission*) OR ("tidal wetland*", reduc*, emission*) OR (mangrov*, reduc*, emission*) OR (salt-marsh*, reduc*, emission*) OR (saltmarsh*, reduc*, emission*) OR (tidal-marsh*, reduc*, emission*) OR (seagrass*, reduc*, emission*) OR (sea-grass*, reduc*, emission*) OR "blue carbon"
Path #20 Freshwater Wetlands	(peat* OR bog OR fen OR "freshwater marsh*" OR "fresh-water marsh*" OR "freshwater *forest*" OR "fresh-water *forest* wetland*" OR "freshwater wetland*" OR "fresh-water wetland*" OR "non-tidal wetland*" OR wetland* OR "swamp forest*") NEAR/3 ("carbon sequest*" OR "carbon stor*" OR "carbon reservoir*" OR "carbon mitigat*" OR carbon-rich OR "increas* cover" OR "cover* increas*" OR gain* OR restor* OR

Restoration & Rehabilitation	regener* OR rehabilit* OR recover* OR rewet* OR re-wet* OR reflood* OR wetting OR "hydro* rehabilit*" OR "restor* hydro*" OR "rehabilit* hydro*" OR "hydro* restor*" OR "restor* water flow" OR "rehabilit* water flow" OR "restor* flow of water" OR "rehabilit* flow of water" OR carbon OR "soil carbon" OR manag* OR "nutrient* manag*" OR fertiliz* OR moss OR carbon OR CO2*) OR (non-tidal, wetland*, restor*) OR (non-tidal, wetland*, rehabilit*) OR (freshwater, wetland, restor*) OR (freshwater, wetland, rehabilit*) OR (fresh-water, wetland, restor*) OR (fresh-water, wetland, rehabilit*) OR (peat*, restor*, CO2*) OR (peat*, "carbon seq*", restor*) OR (peat*, increas*, "carbon seq*", restor*) OR (bog, restor*, CO2*) OR (bog, "carbon seq*", restor*) OR (bog, increas*, "carbon seq*", restor*) OR (fen, restor*, CO2*) OR (fen, "carbon seq*", restor*) OR (fen, increas*, "carbon seq*", restor*) OR (peat*, hydro*, rehabilit*) OR (peat*, hydro*, restor*) OR "vegetation rewet*" OR "vegetation re-wet*" OR ("freshwater forest*", wetland*, restor*, CO2*) OR (freshwater, "forest* wetland*", "carbon seq*", restor*) OR (freshwater, "forest* wetland*", increas*, "carbon seq*", restor*) OR (increas*, wetland*, carbon, restor*) OR (non-tidal, wetland*, increas*, carbon, restor*) OR (wetland*, restor*, CO2*) OR (freshwater, wetland*, "carbon seq*", restor*) OR (freshwater, wetland*, increas*, "carbon seq*", restor*) OR (freshwater, wetland*, restor*, CO2*) OR (peat*, reduc*, emission*) OR (bog, reduc*, emission*) OR (fen, reduc*, emission*) OR (freshwater, marsh*, reduc*, emission*) OR (fresh-water, marsh*, reduc*, emission*) OR (freshwater, *forest*, wetland, reduc*, emission*) OR (fresh-water, *forest*, wetland*, reduc*, emission*) OR (freshwater, wetland*, reduc*, emission*) OR (fresh-water, wetland*, reduc*, emission*) OR (non-tidal, wetland*, reduc*, emission*) OR (wetland*, reduc*, emission*) OR ("swamp forest*", reduc*, emission*) OR "brown carbon"
Path #21 Grassland Restoration & Rehabilitation	(grassland* OR prairie* OR shrubland* OR shrub-land* OR savannah* OR savanna*) NEAR/3 ("carbon sequest*" OR "carbon stor*" OR "carbon reservoir*" OR "carbon mitigat*" OR "carbon-rich" OR "increas* cover" OR "cover* increas*" OR restor* OR reforest* OR rehabilit* OR recover* OR regener* OR reveget* OR re-vegetat* OR replant* OR re-plant* OR establish* OR re-establish* OR enhanc* OR regrow* OR re-grow* OR renew* OR rewild* OR mitigat* OR offset* OR remediat* OR "nat* regener*" OR "assist* nat* regener*" OR seeding OR carbon OR CO2*) OR (grassland*, restor*, CO2*) OR (prairie*, restor*, CO2*) OR (shrubland*, restor*, CO2*) OR (shrub-land*, restor*, CO2*) OR (savannah*, restor*, CO2*) OR (savanna*, restor*, CO2*) OR (grassland*, "carbon seq*", restor*) OR (prairie*, "carbon seq*", restor*) OR (shrubland*, "carbon seq*", restor*) OR (shrub-land*, "carbon seq*", restor*) OR (savannah*, "carbon seq*", restor*) OR (savanna*, "carbon seq*", restor*) OR (grassland*, "increas* carbon seq*", restor*) OR (prairie*, "increas* carbon seq*", restor*) OR (shrubland*, "increas* carbon seq*", restor*) OR (shrub-land*, "increas* carbon seq*", restor*) OR (savannah*, "increas* carbon seq*", restor*) OR (savanna*, "increas* carbon seq*", restor*) OR (grassland*, reduc*, emission*) OR (prairie*, reduc*, emission*) OR (shrubland*, reduc*, emission*) OR (shrub-land*, reduc*, emission*) OR (savannah*, reduc*, emission*) OR (savanna*, reduc*, emission*)
Path #22 Afforestation	(afforestation OR forestation OR reafforestation) NEAR/3 ("carbon sequest*" OR "carbon stor*" OR "carbon reservoir*" OR "carbon mitigat*" OR restor* OR rehabilit* OR recover* OR regener* OR replant* OR re-plant* OR vegetat* OR reveget* OR re-vegetat* OR "tree* planting" OR plantation* OR planted OR rewild* OR "assist* nat* regenerat*" OR "direct seedling" OR "seedling planting" OR succession OR mitigat* OR remediat* OR offset OR transition OR *forest* OR savanna* OR savannah* OR mangrove* OR tundra* OR grass* OR prairie* OR "abandon* land*" OR "abandon* agricultur* land*" OR "abandon* farm*" OR "abandon* agricultur* farm*" OR windbreak* OR tree* OR "tree* cover" OR "direct seedling" OR "seedling planting" OR "available land" OR landscape OR carbon OR CO2*) OR "farm* into *forest*" OR "crop* into *forest*" OR "agricultur* into *forest*" OR (reforest*, "abandon* land*") OR (reforest*, "abandon* agricultur* land*") OR (reforest*, "abandon* farm*") OR (reforest*, "abandon* agricultur* farm*") OR (rewild*, "abandon* land*") OR (rewild*, "abandon* agricultur* land*") OR (rewild*, "abandon* farm*") OR (rewild*, "abandon* agricultur* farm*") OR (avoid*, grass*, afforestation) OR (avoid*, savanna*, afforestation) OR (avoid*, savannah*, afforestation) OR (avoid*, mangrove*, afforestation) OR (avoid*, tundra*, afforestation) OR (avoid*, prairie*, afforestation) OR (avoid*, grass*, forestation) OR (avoid*, savanna*, forestation) OR (avoid*, savannah*, forestation) OR (avoid*, mangrove*, forestation) OR (avoid*, tundra*, forestation) OR (avoid*, prairie*, forestation)

Table S15. The assignment of topics to individual or multiple NCS pathways and co-impacts.

	Economic living standards	Material living standards	Health	General human well-being	Education	Social relations	Security and safety	Subjective well-being	Culture and spirituality	Biodiversity	Environmental co-impacts
Avoided forest conversion	[525, 488, 674, 681, 524, 505, 486, 603, 599, 669, 670]	[525, 196, 405, 488, 681, 524, 159, 144, 486, 603, 599, 669, 670]	[90, 488, 542, 637, 68, 214, 60, 43, 670, 54]	[405, 681, 542, 603, 670]	[486, 669, 670, 584]	[674, 637]	[405, 149, 603, 669]	[674, 681, 542, 637, 603, 670, 54]	[488, 486, 603]	[90, 575, 531, 515, 132, 527, 525, 529, 153, 113, 397, 501, 260, 360, 702, 674, 681, 551, 577, 698, 687, 585, 688, 359, 282, 281, 214, 149, 128, 589, 497, 500, 603, 599, 670, 528, 584, 57]	[575, 531, 515, 132, 527, 529, 153, 113, 397, 196, 331, 702, 674, 637, 524, 457, 551, 505, 577, 698, 687, 688, 282, 214, 159, 150, 149, 144, 128, 60, 43, 589, 497, 500, 486, 603, 599, 669, 670, 528, 54, 584, 57]
Avoided grassland, savannas, shrublands conversion	[427, 505]	[703, 634, 556, 427, 159]	[90]	[]	[584]	[]	[]	[]	[482]	[705, 703, 90, 515, 527, 634, 655, 128, 590, 589, 557, 487, 499, 591, 482, 584, 636, 511]	[705, 703, 515, 527, 331, 634, 556, 427, 655, 505, 159, 128, 589, 487, 499, 482, 584, 636, 511]
Avoided coastal wetland impacts & conversion	[187]	[232, 200, 225, 187, 205]	[180, 204]	[]	[]	[]	[215]	[]	[]	[194, 122, 188, 181, 229, 182, 200, 185, 215, 217, 225, 187, 227, 226, 205, 204, 195, 57]	[194, 193, 232, 122, 188, 181, 229, 182, 200, 180, 185, 215, 225, 187, 227, 226, 205, 204, 195, 57]

Avoided freshwater wetlands impacts	[203, 187]	[201, 232, 203, 116, 222, 187, 207, 715]	[34, 201, 203, 204, 214, 715]	[]	[]	[]	[201]	[]	[]	[194, 212, 34, 231, 122, 188, 116, 229, 182, 222, 206, 187, 204, 214, 57, 198]	[194, 212, 34, 193, 231, 201, 232, 203, 122, 188, 116, 229, 182, 222, 206, 187, 204, 207, 214, 715, 57, 198]
Natural forest manageme nt	[80, 701, 692, 550, 657, 658, 525, 224, 490, 708, 699, 679, 684, 488, 676, 714, 329, 610, 674, 516, 681, 234, 524, 564, 505, 694, 402, 20, 142, 675, 677, 486, 603, 669, 670, 672, 403, 588, 385, 593]	[80, 701, 692, 657, 525, 224, 490, 196, 405, 708, 699, 679, 684, 488, 676, 714, 604, 516, 681, 207, 234, 524, 564, 580, 402, 20, 159, 144, 142, 675, 677, 594, 486, 603, 669, 670, 672, 403, 672, 403, 385]	[550, 490, 488, 542, 638, 68, 214, 60, 670, 54]	[216, 405, 681, 542, 638, 603, 670]	[490, 516, 694, 486, 669, 670, 584, 403]	[490, 674]	[216, 405, 330, 142, 603, 669]	[352, 545, 329, 674, 681, 542, 638, 603, 670, 54]	[490, 488, 694, 486, 603, 586, 403]	[384, 575, 692, 531, 550, 515, 489, 132, 527, 525, 224, 529, 153, 113, 397, 490, 216, 501, 260, 352, 360, 545, 702, 699, 714, 329, 674, 681, 638, 100, 551, 577, 698, 687, 695, 585, 653, 688, 694, 646, 402, 328, 447, 359, 282, 281, 214, 128, 594, 589, 496, 497, 500, 603, 670, 584, 586, 327, 386, 569, 578, 403, 588, 385, 593]	[384, 701, 575, 692, 531, 550, 657, 515, 132, 527, 224, 529, 153, 113, 397, 216, 196, 331, 352, 702, 699, 679, 684, 714, 329, 610, 604, 330, 674, 207, 234, 638, 524, 564, 580, 100, 551, 505, 577, 698, 687, 695, 653, 688, 694, 646, 402, 328, 447, 282, 214, 159, 150, 144, 142, 128, 60, 677, 594, 589, 497, 500, 486, 603, 669, 670, 54, 584, 586, 327, 386, 578, 403, 588, 385, 593]
Improved plantations	[80, 701, 692, 550, 657, 658, 102, 708, 558, 605, 699, 679, 684, 302,	[80, 701, 692, 657, 708, 558, 605, 699, 679, 684, 302, 676, 604, 516,	[550, 102, 60]	[]	[516]	[]	[149]	[352]	[]	[575, 692, 531, 550, 132, 102, 352, 360, 558, 699, 100, 695, 653, 688, 402, 328, 447, 359, 282, 149, 128,	[701, 575, 692, 531, 550, 657, 132, 102, 352, 558, 605, 699, 679, 684, 610, 604, 704, 564, 580, 700, 271, 100, 695, 653, 688, 402, 328,

	676, 610, 516, 239, 704, 564, 700, 271, 143, 402, 20, 675, 151, 677, 243, 139, 599, 672, 96, 385, 593]	239, 704, 564, 580, 700, 271, 601, 402, 20, 675, 677, 594, 243, 139, 599, 672, 96, 385]								151, 594, 599, 386, 578, 385, 593]	447, 282, 150, 149, 128, 60, 151, 677, 594, 243, 139, 599, 386, 578, 96, 385, 593]
Fire management	[]	[]	[]	[]	[]	[]	[104]	[]	[]	[479, 105, 478, 384, 132, 485]	[479, 104, 105, 478, 384, 132]
Avoided/sustainable woodfuel harvest	[610, 606, 151, 677, 608]	[606, 604, 677, 608]	[2]	[]	[]	[]	[]	[]	[]	[2, 151]	[610, 606, 604, 2, 151, 677]
Grazing – optimal intensity	[558, 606, 798, 762, 796, 771, 787, 426, 398, 233, 304, 110, 751]	[348, 558, 606, 604, 798, 1, 762, 796, 771, 787, 426, 398, 233, 304, 110, 751]	[15, 641]	[]	[]	[]	[]	[]	[]	[348, 558, 725, 576]	[348, 558, 606, 604, 725, 798, 1, 762, 796, 771, 787, 426, 15, 398, 233, 457, 641, 576, 751]

Grazing – legumes in pastures	[731, 131, 514, 756, 558, 734, 726, 63, 742, 792, 793, 768, 772, 709, 382, 536, 798, 724, 632, 762, 783, 736, 796, 752, 795, 788, 771, 757, 787, 440, 398, 244, 233, 443, 704, 304, 129, 758, 722, 110, 371, 733, 751, 759, 761]	[731, 131, 348, 514, 756, 201, 196, 558, 647, 734, 789, 710, 726, 63, 742, 792, 786, 793, 768, 772, 709, 382, 536, 798, 724, 632, 762, 783, 736, 796, 752, 795, 788, 771, 794, 757, 787, 440, 398, 244, 233, 791, 443, 704, 304, 129, 758, 8, 722, 159, 715, 110, 565, 766, 371, 733, 751, 759, 761]	[201, 734, 726, 799, 797, 792, 536, 440, 791, 715]	[]	[734]	[732, 734]	[201, 734, 765]	[647, 732, 734, 726]	[]	[664, 348, 558, 213, 789, 797, 784, 725, 711, 790, 757, 791, 443, 785, 758, 8, 565, 766, 371]	[664, 731, 348, 514, 756, 201, 196, 558, 213, 647, 734, 789, 710, 726, 799, 797, 538, 639, 63, 742, 786, 793, 768, 784, 725, 772, 709, 711, 382, 535, 536, 798, 724, 632, 762, 736, 796, 752, 795, 788, 790, 771, 794, 757, 787, 440, 398, 244, 233, 791, 443, 704, 785, 758, 8, 722, 159, 715, 565, 766, 765, 371, 733, 751, 759, 761]
-------------------------------------	---	---	---	----	-------	---------------	-----------------------	-------------------------	----	--	---

Grazing – improved feed	[731, 131, 35, 737, 735, 166, 119, 285, 754, 224, 490, 558, 777, 302, 656, 740, 683, 312, 734, 332, 744, 329, 681, 713, 462, 63, 742, 441, 768, 772, 709, 382, 536, 633, 798, 313, 724, 632, 783, 736, 752, 795, 757, 787, 440, 244, 314, 767, 780, 99, 443, 704, 304, 758, 160, 505, 722, 716, 143, 236, 157, 168, 47, 124, 110, 603, 599, 774, 746, 764, 733, 751, 750, 747,	[731, 131, 35, 737, 735, 166, 119, 285, 754, 224, 490, 558, 777, 302, 656, 740, 683, 312, 734, 332, 744, 329, 681, 713, 462, 63, 742, 441, 768, 772, 709, 382, 536, 633, 798, 313, 724, 632, 783, 736, 752, 795, 757, 787, 440, 244, 314, 767, 780, 99, 443, 704, 304, 758, 160, 505, 722, 304, 758, 8, 160, 722, 503, 236, 157, 715, 168, 47, 124, 110, 603, 599, 774,	[490, 683, 312, 734, 310, 799, 797, 293, 536, 313, 440, 642, 791, 641, 296, 715]	[285, 332, 748, 681, 603]	[490, 656, 312, 734, 748, 596, 313, 746]	[490, 656, 683, 732, 734, 744, 780]	[35, 740, 683, 574, 734, 330, 462, 603, 746, 765]	[352, 647, 683, 732, 734, 744, 748, 329, 681, 716, 739, 603, 746]	[285, 490, 656, 683, 603, 482, 746]	[737, 224, 490, 352, 558, 213, 656, 740, 312, 574, 748, 749, 329, 681, 310, 797, 462, 293, 441, 784, 725, 711, 790, 757, 791, 443, 785, 509, 758, 8, 160, 654, 168, 739, 47, 124, 499, 603, 599, 482, 766, 540]	[731, 737, 166, 119, 285, 754, 224, 331, 352, 558, 777, 213, 647, 312, 574, 734, 749, 329, 596, 330, 713, 207, 310, 799, 797, 63, 293, 742, 441, 768, 784, 725, 772, 709, 711, 382, 536, 633, 798, 313, 724, 632, 736, 752, 795, 790, 794, 757, 787, 440, 642, 244, 314, 767, 780, 791, 99, 443, 641, 704, 785, 509, 758, 8, 160, 654, 505, 506, 722, 716, 503, 236, 157, 715, 168, 739, 47, 499, 603, 599, 482, 774, 746, 769, 766, 765, 764, 733, 540, 751, 750, 747, 541, 125, 759, 761]
-------------------------	--	---	--	---------------------------	--	-------------------------------------	---	---	-------------------------------------	---	---

	541, 125, 759, 761]	746, 766, 764, 733, 540, 751, 750, 747, 541, 125, 759, 761]									
Grazing – animal management	[80, 102, 302, 740, 493, 427, 714, 332, 462, 63, 241, 103, 239, 237, 129, 142, 599, 325]	[80, 302, 740, 427, 714, 332, 462, 63, 241, 103, 240, 239, 237, 129, 142, 599, 325]	[102]	[332, 103]	[]	[]	[740, 462, 142]	[493]	[493, 325]	[153, 102, 740, 493, 714, 462, 240, 654, 496, 599, 325]	[153, 102, 427, 714, 63, 241, 103, 240, 457, 237, 654, 142, 599, 325]
Biochar	[347, 354, 415, 316, 375, 394, 333, 325]	[109, 579, 347, 354, 415, 316, 375, 394, 333, 325, 315, 221]	[]	[221]	[]	[333]	[]	[]	[325, 482]	[109, 579, 652, 654, 590, 487, 325, 315, 482]	[109, 552, 579, 652, 654, 415, 316, 375, 487, 333, 325, 315, 221, 482]
Cropland nutrient management	[246, 472, 322, 333]	[320, 246, 472, 723, 322, 333]	[246]	[]	[]	[333]	[]	[]	[]	[322]	[320, 246, 333]
Conservation agriculture	[464, 438, 425, 347, 469, 470, 317, 471, 354, 468, 459, 418, 246, 419, 465, 426, 453, 415,	[464, 109, 438, 425, 347, 469, 470, 317, 471, 354, 789, 320, 468, 459, 418, 246, 419, 465,	[246, 467]	[221]	[]	[]	[]	[]	[]	[109, 789, 419, 322, 690]	[109, 438, 425, 317, 471, 789, 320, 459, 418, 246, 419, 439, 426, 453, 415, 221, 16, 690]

	473, 467, 472, 322, 318, 279]	439, 426, 453, 415, 473, 472, 322, 318, 221, 16, 279]									
Trees in croplands and agroforestry	[438, 169, 469, 470, 317, 471, 427, 372, 433, 793, 468, 314, 437, 375, 322, 333, 434, 279, 403, 530, 410]	[703, 109, 438, 169, 634, 469, 470, 317, 471, 427, 372, 433, 749, 789, 793, 468, 439, 314, 437, 375, 322, 333, 434, 221, 279, 565, 403, 530, 410]	[]	[434, 221]	[403]	[732, 333]	[330]	[732]	[434, 403]	[703, 109, 634, 749, 789, 509, 322, 167, 487, 636, 690, 327, 565, 403]	[703, 109, 552, 438, 169, 634, 317, 471, 427, 372, 749, 330, 789, 793, 439, 314, 509, 375, 167, 487, 333, 221, 636, 690, 327, 565, 403, 530]
Improved rice cultivation	[753, 119, 285, 514, 754, 756, 275, 777, 726, 441, 724, 440, 398, 244, 233, 682, 747, 761]	[348, 753, 119, 285, 514, 754, 756, 275, 777, 726, 441, 724, 440, 398, 244, 233, 682, 747, 761]	[726, 440, 18, 15]	[285]	[]	[]	[18]	[726]	[285]	[348, 441]	[348, 753, 119, 285, 514, 754, 756, 275, 777, 726, 538, 441, 724, 440, 399, 15, 398, 244, 233, 682, 747, 761]

Forest Reforestation & Rehabilitation	[692, 558, 699, 679, 488, 674, 681, 524, 505, 142, 486, 669, 588, 385]	[692, 196, 405, 558, 699, 679, 488, 681, 524, 159, 144, 142, 486, 669, 385]	[488, 542, 637, 638, 68, 214, 60, 43, 54]	[216, 405, 681, 542, 638]	[486, 669]	[674, 637, 498]	[216, 405, 330, 149, 142, 669]	[352, 595, 674, 681, 542, 637, 638, 498, 54]	[488, 486]	[692, 489, 132, 527, 113, 216, 501, 260, 352, 360, 558, 702, 699, 595, 674, 681, 638, 498, 306, 100, 551, 654, 577, 698, 688, 646, 359, 282, 214, 149, 128, 589, 496, 497, 500, 578, 588, 57, 385]	[692, 132, 527, 113, 216, 196, 331, 352, 558, 702, 699, 679, 330, 674, 637, 638, 524, 100, 551, 654, 505, 577, 698, 688, 646, 282, 214, 159, 150, 149, 144, 142, 128, 60, 43, 589, 497, 500, 486, 669, 54, 578, 588, 57, 385]
Afforestation	[187]	[232, 200, 225, 187, 205, 159]	[180, 204]	[]	[]	[]	[215]	[230, 208]	[]	[194, 230, 170, 122, 188, 208, 181, 229, 182, 200, 185, 215, 217, 225, 187, 227, 226, 205, 204, 785, 195, 57]	[194, 230, 232, 170, 122, 188, 208, 181, 229, 182, 200, 180, 185, 215, 225, 187, 227, 226, 205, 204, 785, 159, 195, 57]
Grassland restoration and rehabilitation	[203, 187, 110]	[201, 232, 203, 116, 222, 187, 159, 110]	[34, 201, 203, 204]	[]	[]	[]	[201]	[230, 208]	[]	[194, 212, 34, 230, 231, 170, 122, 188, 116, 208, 229, 182, 220, 222, 206, 187, 204, 57, 198]	[194, 212, 34, 230, 231, 201, 232, 170, 203, 122, 188, 116, 208, 229, 182, 220, 222, 206, 187, 204, 159, 57, 198]
Coastal wetlands restoration & rehabilitation	[681, 505, 157]	[703, 579, 634, 556, 681, 157, 159, 565]	[]	[681]	[]	[]	[]	[681]	[482]	[705, 703, 664, 515, 527, 579, 634, 681, 655, 167, 128, 590, 589, 557, 487, 499, 482, 636, 690, 565, 511]	[705, 703, 664, 515, 527, 331, 579, 634, 556, 655, 505, 157, 159, 167, 128, 589, 487, 499, 482, 495, 636, 690, 565, 511]

Freshwater wetlands restoration	[558, 679, 329, 524]	[405, 558, 679, 524]	[542, 68, 43, 54]	[405, 542]	[]	[]	[405]	[329, 595, 542, 54]	[]	[531, 527, 360, 558, 329, 595, 306, 698, 128, 589, 496]	[531, 527, 558, 679, 329, 524, 698, 128, 43, 589, 54, 495]
--	----------------------	----------------------	-------------------	------------	----	----	-------	---------------------	----	---	--

Table S16. Comprehensive List of Trigger Words, Symbols, Prefixes, and Currency Names for Cost Information Detection.

[illegible]

Table S17. The counts of disciplines represented among the scientific abstracts in the sample.

Discipline	Count of abstracts
Environmental Sciences	40923
Ecology	34111
Agronomy	23472
Plant Sciences	21455
Forestry	17372
Soil Science	14685
Water Resources	11381
Agriculture: Multidisciplinary	10323
Biodiversity Conservation	9654
Geosciences: Multidisciplinary	8085
Environmental Studies	7817
Marine & Freshwater Biology	7672
Agriculture: Dairy & Animal Science	5893
Engineering: Environmental	5739
Multidisciplinary Sciences	5599
Horticulture	5369
Entomology	4701
Geography: Physical	4173
Green & Sustainable Science & Technology	3933
Meteorology & Atmospheric Sciences	3764
Economics	3689
Zoology	3559
Energy & Fuels	3532
Biotechnology & Applied Microbiology	3412
Food Science & Technology	3404
Agricultural Engineering	3316
Oceanography	3077
Remote Sensing	2521
Biology	2231
Geography	2013
Veterinary Sciences	1890
Engineering: Civil	1803
Chemistry: Analytical	1567
Imaging Science & Photographic Technology	1517

Limnology	1514
Agricultural Economics & Policy	1491
Engineering: Chemical	1470
Regional & Urban Planning	1387
Microbiology	1369
Fisheries	1182
Development Studies	1100
Biochemistry & Molecular Biology	1086
Genetics & Heredity	1082
Evolutionary Biology	1077
Computer Science: Multidisciplinary	1012
Urban Studies	968
Toxicology	928
Ornithology	925
Public Environmental & Occupational Health	919
Materials Science	796
Chemistry: Multidisciplinary	775
Engineering: Electrical & Electronic	746
Chemistry: Applied	727
Sociology	688
Engineering: Multidisciplinary	666
Anthropology	529
Geochemistry & Geophysics	525
Mycology	518
Computer Science: Information Systems	464
Materials Science: Paper & Wood	453
Paleontology	444
Thermodynamics	414
Operations Research & Management Science	399
Nutrition & Dietetics	356
Business	335
Management	331
Physics: Applied	329
Computer Science: Theory & Methods	326
Geology	299
Computer Science: Artificial Intelligence	295
Mathematics: Interdisciplinary Applications	283
Pharmacology & Pharmacy	281

Social Sciences: Interdisciplinary	269
Mathematics: Applied	262
Area Studies	244
Engineering: Mechanical	235
Construction & Building Technology	235
Physiology	235
Chemistry: Physical	211
Parasitology	198
Instruments & Instrumentation	197
Behavioral Sciences	197
Optics	191
Biochemical Research Methods	170
Education & Educational Research	165
Telecommunications	163
Statistics & Probability	161
Mechanics	155
Political Science	149
Biophysics	146
Law	143
International Relations	142
History & Philosophy Of Science	134
Cell Biology	133
Automation & Control Systems	130
Engineering: Geological	126
Mathematical & Computational Biology	124
Archaeology	120
Public Administration	118
Chemistry: Medicinal	112
Computer Science: Software Engineering	109
Business: Finance	106
Polymer Science	105
Engineering: Ocean	104
Hospitality: Leisure, Sport & Tourism	102
Tropical Medicine	101
Reproductive Biology	99
Engineering: Industrial	96
Integrative & Complementary Medicine	84
Physics: Multidisciplinary	79

Metallurgy & Metallurgical Engineering	79
Engineering: Manufacturing	76
Architecture	74
Immunology	73
History	72
Mining & Mineral Processing	71
Education: Scientific Disciplines	62
Transportation Science & Technology	62
Engineering: Marine	62
Infectious Diseases	62
Medicine: Research & Experimental	59
Ethics	59
Virology	57
Computer Science: Hardware & Architecture	56
Demography	55
Engineering: Biomedical	53
Endocrinology & Metabolism	53
Nuclear Science & Technology	52
Neurosciences	52
Social Sciences: Mathematical Methods	51
Physics: Condensed Matter	51
Spectroscopy	51
Developmental Biology	50
Engineering: Aerospace	48
Mineralogy	48
Materials Science: Textiles	47
Information Science & Library Science	45
Nanoscience & Nanotechnology	45
Psychology: Multidisciplinary	42
Humanities: Multidisciplinary	40
Chemistry: Inorganic & Nuclear	40
Health Care Sciences & Services	40
Transportation	37
Medicine: General & Internal	34
Art	34
Electrochemistry	33
Materials Science: Biomaterials	30
History Of Social Sciences	29

Social Issues	28
Materials Science: Composites	27
Obstetrics & Gynecology	26
Astronomy & Astrophysics	26
Surgery	25
Psychology: Biological	24
Radiology: Nuclear Medicine & Medical Imaging	24
Robotics	24
Physics: Fluids & Plasmas	22
Pediatrics	20
Materials Science: Characterization & Testing	20
Mathematics	20
Engineering: Petroleum	19
Cardiac & Cardiovascular Systems	19
Physics: Mathematical	18
Computer Science: Cybernetics	18
Chemistry: Organic	17
Respiratory System	16
Psychiatry	16
Health Policy & Services	15
Asian Studies	15
Sport Sciences	14
Physics: Atomic: Molecular & Chemical	14
Communication	13
Peripheral Vascular Disease	13
Social Sciences: Biomedical	12
Materials Science: Coatings & Films	12
Psychology	12
Medical Informatics	12
("Womens Studies"	12
Philosophy	11
Religion	11
Medical Laboratory Technology	11
Clinical Neurology	11
Anatomy & Morphology	10
Pathology	10
Psychology: Applied	10
Oncology	10

Orthopedics	9
Education: Special	9
Psychology: Clinical	9
Criminology & Penology	9
Critical Care Medicine	8
Ergonomics	8
Ethnic Studies	8
Microscopy	7
Psychology: Developmental	7
Acoustics	7
Physics: Nuclear	7
Psychology: Experimental	7
Medicine: Legal	7
Industrial Relations & Labor	7
Dentistry: Oral Surgery & Medicine	6
Cultural Studies	6
Andrology	6
Materials Science: Ceramics	6
Social Work	6
Gastroenterology & Hepatology	5
Language & Linguistics	5
Linguistics	5
Substance Abuse	5
Rehabilitation	5
Transplantation	5
Psychology: Educational	4
Neuroimaging	4
Geriatrics & Gerontology	4
Urology & Nephrology	4
Ophthalmology	4
Dermatology	4
Nursing	4
Audiology & Speech-Language Pathology	3
Hematology	3
Rheumatology	2
Gerontology	2
Medieval & Renaissance Studies	2
Crystallography	2

Psychology: Social	2
Literature	2
Literature: African/Australian/Canadian	1
Primary Health Care	1
Medical Ethics	1
Family Studies	1
Cell & Tissue Engineering	1
Anesthesiology	1
Emergency Medicine	1
Otorhinolaryngology	1
Folklore	1
Allergy	1
Literary Theory & Criticism	1
Missing	72138