Application Module

Systematic Review and Meta-analysis

2023

Colandr
Rayyan
OpenMEE

Application Module

Systematic Review and Meta-analysis 2023

Colandr | Rayyan | OpenMEE

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Rahman MM, Nabella DM, Tarigan SD, Siregar IZ, Purnomo H. 2024. *Application Module: Systematic Review and Meta-analysis*. Bogor, Indonesia: CIFOR.

Photos by the authors
Screenshots taken from:
https://www.colandrapp.com/
https://www.rayyan.ai/
http://www.cebm.brown.edu/openmee/

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Foreword

IPB University and CIFOR held training sessions entitled "The 1st Training Series of TRADE Hub Indonesia on Social Network Analysis and Qualitative Analysis" on 7 and 14 November 2020. This TRADE Hub Indonesia training was part of a series aimed at supporting TRADE Hub efforts to increase the relevance of, and promote the application of research, and help policymakers at all levels to develop and apply relevant policies and regulations more effectively. Target participants in the training series were not only TRADE Hub researchers in Indonesia, but also young researchers from universities and other institutions. The TRADE Hub Indonesia Training Series was expected to become a learning platform for stakeholders in Indonesia (policymakers, financial institutions and the private sector), and for students, academics, young researchers and practitioners with knowledge and skills to create robust research products, improve decision-making processes, and formulate and implement effective science-based policies.

The first training series focused on research methodologies and techniques based on the realization that researchers have important knowledge and skills to create robust research products in the topic of sustainable development, which is always complex, and had become even more so in the midst of the pandemic. Material from the training has now been compiled into book form to improve accessibility to this knowledge product.

The authors

Colandr

Table of contents

Training materials
https://ipb.link/tradehub-colandr

1. About Colandr

Colandr (https://www.colandrapp.com/) is a web-based open access platform for conducting evidence reviews. Colandr can be used by collaborative teams of any size, and provides an organizational structure for managing information throughout the evidence review process. The Colandr draft is prepared on the basis of systematic evidence synthesis steps, however, it can be used for any type of review or document synthesis. Colandr is a two-system platform (see diagram below). System 1 focuses on intelligent sorting citations by relevance for inclusion at the next stage of review. System 2 is for semi-automatic classification of included documents for user-defined categories. At each stage, machine learning and natural language processing algorithms work in the background to learn what is relevant for each review, and suggest more relevant citations and possible classifications. At both of these stages, the process is semi-automated, so the final decision for inclusion or exclusion and classification must be made by individual users. Colandr maintains this level of user oversight to ensure transparency in the decision process. Colandr is supported by The Science for Nature and People Partnership, DataKind, Conservation International and The Center for Biodiversity and Conservation at the American Museum of Natural History.
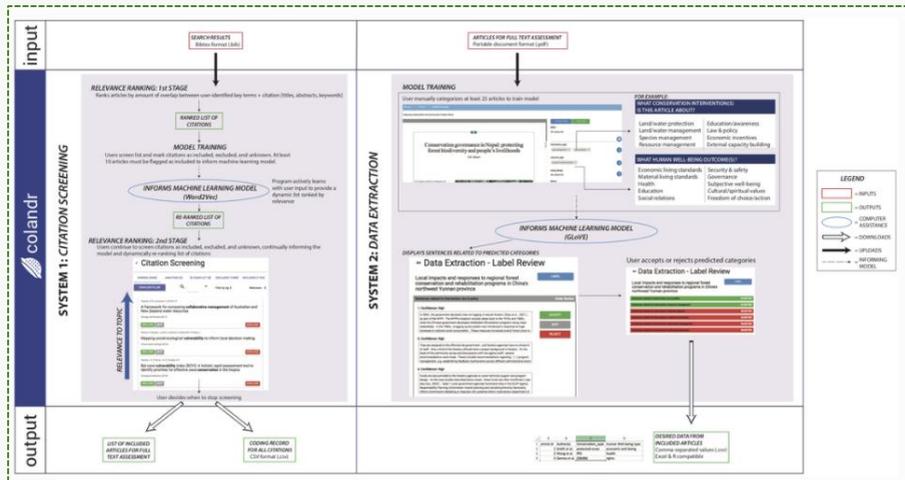
1.1. Pros of Colandr

1. Smart sorting and text mining:

   Colandr is powered by machine learning and natural language processing approaches that drive intelligent sorting of quotations and classification of predictive documents.

2. Open access and open source:

   Colandr is free to use and built on open science principles to encourage collaborative development.

3. No black box processes:

   Colandr helps speed up the synthesis process, but maintains user supervision throughout the process, ensuring transparency in decisions.

1.2. Colandr features

1. Collaborative teamwork

2. Cross-checking between review team members

3. Help in structuring search strings

4. Citation uploads in a common bibliographic format (e.g., BibTex and RIS)

5. Citation filtering on titles and abstracts powered by machine learning (sorts by relevance for each review)

6. Upload a PDF

7. Data extraction from full text is supported by natural language processing

8. Export filtering decisions and extracted data in comma-separated value (CSV) format.

2. Colandr registration

The steps to register a Colandr account are as follows:

1. Open the Colandr website through your browser at https://www.colandrapp.com/

2. Enter the SIGN UP menu next to the words SIGN IN.
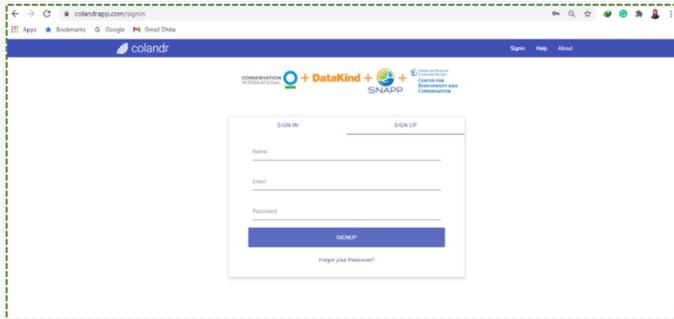
3. Fill in the required data for registration.

    Name   = First name and last name, e.g., Dhita Mutiara Nabella

    Email   = Your email address, e.g., dhita.mutiara@email.com

    Password = The password you wish to use, e.g., Password1234

4. Once filled in, click **SIGN UP**.
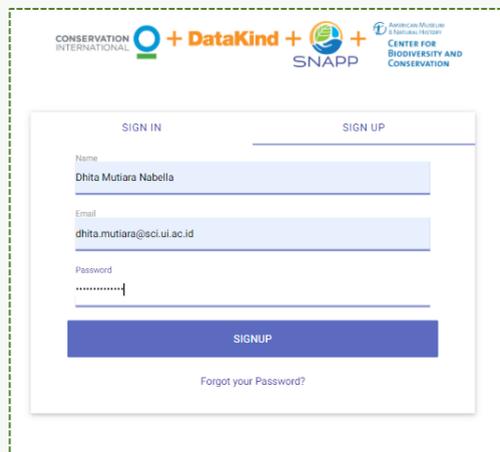
5. A notification will appear stating that you have signed up, and asking you to check your email to confirm your account.

6. The confirmation email from Colandr can take some time to arrive. If you have not received a confirmation email within 24 hours, you can contact the Colandr team at colandrteam@gmail.com.

7. Once you have confirmed your account via email, you can open the SIGN IN page at the following link: https://colandrapp.com/signin.

8. Keep a record of your registered email and password.

9. Once the registration is complete, your account is ready to use.

3. Creating reviews

1. After signing in by entering your email and password, click **CREATE REVIEW**.

2. Next, write the name and a brief description of the review being carried out.

Examples:

Review name	:	Palm oil trade drivers and trade outcomes
Description	:	Palm oil trade driver and trade outcome linkages

4. Basic information

1. After creating the review, click **Review Settings** to set the basic foundations of the systematic review you will perform.

2. The settings section consists of:

   a. **Basic Information**: This comprises the title and description of the review you entered when creating the review. These can be updated if necessary. Click **UPDATE**.

   b. **Collaboration**: Here you can invite others to collaborate by adding their email addresses. This will allow them to access the review you are creating. Enter their email address(es), then click **INVITE**.

   c. **Collaboration Settings**: If it is necessary to double check citations or full texts, the setting can be changed to two screeners. Check your preference and click **UPDATE COLLABORATION SETTINGS**.

   d. **Freeze review**: You can click this if you want to prevent any changes to the review.
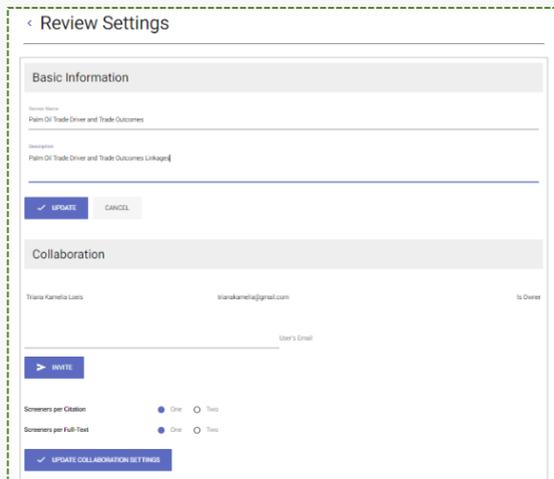
e. **Delete Review**: Click this if you want to delete a review you have created.

4.1. Planning

1. Click the title of the review you have created, and a display will appear as shown below.
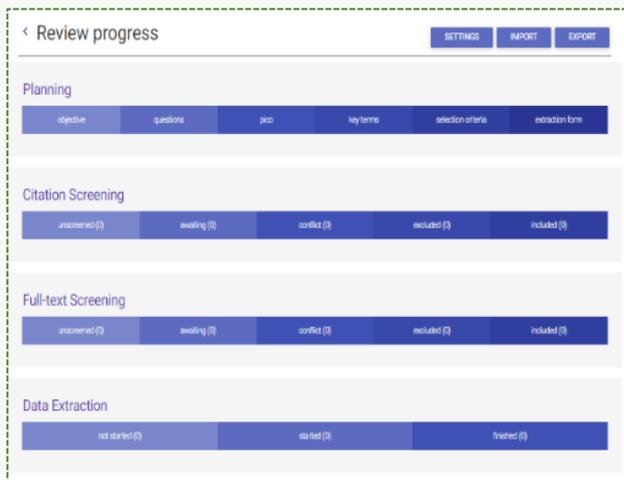
2. This progress review display consists of four parts: Planning, Citation Screening, Full-text Screening and Data Extraction.

3. The first stage is planning. Click **Planning**, and the following display will appear.
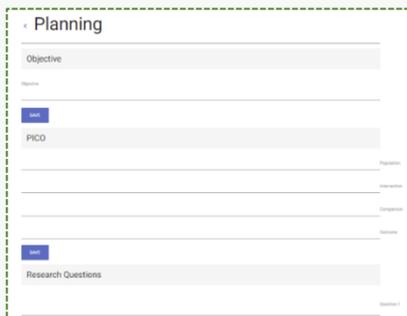
4. The aim of the planning stage is to prepare related systematic reviews. Planning consists of:

   a. **Objective**: This is the purpose of the research being carried out. It needs to be written to ensure team members have the same understanding of the research objective. Example: To determine relationships between palm oil trade drivers and outcomes.

   b. **PICO**: This is to define research criteria, and consists of Population, Intervention, Comparison and Outcomes. Click **SAVE** when you have filled in all PICO fields.

Examples:
   a) Population   : Global palm oil trade stakeholders
   b) Intervention   : Institutions (governance, policy); standardization
   c) Comparison   : Before and after intervention, more or less sustainable
   d) Outcomes   : Economic growth, income, food security, job creation.

c. **Research Questions***:* Research questions to be answered through the research. You can write primary questions and secondary questions for more detail.

Examples:

- What evidence exists for linkages of palm oil trade drivers to outcomes?
- What is the distribution of the evidence base in terms of overall quantity of articles, study design types, interventions examined, outcomes measured, governance regimes, ecoregions and geographical locations?
- What types of palm oil trade relations have been studied and how much evidence is there from different types of research?

d. **Search items**: Keywords related to research are divided into three categories: Term (main keyterms); Synonyms (words with similar meanings to keyterms, separated by commas); Group (associated group for the keyterms).

Examples:

Term	Synonyms	Group
oil palm	palm oil, palm kernel	Trade driver
commodity crops	oil seed, cash crop	Trade driver
land rent	land legality, land tenure	Trade driver
smallholder	smallholders, farmers	Trade driver
CPO fund	palm oil fund, export levy	Trade driver
poverty	impoverished, least developed	Trade outcome
livelihoods	social well-being, lifestyle	Trade outcome
regional revenue	regional revenue	Trade outcome
conservation	forest preservation, protection	Trade outcome
ecosystem service		Trade outcome

One keywords have been entered, a Boolean Search Query will be generated automatically.

e. **Selection Criteria**. The criteria that will be used to determine whether the article being processed is a related article (criteria for inclusion/exclusion), accompanied by an explanation of these criteria.

Examples:

| Selection Criteria	Label
Population	Global palm oil stakeholders
Palm oil trade drivers	Market, endowment, institution
Environmental impact	Food security, sustainability
Intervention	Trade policy, government regulation
Duplicate	Duplicate articles
Timeframe	The last 15 years
Study design	Relation between drivers and outcomes
Topic	Relevant to trade
Others	Not accessible or not found

4.2. Importing citations

Before the citation screening stage, it is necessary to import the citations that have been created. Steps for importing citations are as follows:

1. Open Mendeley, an application to help manage the citations you need.

2. If you do not have a Mendeley account, you need to create one at https://www.mendeley.com/.

3. Click **Create a free account**.

4. Fill in your email address, name and password. Click **Register**.

5. Check the registered email address to confirm the account has been created.

6. Click confirm email, and the following display will appear. Click **Continue to Mendeley**.
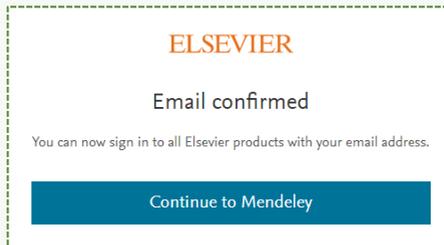
7. Then write down your status and subject of study. For example, "student studying environmental science".

8. We recommend downloading **Mendeley Desktop**.
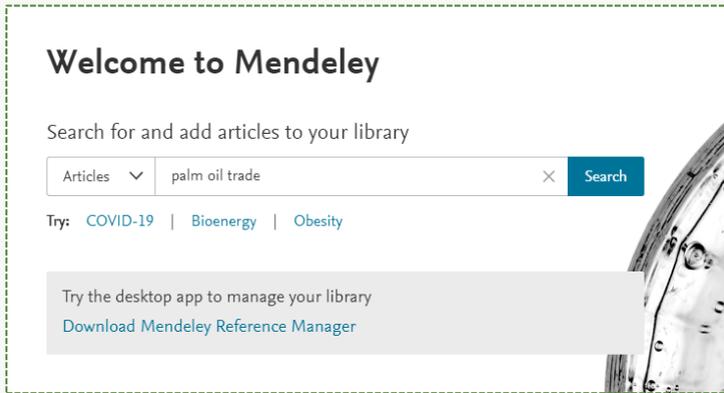
9. After downloading Mendeley and signing in to your account, click **Search** and type keywords for your search, e.g., palm oil trade.

10. A list of relevant literature will appear. For these citations to enter Colandr, they need to be exported from Mendeley in RIS format. To do this, select the articles you want to export, and click **File**, then **Export**. Enter the name of the folder you want to save the articles to, then in the **Save as type:** field select RIS - Research Information Systems (*ris), and click **Save**.
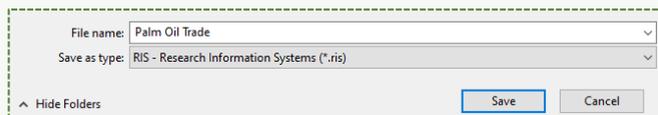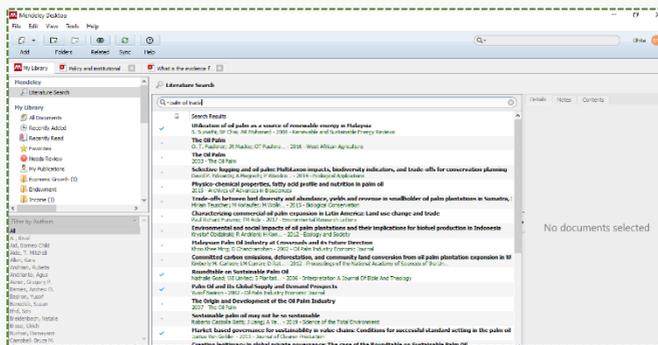
11. After saving the articles in RIS format, you can return to the Colandr website. To facilitate this tutorial (without the need to install Mendeley), click the following link to access sample folders that have already been converted to RIS: bit.ly/ContohFormatRIS

12. Download the RIS samples, then, in the **Review progress** page in Colandr, click **IMPORT**.

13. The following display will appear.
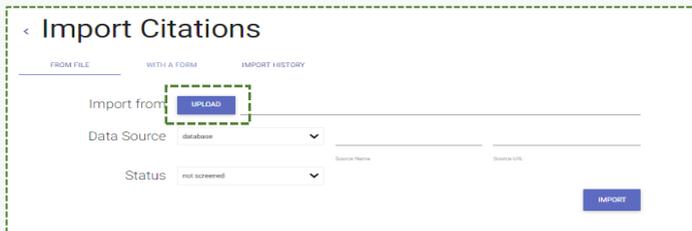
14. Click **UPLOAD**, select a downloaded RIS folder, then fill in the fields as follows:
    a. Data source: Database
    b. Source name: Mendeley
    c. Source URL: https://www.mendeley.com/
    d. Status: not screened
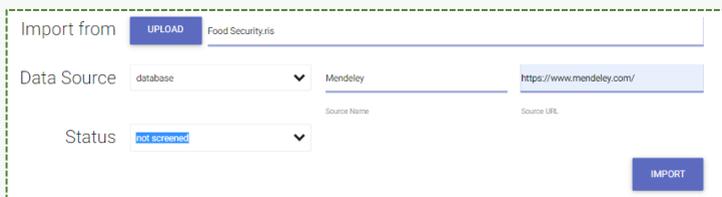
15. Once filled, click **IMPORT**. The following display will appear.
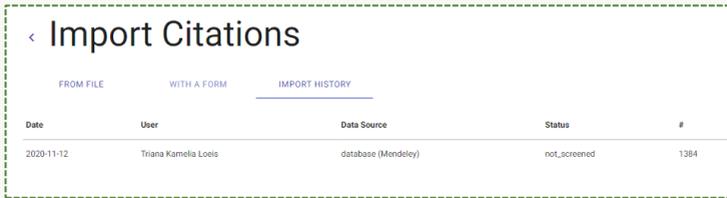
16. Repeat the same steps for the subsequent imports. In this case, you will upload three RIS files. Once done, the import history will be as follows. It also shows the number of articles in each of the imported RIS folders.
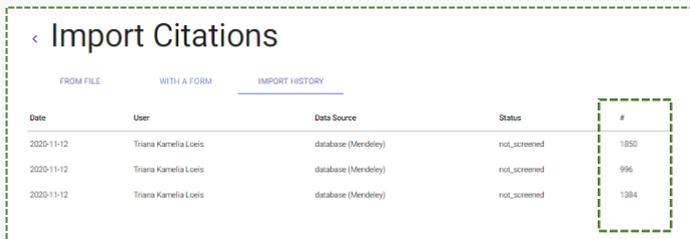
4.3. System 1: Citation screening

1. After uploading the RIS folders, return to the **Review progress** page. It will show the number of unscreened articles. In this case there are 4,230.

2. Click the **unscreened** toggle, so the following display appears.

3. Articles in the **Citation Screening** page will be divided into five categories:
   a. **SCREEN**: For articles that have yet to be screened
   b. **AWAITING**: For skipped articles
   c. **IN CONFLICT**: For articles where different reviewers have yet to agree on their inclusion or exclusion
   d. **EXCLUDED**: For articles clearly chosen for exclusion
   e. **INCLUDED**: For articles clearly selected to proceed to the subsequent screening stage (full-text screening)

4. During the **Citation Screening** stage, you semi-manually choose which articles are relevant to your research by reading their titles and abstracts.

5. After reading an article's title and abstract, you as a reviewer can determine whether or not it is relevant. If so, click **INCLUDE**, if not, click **EXCLUDE**. If you choose to exclude, you will be asked to state the reason for exclusion according to the criteria you established during the planning stage.

6. An example of an irrelevant article being excluded from the palm oil trade drivers folder is shown below.

7. The article will then be included in the **EXCLUDED** category, as shown below.
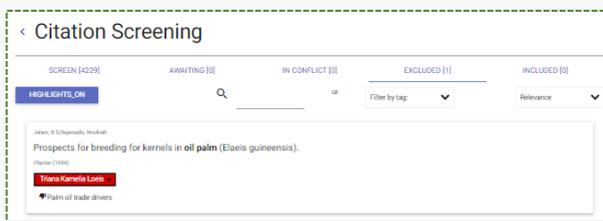
8. If an article is excluded in error, it can still be re-included. There are three options for doing so:
   a. **Remove**: To remove the article from the **EXCLUDED** category and return it to the **SCREEN** category;
   b. **Switch**: To move it from the **EXCLUDED** to the **INCLUDED** category;
   c. **Edit**: To change the criteria or reason for the article being included in the **EXCLUDED** category.
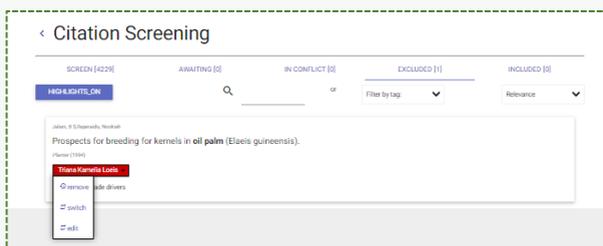
9. Repeat step number 5 until all articles have been screened. The screening process is easier if it is carried out as a team effort.

10. Colandr will learn patterns from your exclusion-inclusion criteria and search terms from the treatment of 10 articles or papers. It will then make suggestions for the remaining articles by listing them in order of relevance.

11. When no articles remain in the **SCREEN** category, then System 1 citation screening is complete. Next, proceed to System 2, which is full-text screening.

4.4. System 2: Full-text screening

1. The categories contained in System 2 are the same as those in System 1, and consist of:
   a. **SCREEN**: For articles that have yet to be screened
   b. **AWAITING**: For skipped articles
   c. **IN CONFLICT**: For articles where different reviewers have yet to agree on their inclusion or exclusion
   d. **EXCLUDED**: For articles clearly chosen for exclusion
   e. **INCLUDED**: For articles clearly selected to proceed to the subsequent stage.

2. Before including or excluding an article, you as the reviewer need to input the full-text of the article manually. Click **Add full text**, then select the article. Wait a moment while the article is being uploaded. When the upload is complete, the following display will appear.

3. After reading the full-text, you can decide whether the article is still relevant in the same way as in System 1, by clicking **INCLUDE** if relevant, and **EXCLUDE** if not, accompanied by the criteria for exclusion.
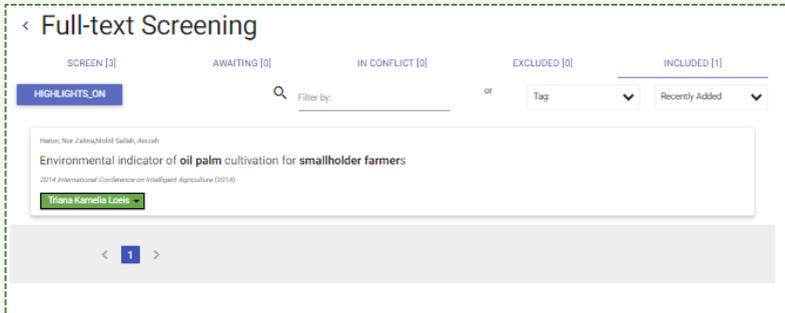
4. Repeat step 3 for all articles remaining in the **SCREEN** category.

5. Colandr will study your decisions for including and excluding every 35 articles or papers. It will then list the articles in suggested order of relevance.

6. When no articles remain in the **SCREEN** category, then System 2 full-text screening is complete.

4.5. Extracting data

1. The aim of data extraction is to label articles placed in the **INCLUDED** category during full-text screening. Click the **Data Extraction Form** in the planning section.

2. There are no specific provisions for labelling, as shown below.

3. Return to the **Data Extraction** page shown in the picture below, and click **not started**.

4. Then click **Review Labels** on the intended article. A full-text article will open accompanied by a label you wrote from reading the full-text screening.
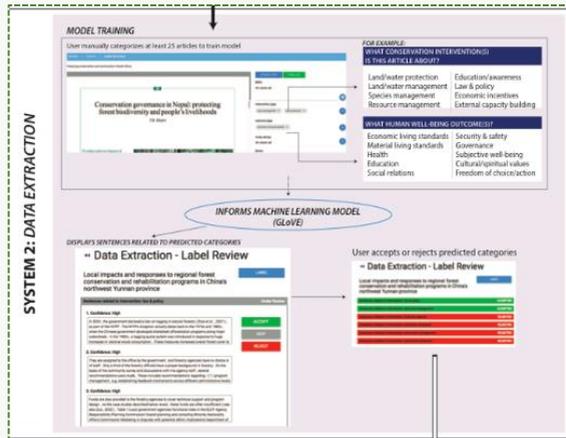
4.6. Exporting data

1. The aim of exporting data is to obtain data from Colandr's processing results, to know how many articles were excluded and included.

2. Click **EXPORT** as shown below.

3. Details of the results of Colandr processing will appear as shown below.

Total studies	6086
database	6086
Unique studies	3898
Screened citations	2593
Excluded citations	1545
Screened fulltexts	1043
Excluded fulltexts	663
Studies with data extracted	1

Exclusions by reason

Study design	113
Topic	214
Others	240
Population	60
Palm oil trade drivers	141
Economic impact	72
Intervention	33
Environmental impact	73
Timeframe	83
Duplicate	13

REFRESH   **CSV**

4. Click **CSV** to download the results of Colandr processing in Excel form.

5. Clarification of Colandr processing being complete comes with the creation of an Excel file as shown above.

5. Data visualization (evidence maps)

The resulting CSV data can be processed through other software to create visualizations. One example can be accessed at the following website https://www.natureandpeopleevidence.org/.

Evidence map of conservation-human well-being linkages

Numbers within the evidence map indicate how many unique articles document that nature-based intervention and human well-being outcome linkage. Filter the evidence map by desired region and biome on the left panel.
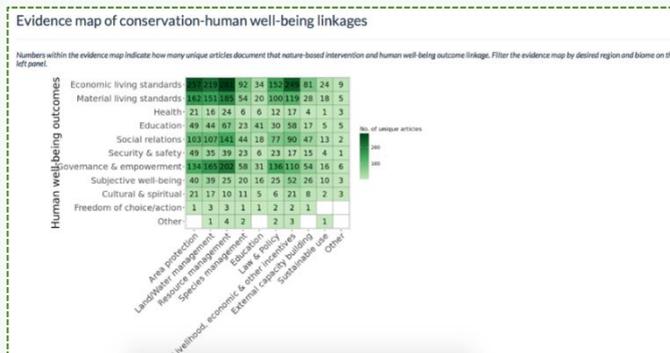
6. Frequently asked questions

Signing up and logging in

1. I haven't received a confirmation email and can't log in. What should I do?
   - Please check your email spam folder. If you still don't have it, please email colandrteam@gmail.com mailto:colandrteam@gmail.com

Setting up your review

1. Why can't I edit the review description or the planning page?
   - Only the review owner can edit the description and planning sections. To change review owners, go to REVIEW SETTING → COLLABORATION
2. How do I add research questions?
   - You have to add the research question block and then save it before you can edit text – hit ADD, and then hit SAVE, and then type to your heart's content.
3. Does Colandr connect to a citation database?
   - No, you need to connect to and export citations in a different system. However, Colandr will help you generate a Boolean search string for database searches.

Importing files

1. What file types can be imported?
   - .txt, .ris, and .bib files can be imported. In practice, we suggest exporting .ris files directly from your citation manager or database of choice.
2. What is the maximum size of a single import?
   - 40 MB. If a file exceeds 40 MB, please separate it into different files for import.
3. Can I delete files that have already been imported?
   - No

Machine learning

1. How fast does Colandr's citation screening learn existing patterns?
   - Every 10 citations screened in the same review (including by multiple collaborators) the citation screener learns and the relevance ranking is updated.
2. Colandr isn't automatically extracting my metadata, why is that?
   - Colandr needs to be trained on 50 hand-coded metadata extractions in the same review (including by multiple collaborators) before starting to offer suggestions for metadata extraction.
3. Why doesn't Colandr make a decision for me if something should be included or excluded?
   - The process is computer assisted, not computer done. You as a reviewer decide whether the article is relevant or not to the research you do.

Screening articles

1. Are duplicate articles automatically removed?
   - Yes, a process runs in the background to identify and remove duplicates by title and author(s). This process is not instantaneous and can take up to 15 minutes to complete.

Full-text articles

1. Does Colandr connect to a database for full text?
   - No, you need to find and import full-text papers manually.
2. Does Colandr have a mass upload feature for full text?

- No, you need to match the paper to a full text manually in a one-to-one upload.

3. Can you delete a PDF that has been imported?

    - No. Currently theres is no option to do that. However, if you need to delete an incorrect PDF, please email colandrteam@gmail.com with your review number and the title of the citation title that has the wrong PDF.

7. Colandr community
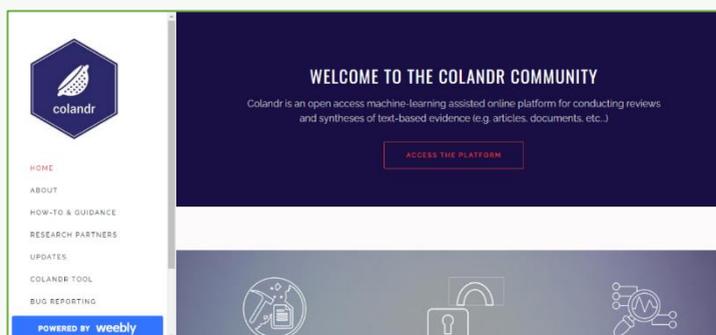
1. The Colandr team has set up a community page to connect fellow researchers, provide the latest news relating to Colandr, and ask questions about issues or difficulties faced when using Colandr. It is also possible to make suggestions for the future development of Colandr.

2. The Colandr community can be accessed at the following link: https://www.colandrcommunity.com/

Rayyan

TABLE OF CONTENTS

1. About Rayyan

Rayyan is a free online application to help researchers with systematic review methodologies and meta-analysis projects. Rayyan is one of the many software products of Qatar Computing Research Institute (QCRI), the creative and innovative entity of Qatar Foundation for Education, Science and Community Development. Rayyan allows users to upload quotes and full-text articles as part of a single review, the ability to create multiple review projects, or even collaborate on publicly available projects. Rayyan aims to offer researchers a one-stop dashboard to work out the details of their processes while also allowing their collaborators to see each other's processes (Johnson and Phillips 2018).[1]

1.1. Pros of Rayyan

1. The application can be used for free.
2. It is a website application, so you can access it anywhere and anytime, and there is no application version (desktop version).
3. You can create and collaborate on multiple reviews as many times as needed.
4. You can see the progress of work from other review teams.
5. You can set a review folder for screening.

1.2. Rayyan registration

Here are the steps to register a Rayyan account:

1. Open the Rayyan website through your browser at https://rayyan.ai or go directly to https://rayyan.ai/users/sign_up for registration.
2. Enter your email and country as shown in the following screenshot, and click **Create Account**.

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[1] Johnson N and Phillips M. 2018. Rayyan for systematic reviews. *Journal of Electronic Resources Librarianship* 30(1): 46–48. https://doi.org./10.1080/1941126X.2018.1444339
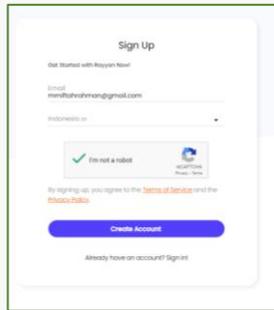
3. You will receive a confirmation email to activate the account. Click **Confirm my account**.
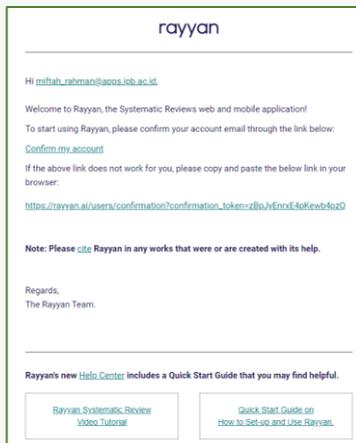
4. You will then be asked to create a password and add your name. Fill in the fields and click **Confirm Account**.
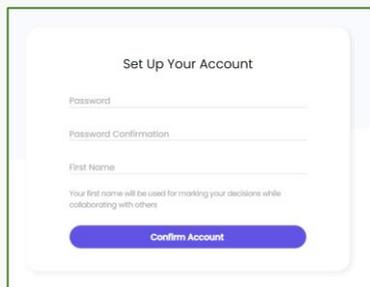
5. You will be asked to choose Rayyan membership, you can choose a free trial.

6. Once you are logged in to the dashboard, you can start a review.
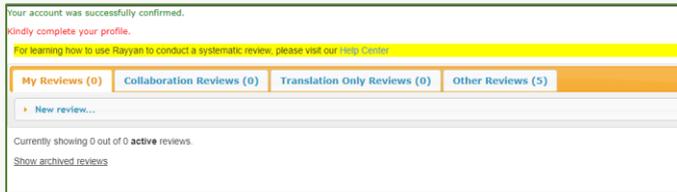
The dashboard consists of four tabs:

- **My Reviews**: For reviews you make

- **Collaboration Reviews**: For reviews you are invited to collaborate in

- **Translation Only Reviews**: For reviews you are invited to translate

- **Other Reviews**: For reviews made publicly available by others that you can collaborate in.

2. Creating reviews

1. Creating a review starts by clicking **New Review**, then adding the title and description of the review, and clicking **Create**.

2. After making a review, upload selected references with the following formats:

- EndNote Export
- Refman/RIS
- BibTeX
- CSV
- PubMed XML
- New PubMed Format
- Web of Science/CIW

Click **Select files** then select the files that are available. Once the uploads are complete, click **Continue.** On the right side of the page there are guides for uploading from different files and databases. You can upload a maximum of 10 documents (100 MB) at a time. Rayyan will upload documents for review.

3. All uploaded references will appear in the centre of the dashboard. If you click on the reference, the detailed information will appear at the bottom. On the left, Rayyan will display a summary of the uploaded references. You cannot edit or delete individual references, only the entire list of references by clicking the trash can icon.

4. If you want to add references, you can do so by clicking **New Search**.

5. As soon as references are uploaded, Rayyan will automatically identify duplicates and delete them automatically. To double check, you can click **Detect duplicates**. Any duplications detected will be recorded on the left side of the dashboard.

6. Once detected, you can validate the reference under **Unresolved** in the top left corner.

7. Then click the duplicate reference and consider the duplicate percentage to decide whether to delete it or not.
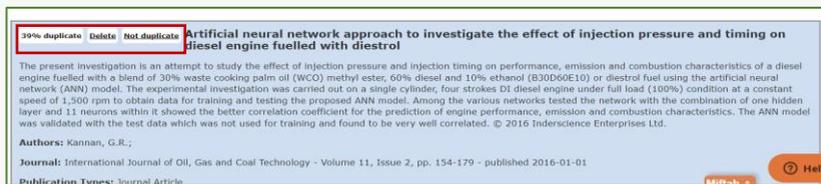
8. Ensure you do not delete all duplicate references.

3. Assigning and managing roles

There are four assignments (types) in Rayyan:

- **Collaborator**: Collaborators can do everything on a review except delete it, invite others, or delete search methods they have not created.

- **Translator**: Translators have additional functionality for translating article abstracts into other languages.

- **Reviewer**: Reviewers can help filter articles by making inclusion decisions (include/exclude/maybe) and adding reasons, labels, and notes.

- **Viewer**: Viewers can see all articles in the review but cannot add, delete, label, or include/exclude anything.

3.1. Inviting collaborators

You can invite multiple collaborators (unlimited) to review. Return to the dashboard or click **All reviews**. You can invite them by clicking **Invite**, then specifying their **Type** and entering the email address they used to register with Rayyan.
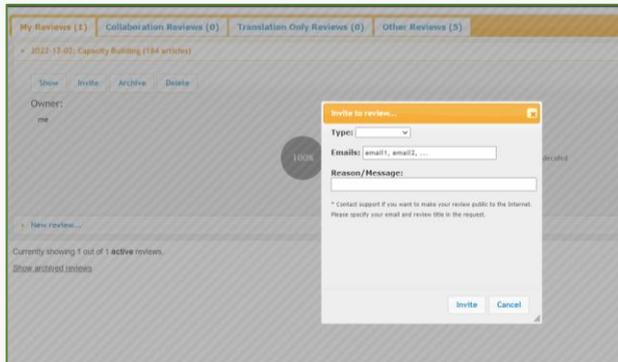
Collaborators will then receive an email notification. Once they have logged into their Rayyan account (using the email address their invitation was sent to), they can find the reviews they are invited to participate in listed under the **Collaboration Reviews** tab.

In addition to the web-based version, Rayyan is also available as a mobile application. The app is designed for reviewers to be able to work on the go and even work offline to take advantage of dynamic schedules. The app can be downloaded for IOS and Android devices.

4. Screening references

1. On the **Review** page, click the review title.

   The **Blind** feature is active by default. The function of this feature is to make reviewers unable to see decisions, labels, and notes from other reviewers to minimize the risk of bias. If you want to turn it off, click the **Blind ON** button.

2. Click **Show** to open the review page.

3. On the review page, you will see a list of references you have uploaded. Click on a reference to see its full details.

   You can see all the uploaded information at the bottom. Note that the **Topics** field will include all keywords present in the file or uploaded references. In addition, other keywords are also added by Rayyan's algorithm engine. This is useful if there are not enough keywords (or no keywords at all) that can be defined in the file.

4. To include an article, click **Include** or press **I** on your keyboard. Your name will be displayed in a green box to the left of the article title.

5. To exclude an article, click **Exclude** or press **E** on your keyboard. Your name will be displayed in a red box to the left of the article title. You can also add an optional exclusion reason by selecting a reason from the list, or typing a new one.

6. If you are unsure, click **Maybe** press **M** on your keyboard. Your name will be displayed in a white box to the left of the article title.

7. The summary on the left of the page will update to show the inclusion decisions.

8. You can also add labels or notes to any of your uploaded articles. Labels should be short and filterable, while notes are usually longer and cannot be filtered.

9. To add a label, enter the label you want to add in the **Label box**, and then click **+.... (new)**.

10. The label will be displayed in a blue box to the left of the article title.
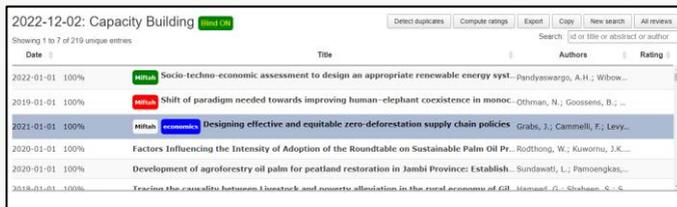
11. To remove a label, click the article that you want to delete, and then click **Remove** in the Label box.

12. To add a note, click **Add Note** to open the Notes dialogue box. Type your note and then click **Save**. You can then find the added notes at the bottom of the article details.
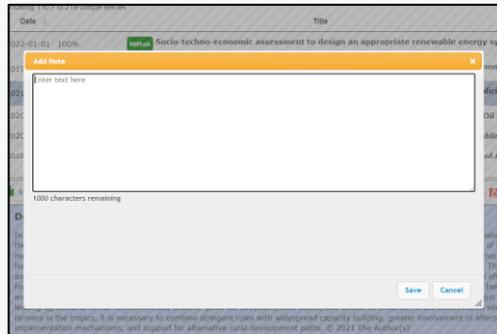
13. To delete a note, click the **trash can icon** to the left of the note, then confirm.

5. Uploading PDF full texts

1. Click on the article you want to upload a PDF file to. Note that you can select multiple articles at once using the keyboard shortcuts described here.

2. Click **Upload PDF full texts**.
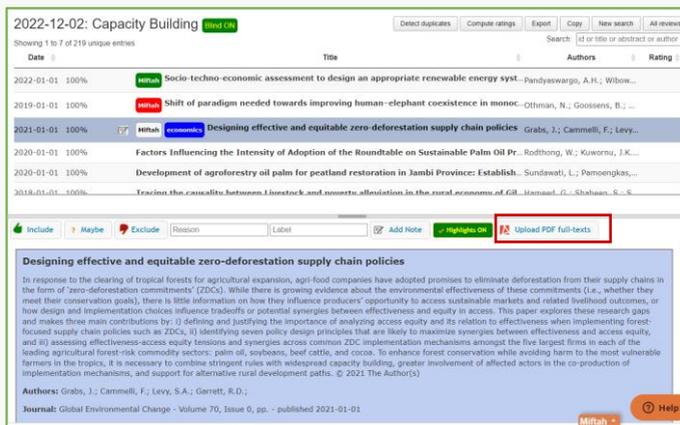
3. In the upload dialogue box, click **Add PDF files**.
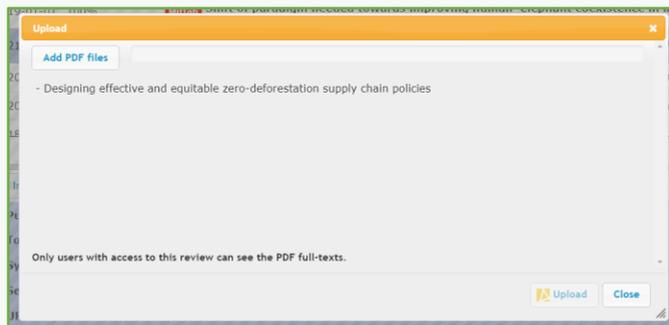
4. Click **Upload**. You can then find the added file at the bottom of the article details.

5. To delete a PDF file, click the **trash can icon** to the right of the file name, then confirm.

6. Once your review has at least one PDF file uploaded, a new box will be added on the left displaying the count of references/articles with the full PDF text.
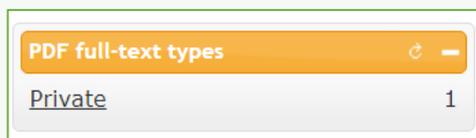
6. Exporting references in Rayyan

1. On the review page, select a filter from the toolbox on the left to select a subset of articles you want to export. You can also use Rayyan search which supports NLP.

2. Click **Export**.

3. In the Export options box:
   - Select **Filtered** to export the filtered data group, or **All** to export all review articles.
   - Choose a format to export articles in: **RefMan**, **BibTeX**, **EndNote** or **CSV**.
   - Choose whether to include **abstracts**, **decisions**, **labels** and **reasons**.
   - Choose a format for author name: **Last**, **First** or First, Last.

4. Click **Export**.

5. You should then see the following message:
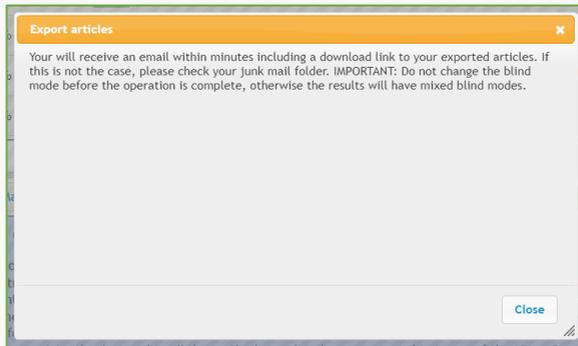
6. Rayyan will generate an export file that can be downloaded from any device via a link sent to your email. Click the link to download your zip file.

rayyan

Dear Mr Miftah Rahman,

This is to let you know that the export of articles you had requested for the below review is ready to download:

Review title: Capacity Building
Review description:

You can download the exported file by clicking here.

If the above link does not work for you, please copy and paste the below link in your browser: https://s3.amazonaws.com/rayyan-prod/export/ 275e01c9534aeeeb_281637_551394_2022-12-02_13-08-32.zip

The link will remain **valid for 3 days only**. After that, the file will be automatically deleted from our servers.

Regards,
The Rayyan Team.

The downloaded zip file will contain exported references (**articles**) and customizations (**customizations_log**). The article file will have Rayyan-specific information (decision, label and reason for exception) added to the notes field of each record. The customization file will include a history of all adjustments made to the review and is helpful in tracking all activities.

Name	Type	Compressed size	Password ...	Size	Ratio	Date modified
articles	RIS Formatted File	51 KB	No	159 KB	69%	02-Dec-22 13:08
customizations_log	Microsoft Excel Comma S...	1 KB	No	6 KB	89%	02-Dec-22 13:08

Each action in the log file is logged with a timestamp, user email, article ID and action details. The value after the **included key** determines the decision on the article **(**-1 exclude / 0 maybe **/** 1 include). As for label/reason, the key is label/reason and the value will indicate whether this label/reason was added (**1**), or **deleted**.

OpenMEE

Training materials

https://ipb.link/tradehub-meta

1. Meta-analyses

Meta-analyses (MA) are continuations of systematic literature reviews (SLR). Systematic review is an objective and reproducible method of finding answers to specific research questions, by gathering all available studies related to that question and reviewing and analysing the results. Meta-analyses differ from systematic reviews in that they use statistical methods to combine estimates from two or more different studies to form composite estimates (Kang 2005).[2] If in systematic review, it is not possible to form a combined estimate (statistically), then it is not followed by meta-analysis; However, if it is possible to form combined estimates from the extracted data, meta-analyses can be used.

2. About OpenMEE

OpenMEE is an open source, stand-alone meta-analysis program, developed for analyses in the fields of ecology and evolution with the R program. OpenMEE is built like a spreadsheet where study data, such as averages and sample sizes, can be entered manually, copied and pasted, or added using a **data import tool**. OpenMEE has the ability for complete modelling for effect size estimation, conventional heterogeneity testing (Q-test), and fixed and random effects. More information can be found at http://www.cebm.brown.edu/openmee/help.html.

3. Downloading and installing OpenMEE

1. To install OpenMEE, you can download the application at the following link http://www.cebm.brown.edu/open_mee/download.html. Make sure to download and install according to your computer's specifications. OpenMEE is available for both MacOS (El Capitan) and Windows (8 and 10 64 bit).

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[2] Kang H. 2015. Statistical considerations in meta-analysis. *Hanyang Medical Reviews* 35(1): 23–32.

2. Save the zip file in an easily accessible place, then extract it (just double-clicking in most systems).

3. Run the program by clicking LaunchOpenMEE.exe in Windows or the OpenMEE application on Mac. Then it appears like a master spreadsheet. Sometimes this can take a while.
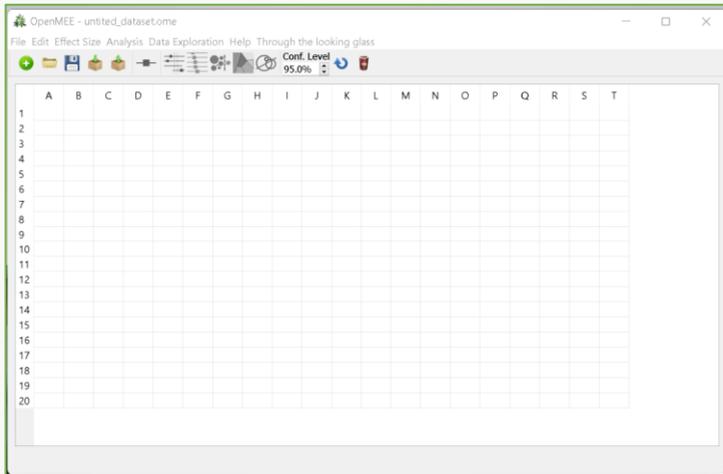
4. Data preparation

To make it easier to understand the application of OpenMEE, this module uses data from Bohada-Murillo et al. 2020,[3] and uses supplementary data from the journal. The data needed in meta-analysis generally uses average data (X), the number of n objects (N), and standard deviation (S) from two groups, namely control (c) and treatment or experiment result data (e) so that you get Xc, Nc and Sc data for control and Xe, Se and Ne for experiments, and other variable data (moderator variables) to be analysed.

Data preparation can be done directly in OpenMEE, but to make it easier to build data structures, you can create a worksheet in Excel first, like the one below (data using Bohada-Murillo et al. 2020).

---

[3] Bohada-Murillo M, Castaño-Villa GJ, Fonturbel FE. 2020. The effects of forestry and agroforestry plantations on bird diversity: A global synthesis. *Land Degradation & Development* 31(5): 646–654.

Case ID	Ref	Xc	Sc	Nc	Xe	Se	Ne	Agroecosystem	Zone	Context	Latitude	Longitude	Region	Hotspot
A01	2	15.5	12.8	459	41.9	3.4	40	Coffee	Tropical	Mainland	18.42	-95	Panamanian	Mesoamerica
A02	13	39.36	8.51	4	85.81	10.63	4	Coffee	Tropical	Mainland	9.17	-79.38	Panamanian	Mesoamerica
A03	15	21.92	1.13	6	14.49	1.32	5	Coffee	Tropical	Mainland	10.58	77.4	Oriental	Western Ghats and Sri Lanka
A04	15	17.07	1.9	6	14.49	1.32	5	Coffee	Tropical	Mainland	10.58	77.4	Oriental	Western Ghats and Sri Lanka
A05	10	15.8	7.6	20	8.3	3.5	20	Plantation	Tropical	Mainland	23.8	92.53	Oriental	South-Central China
A06	45	4.79	0.59	2	1.3	0.13	2	Plantation	Tropical	Mainland	9.22	-79.78	Panamanian	Mesoamerica
A07	19	5	1.31	9	5.87	1.31	6	Plantation	Temperate	Mainland	35.6	-85.57	Nearctic	No hotspot
A08	30	6.9	4.6	34	6.23	4.41	30	Plantation	Tropical	Island	10.67	-61.4	Neotropical	Caribbean
A09	22	21.46	7.75	24	16.03	6.31	30	Plantation	Temperate	Mainland	49.95	4.77	Palearctic	No hotspot
A10	23	6.65	1.39	5	8.28	2.67	5	Plantation	Tropical	Mainland	19.49	-101.98	Panamanian	Mesoamerica

1. After the data to be processed has been neatly processed in Excel (.csv), you can import the data in OpenMEE.
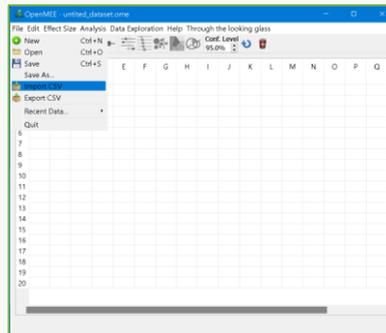
2. Check to ensure the imported document is *.csv and has a label. Then click **select csv file** and select the document you wish to upload. Then click **OK**.
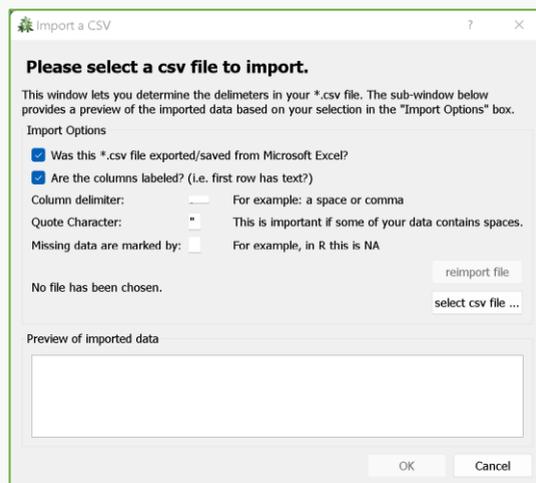
3. Once the data has been imported, it will be displayed by OpenMEE as follows.

4. Once the data appears, you must define each variable. The first thing is to define the **Case ID** to be the **Study ID**.

5. After that, you define Xe, Se and Ne as number formats (**Count** or **Continuous**) by right-clicking on the category header. If the data is an integer or discrete, then select **Count**. If it is a decimal or continuous number then select **Continuous**. Do the same with Xc, Sc and Nc.

5. Calculating effect size

An advantage of OpenMEE is that Effect Size calculation is done automatically, negating the need to calculate manually. All you have to do is click **Effect Size** and select **Calculate Effect Size**.

1. Then select **Data Type** (Means and Standard Deviation) and **Effect Size** (Hedges' d). Both of these settings adjust to the data used, which is experimental data. After that click **Next**.

2. After setting the data type and effect size, define the data type with the appropriate category name, and then click **Finish**.

After calculating the effect size, there are two new columns of data at the far right, namely **d** and **Var(d)**

6. Data analysis

1. Data analysis begins after the effect size is known. Data analysis begins by clicking **Analysis**, then select **Meta-Analysis** and **Standard Meta-Analysis** to calculate the summary effect size or mean effect size of all studies analysed.
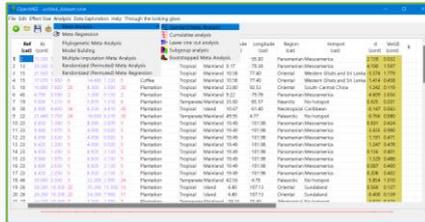
2. After that, the **data type** and **effect size** options appear. Click **Next**.
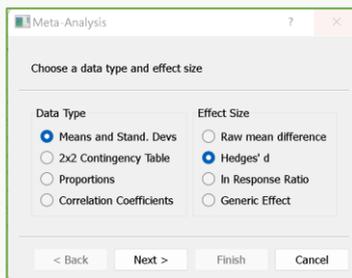
3. Then select the column containing the effect size (d) and its variance (Var(d)), and click **Next**.
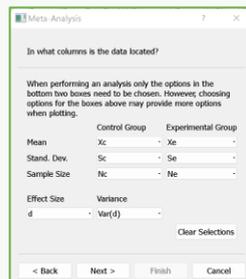
4. Once defined for the variables, select the study to be analysed, if it is all of them, click **Select All**, then click **Next** if there are no problems related to categories and missing data.
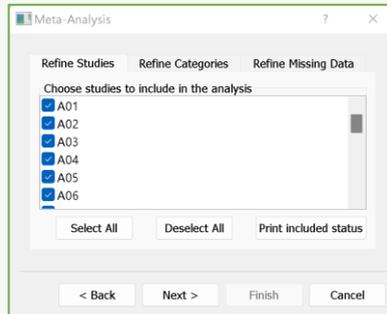
5. For analysis, you must choose the **analysis method** to be used. Generally use **Continuous Random-Effects** with the **DerSimonian-Lard** Random-Effects Method. Then click **Next**.
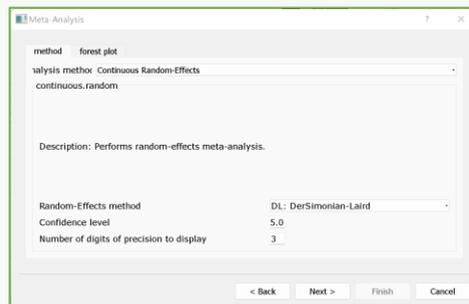
6. A dialogue box will appear containing summary data and the chosen method. If the data and method are correct, click **Finish**.
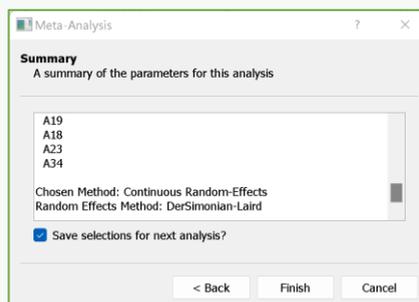
7. After doing so, the analysis data immediately appears as follows, showing significance, variance and heterogeneity, as well as the forest plot analysed in the study.
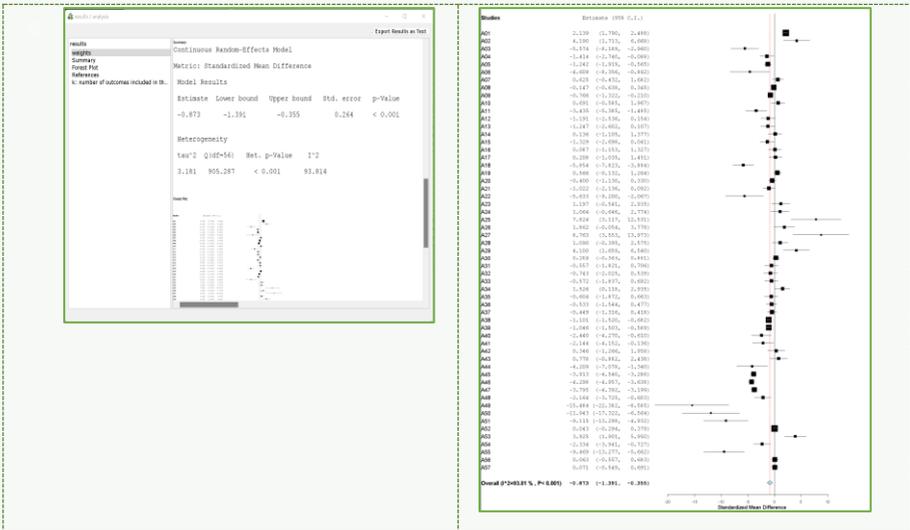
As an illustration, this graph shows control values being greater than those of the experiment.

6.1. Cumulative meta-analyses

Cumulative meta-analysis is a meta-analytical approach in which studies are added one at a time, and changes in the size of cumulative effects are observed. To perform a cumulative meta-analysis in OpenMEE, simply select **Cumulative Meta-Analysis** from the **Analysis** menu. The following figure shows an example of a forest plot generated from a cumulative meta-analysis. The left side displays the usual study estimates and confidence intervals; the right side shows the effect on the overall estimate (summary) as the study was included in the meta-analysis.

Cumulative Forest Plot
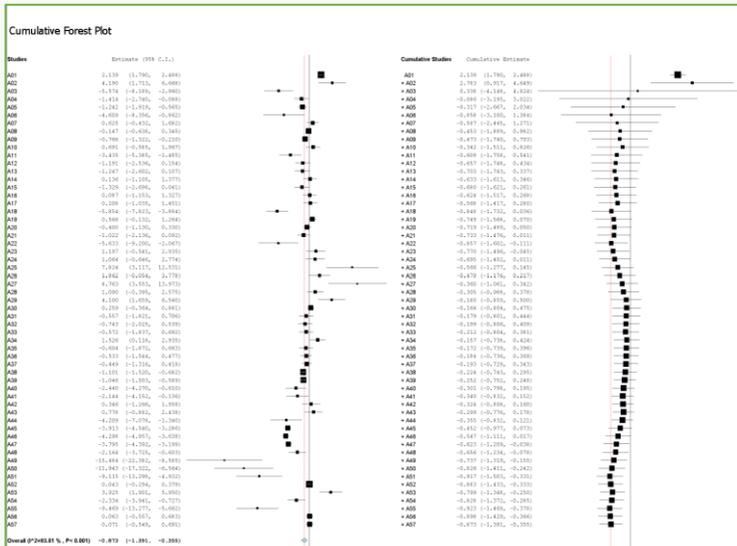
6.2. Leave-one-out meta-analyses

The leave-one-out meta-analysis is conceptually similar to the cumulative meta-analysis, except the analysis does not add studies one at a time, but rather holds each study in turn. It is this exploratory iteration that can underscore influential studies (summary estimates that leave influential studies will differ substantially from those that include them). An example output of a leave-one-out analysis is shown below.
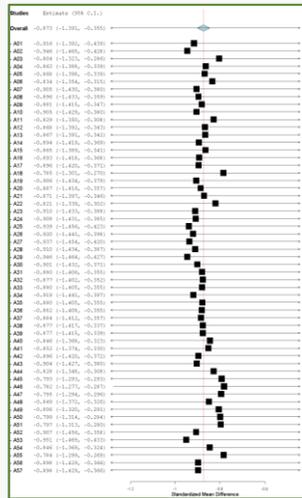
6.3. Subgroup meta-analyses

In a subgroup meta-analysis, studies are divided into different study groups (e.g., studies conducted on oil palm plantations versus all other landscapes) and run separate meta-analyses of these study groups. It is an exploratory iteration that can see differences between groups. The options for subgroup meta-analyses are the same as for standard meta-analyses except that categorical variables should be selected. For example, if the selected variable is agroecosystems, then subgroup analyses will be run on studies of each observed agroecosystem. In the example shown below, this includes coffee and plantations.
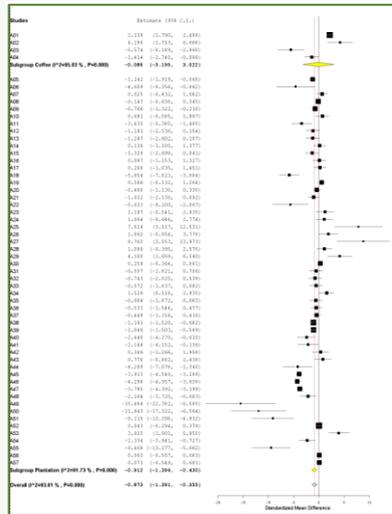
7. Publication bias

OpenMEE includes standard tools for publication bias diagnostics, including **funnel plots**. These can be generated by selecting the **Funnel Plot** option under the **Publication Bias** sub-menu in **Data Exploration**. An example output is shown below. We warn users to interpret this with caution, and read critiques of this funnel plot.
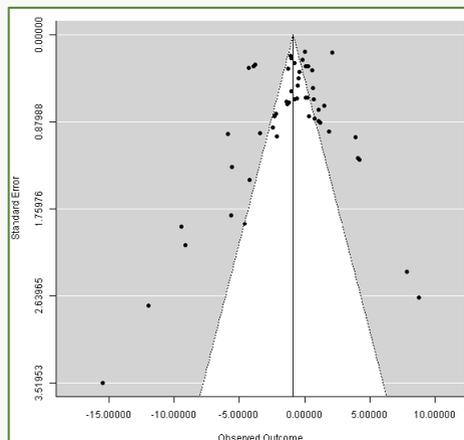
Center for International Forestry Research (CIFOR)

CIFOR advances human well-being, equity and environmental integrity by conducting innovative research, developing partners' capacity, and actively engaging in dialogue with all stakeholders to inform policies and practices that affect forests and people. CIFOR is a CGIAR Research Center. Our headquarters are in Bogor, Indonesia, with offices in Nairobi, Kenya; Yaounde, Cameroon; Lima, Peru and Bonn, Germany.