LEAD LEVERAGING EVIDENCE FOR ACCESS AND DEVELOPMENT
KREA UNIVERSITY

CGIAR GENDER Platform

CONDUCTING A SYSTEMATIC REVIEW: METHODOLOGY AND STEPS

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1. INTRODUCTION

Systematic reviews have gained momentum as a key method of evidence synthesis in global development research in recent times. As defined in the Cochrane Handbook on Systematic reviews "Systematic reviews seek to collate evidence that fits pre-specified eligibility criteria in order to answer a specific research question. They aim to minimize bias by using explicit, systematic methods documented in advance with a protocol.[1]"

It is important to highlight that a systematic review is different from a literature review. While a literature review qualitatively summarises evidence with no specific protocol or search criteria, a systematic review is based on a clearly formulated question, identifies relevant studies, appraises their quality and summarizes the evidence by use of a selected explicit methodology. It is this explicit and systematic approach that distinguishes systematic reviews from traditional reviews and commentaries.[2] It is also important to distinguish between a systematic review and a meta-analysis. While a systematic review refers to the entire process of selection, evaluation and synthesis of evidence; meta-analysis is a specialised sub-set of systematic review.[3] Meta-analysis refers to the statistical approach of combining data derived from systematic review. It uses statistical techniques to combine the data examined from individual research studies and uses the pooled data to come to new statistical conclusions. Hence not all systematic reviews will include a meta-analysis, but a meta-analysis is necessarily in a systematic review.[4]

The main purpose of this document is to provide guidelines, recommendations and propose a methodology for conducting mixed-method systematic reviews for evidence synthesis for "gender in agriculture and food systems" for the CGIAR GENDER Platform. In this document we highlight some of the good practices from leading organisations[5] who have contributed to the development of methodology for Systematic Reviews over the years. Throughout the document, we refer to relevant guidelines recommended by these organisations for conducting systematic reviews and adapt it to the proposed questions that include synthesis of qualitative, quantitative and mixed-method evidence.

2. METHODOLOGY

The Cochrane definition of systematic reviews provides a guiding framework to develop the protocols and approach for a systematic review. As reflected in the definition, the first step of conducting a systematic review is to formulate or define a specific question that we seek to answer, following which we develop the protocol document that guides the eligibility and inclusion criteria and appropriate method of data synthesis that collates the evidence to help answer the specific question.

This section explains steps and methods for guiding reviewers on conducting a systematic review, using examples from published systematic reviews and different types of studies.

To illustrate the approach, we use example research questions and elaborate the stepwise proposed methodology for conducting a systematic review. Some of the potential research questions are:

1. How does the use of ICT-based tools for accessing information (e.g., videos on fertilizer application or pest management) help women broaden their markets for inputs and outputs?
2. Collective-based agriculture-value chain interventions are increasingly focussing on women. How do these interventions

[1] https://training.cochrane.org/handbook/current/chapter-i

[2] https://www.ncbi.nlm.nih.gov/pmc/articles/PMC539417/

[3] https://ncu.libguides.com/organize_research

[4] Akhter S., Pauyo T., Khan M. (2019) What Is the Difference Between a Systematic Review and a Meta-analysis?. In: Musahl V. et al. (eds) Basic Methods Handbook for Clinical Orthopaedic Research. Springer, Berlin, Heidelberg. https://doi.org/10.1007/978-3-662-58254-1_37

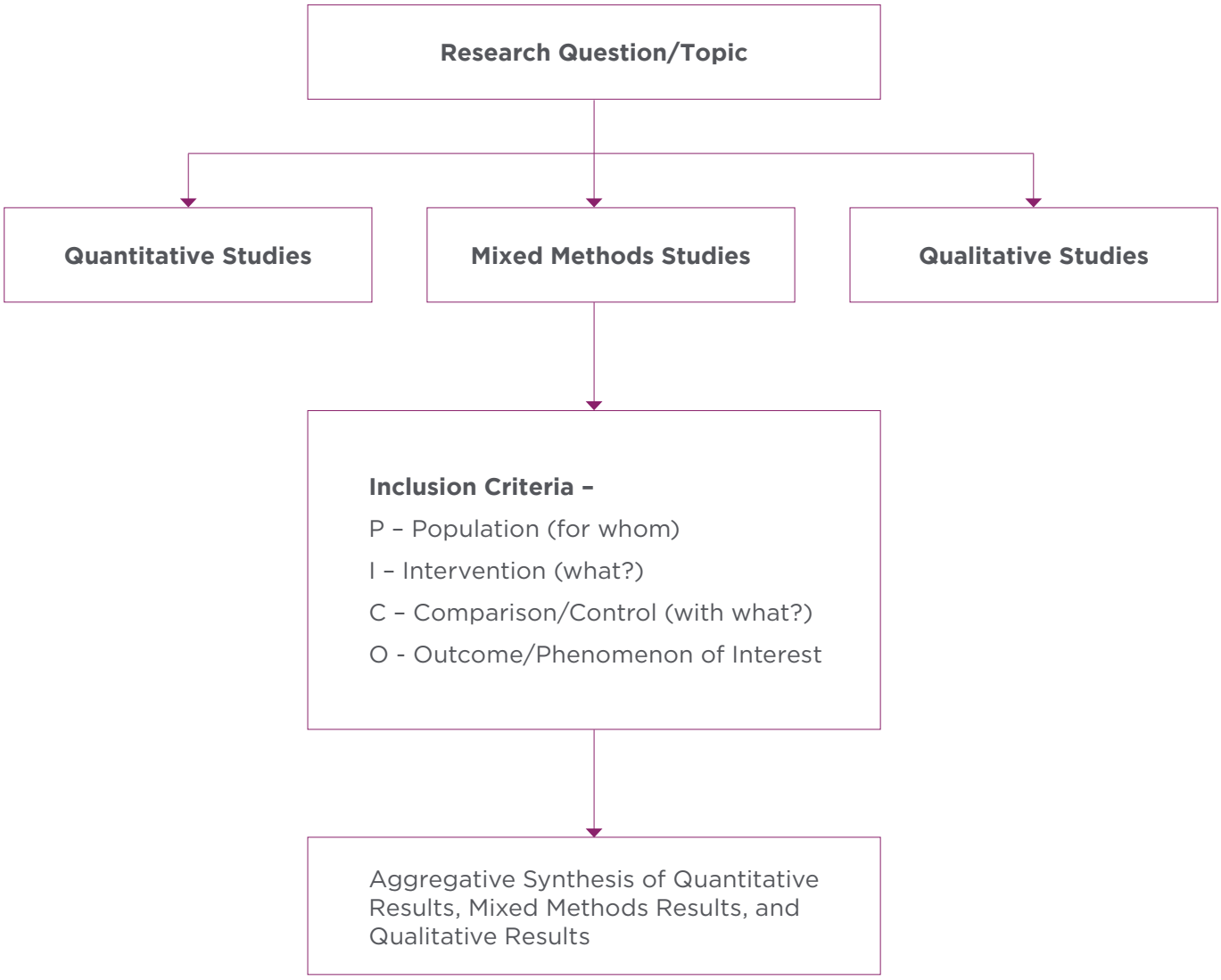
[5] PRISMA, Cochrane, MOOSE, GRADE, IMMANA, CAMPBELL COLLABORATIONS, 3ie

affect intra-household work allocation? Are they adding to women's existing responsibilities or is there a reallocation of roles and responsibilities?

3. How is migration (both seasonal and long term) affecting women's decision making and labour-force participation in agriculture value chains?

With illustrative examples we will diverge from the traditional approach of conducting a systematic review that include either studies using quantitative methods (RCT, impact evaluations, etc.) or qualitative (FGD's, KII's, Case studies etc.) or mixed methods (quasi-experimental studies). We propose to include all types of studies that will help answer the relevant research questions. Having included all types of evidence, the synthesis method for evidence would also be mixed (both qualitative and quantitative). A mixed-methods systematic review applies the principles of mixed-methods research to the review process, that is, studies from different research traditions (but focused on the same topic) are combined to generate evidence to guide decision-making.

FIGURE 1: SEQUENTIAL METHODOLOGY FOR SYSTEMATIC REVIEW



a. Defining questions/topic

Developing a systematic review should necessarily start with formulation of a priori well-defined and specific research question. Systematic review must address answerable questions and fill important gaps in knowledge. Some of the dimensions that must be clearly articulated include:

- What is the specific question that you want to answer?
- What data will be needed to answer the specific question?
- How will one determine what constitutes a satisfactory answer?
- And what falls within or outside the scope of the study?

A good way is to start with a broad question and then narrow it down. Typically, the PICO tool can be a guiding framework to help you narrow down a question with quantitative, qualitative and mixed methods studies; where PICO stands for:

P-Population

I-Intervention

C-Control/Comparisons (if applicable)

O- Outcomes

Here Population refers to the target group or the subject of our interest; Intervention refers to the exposure/treatment that the population was exposed to or treated with; Control/ Comparisons may be applicable in certain cases and may not be in some, this basically refers to the comparison group and; Outcome refers to the accomplished, measured, improvement or results of a particular intervention or program. In certain cases, PICO is also adapted as **PICOS** (S-study design) or **PICOT** (Time-frame).

A well-formulated question will guide many aspects of the review process, including determining eligibility criteria, searching for studies, collecting data from included studies, and presenting findings.[6] For a systematic review that includes quantitative, qualitative studies and mixed-method studies we adapt the PICO technique to guide formulation of a good question as discussed below.

Using this guiding principle, let us analyse the following title for a systematic review:

"The effect of training, innovation and new technology on African smallholder farmers' economic outcomes and food security[7]"

In the above systematic review, it becomes very easy to identify the Population/Sample/ setting (African smallholder farmers), Intervention- training, innovation and new technology, Outcome/Phenomenon of interest – economic outcomes and food security and hence is an example of a good title. In the context of systematic reviews for gender and food systems and/or agriculture one has to be additionally specific about the sector or system and the population. For example, sectors may include a specific livestock commodity group (poultry, sheep or cattle), producers of a specific crop (potato farmer, rice cultivators, vegetable growers etc.), processing, retail, or consumer studies, or may include more than one level of the farm to fork continuum. If the same study is adapted using a gender lens, a suggestive good title would be: "The effect of training , innovation and new technology on African smallholder women farmers' economic outcomes and food security".

The target population should be clearly specified and one has to ensure that the title is not gender-blind or gender-neutral.

Consider the following research questions from a systematic review:

Development interventions in agriculture value chains are increasingly focusing more on women. How do these interventions affect intra-household work allocation? Are they adding to women's existing responsibilities or is there a reallocation of roles and responsibilities?

Though these are well-focused questions, they lack clarity on certain aspects. For example, they do not clearly lay out the intervention/program (development interventions in agricultural value chain) as compared to the previous question

[6] https://training.cochrane.org/handbook/current/chapter-02

[7] https://www.campbellcollaboration.org/better-evidence/training-innovation-new-tech-african-smallholder-farmers.html

(training, innovation and new technology). Hence, while developing the above-mentioned research question one has to refine the research question to include the specific intervention/ program that is being studied. Other aspects to consider are: Who is the target population? Is this for a specific geography? What are the outcomes of interest? A suggestive title for the research question above could be:

> "The impact of collective-based agricultural value chain interventions on the time use and efficiency of women smallholder farmers in Asia and Africa"
>
> One can even define this further by specifying the type of value chain, i.e., livestock value chain, small ruminant and poultry value chain or any specific crop value chain.
>
> A well-defined research question to understand the impact of ICT based tools (e.g., videos on fertilizer application or pest management) on women farmers is:
>
> "The impact of ICT-based tools for accessing information on women farmers access to technical information and market "
>
> In the above question, we can clearly identify the target population with a focus on a specific region/geography (i.e., women farmers from a specific geography say low income countries), intervention (i.e., ICT-based tools for accessing information), and outcomes (i.e., broader markets for inputs and outputs/ access to technical information and market").
>
> On the other hand, consider the following example of a systematic review that examines the impact of an intervention through a gender lens:
>
> "The impact of ICT-based tools for accessing information on farmers to broaden their markets for inputs and outputs"
>
> The title above identifies the intervention and outcome, but is gender blind in identifying the target population.

b. Conducting preliminary searches

After the specific research question has been formulated, a preliminary search is conducted to map existing evidence. There are multiple objectives in conducting a preliminary search. First, we would want to ensure that no systematic review or meta-analysis on the same topic has been recently published (say in the last two to three years). Second, we can determine if there is sufficient evidence available to undertake a systematic review. This should ideally be two/ three or more studies with very less heterogeneity (methodological or statistical variability among studies is referred to as heterogeneity in systematic review) amongst them. The heterogeneity may arise due to differences in the demographics of participants, interventions or measurement of outcomes, variations in intervention effects etc. While doing a systematic review it is important to understand the heterogeneity as these differences can indicate that a particular intervention/program may not be working in the same way every time it is implemented. By investigating these differences, we can reach a deeper understanding of what factors influence the uptake and impact of the intervention/program, and what result we can expect the next time the intervention/program is implemented. For instance, the impact of agricultural technology would be different for women farmers in high-income countries vs low-income countries, and for large farmers vs small farmers. In case there exists too much heterogeneity in the studies one may want to explore the heterogeneity and understand the reason for it by doing multiple reviews to check for mistakes in reporting or documenting, avoiding too many statistical analyses and relying mostly on qualitative methods of evidence synthesis. Third, if evidence synthesis studies do exist, it is important to map the type of evidence synthesis (systematic review, meta-analysis etc.) and the methods (quantitative, qualitative or mixed) employed by them.

One should generate a comprehensive and complete list of all primary research that can contribute to answering the question posed in the review. There are multiple processes to ensure this. The search for studies should be extensive. Multiple resources (both computerized and printed,) should be searched. Some important databases to be explored are: J-store, EconLit, AGRIS, JGate, NBER, PLOS, NCBI, NIH. 3ie, AgEcon Search, AGRIS, CAB Direct, Dissertation Express, EBSCO, ELDIS, IDEAS, JOLIS, Social Science Citation Index, USAID Lib, USDA, World Bank, FAO, CGIAR repositories.

Keywords and search tags need to be identified to initiate the search. We suggest using multiple search tags with various combinations of relevant keywords, since the structure of terminology for reporting studies in gender in agriculture and food systems may vary in the literature and also in different databases and repositories ("gender", "women'', "women and men", "men-absent household", "female-headed households" etc.). A detailed discussion on developing effective key search is discussed in section d. Next we do a thorough search for "grey-area" literature as well. We would also visit PROSPERO and other systematic review registration websites like Figshare, GitHub, Campbell, Cochrane or research gate (to see the list of systematic reviews completed as well as registered as ongoing to complete a comprehensive search). **PROSPERO**[8] is one of the well-known and heavily utilised protocol registration sites. It includes protocols for systematic review and meta-analysis where one can find examples of published protocols.

c. Draft Protocol

The Protocol document provides a roadmap to guide the systematic review. It helps to decide, in advance, how one shall handle issues in the systematic reviews/ meta-analysis. For example: *which databases should be searched? What instruments should be used for quality appraisal? What should be the eligibility criteria (inclusion/ exclusion criteria) for including studies in the review?*

When developing the review protocol, one of the first steps is to determine the elements of the review question (including the population/ sample, intervention/program, comparator and outcome/Phenomenon of interest, or PICO elements) and how the intervention, in the specified population, produces the expected outcomes (Chapter 2, Section 2.5.1, Chapter 17, Section 17.2.1, Cochrane Handbook of systematic review). The eligibility criteria are based on the PICO elements of the review question. The population or sample interventions, study design, method of evaluations and comparators in the review question usually translate directly into eligibility criteria for the review, though this is not always a straightforward process and requires a thoughtful approach. The protocol creates a comprehensive study plan to help overcome any issues that may arise during the review. For the above-mentioned examples, we suggest some inclusion criteria that will help define the protocol.

1. "The effect of training, innovation and new technology on African smallholder women farmers' economic outcomes and food security"

To be eligible for inclusion in this review, studies were required to: a) be conducted in Africa; b) feature smallholder women farmers as the target population; c) evaluate a training programme and/or facilitation of innovation and new technology; d) measure the effects of these interventions on economic outcomes or food security; and e) use experimental or quasi-experimental methods or descriptive, qualitative and mixed methods.

2. "The impact of Collective based agricultural value chain intervention on the time use and efficiency of women smallholder farmers in Asia and Africa" will have the following inclusion criteria:

   a) The target populations would be the smallholder women farmers b) The included geography would be Asia and Africa c) evaluate the impact of collective based intervention in the agricultural value chain. d) agriculture would include crop, fishery,

[8] The International Prospective Register of Systematic Reviews (PROSPERO) https://www.crd.york.ac.uk/prospero/

forestry and livestock. e) measure the impact of the collective based agricultural value chain intervention on the outcome of interest (i.e., time use and efficiency) f) will include studies in English language g) specify a year of inclusion (e.g. 2007 onwards). It is suggested that review authors should attempt to identify and evaluate the eligibility of all available studies without any restrictions, most of the systematic reviews may however have a language or date restriction or both. The systematic review should clearly describe and provide strong reasoning for such restrictions. As discussed in the Cochrane handbook (2017),[9] restricting the language to English may potentially leave out important studies published in other languages. Identifying, translating and extracting data from languages other than English can have significant implications on the cost and time required for conducting the review. Date restrictions should be applied if it is known that the relevant studies could only have been reported during a specific time period, say, a particular intervention was available only after a certain period of time, or been implemented through a program/policy in a specific year.

3. Inclusion criteria for guiding the protocol for the study "The impact of ICT-based tools for accessing information on the women farmers of low and middle-income countries to broaden their markets for inputs and outputs" are:

   a) Feature women farmers of low and middle-income countries as target population b) evaluate or analyse the impact of ICT-based tools for accessing information c) specify an inclusion year (e.g. from 2010 onwards), d) specify the domains (crops, livestock, forestry and fish) e) language of the papers being reviewed (English only or English and German, etc.) f) measure the effect of ICT-based tools on the outcome of interest i.e., broaden market for inputs/outputs/ Access to technical and market information g) specify the geography included (Asia and Africa, or only Asia, or only pacific or all the countries) h) specify the study design to be included (quantitative, qualitative and mixed methods).

As mentioned above, **PROSPERO**[10] is one of the well-known and heavily utilised protocol registration sites where review protocols can be registered. While registering systematic review protocols is not mandatory, doing so promotes transparency, helps reduce potential for bias and serves to avoid unintended duplication of reviews.

d. Design and execution of comprehensive research

The protocol document should include a comprehensive search strategy that can be executed by the team of reviewers. The team should ideally comprise at least three individuals (with expertise in the topic area under review, statistical expertise and an individual who has prior experience of conducting a systematic review). A detailed discussion on team composition is included in section 3. The objective in designing and executing a comprehensive search is to identify all potentially relevant studies, those which contain data that answers the research question. One of the good practices is to search multiple databases. One can use search tags and keywords as suggested below along with identifying all relevant work.

A potential strategy for identifying keywords is to break the study question into various components (population, intervention, outcome, sector, phenomenon of interest etc). Then, identify search terms that best capture the subject of each component and identify which terms may be a subset of other more important terms. One may also combine search terms within each component using "OR" (to ensure that all records with at least one of the specified terms are identified) or using 'AND' (to ensure that all the components must appear in the record). For example, component combinations may include: Population AND intervention, Intervention AND outcome, Population AND outcome, Population AND intervention AND outcome. As highlighted earlier in this

[9] https://handbook-5-1.cochrane.org/chapter_10/10_2_2_4_language_bias.htm

[10] The International Prospective Register of Systematic Reviews (PROSPERO) https://www.crd.york.ac.uk/prospero/

document, we need to take extra precautions in identifying different terminologies that may represent either the population (women, female, woman and men, gender, etc.), the program or intervention (say ICT, technology, mobile phone, digital technology, etc.) or the outcome of interest (say food security, food sovereignty, nutrition, health, malnutrition, food deficiency, time use efficiency, access to markets etc.).

For the study titled *"The effect of training, innovation and new technology on African smallholder women farmers' economic outcomes and food security",* some of the search tags can include:

i. training, innovation and new technology on African women smallholder farmers
ii. effect of training, innovation and new technology on economic outcomes for women farmers
iii. effect of training, innovation and new technology on food security of women farmers
iv. African women smallholder farmers' economic outcomes and food security
v. effect of training, innovation and new technology on food security on female farmers
vi. Effect of training, innovation and technology on women and men farmers.

Similarly, for the topic "The impact of ICT-based tools for accessing information on women farmers to broaden their access to technical information and market" search tags may include:

i. access to technical information and market by women farmers
ii. women farmers and market for inputs
iii. technology and gender in agriculture
iv. information, technology and gender in agriculture
v. women farmers , ICT tools and markets
vi. women farmers and impact of ICT based tools
vii. use of ICT based tools by women farmers for better market access
viii. ICT and women farmers access to markets
ix. Technology and female farmers access to information and market

It is also important to document and report the search process in the final report. The report should document and identify all potentially relevant primary search results, the names of databases searched (electronic and physical archives/records); name of host/system used to access the database, for example through PLOS, J-store, CAB, AGRICOLA, etc. along with the date of search and the years covered by the search and the complete search strategy used including all search terms, number of articles retrieved using each specific search term in each database, and the total articles retrieved within each of the components. It is also important to document if any issue or volume has been missed for a particular data source. Relevant databases for "gender and agriculture" include JSTOR, EconLit, AGRIS, J-Gate, NBER, PLOS, NCBI, NIH, 3ie, AgEcon Search, CAB Direct, Dissertation Express, EBSCO, ELDIS, IDEAS, JOLIS, Social Science Citation Index, USAID Lib, and USDA, Google (advance search), Google Scholar, OECD/DAC Evaluation database, CGIAR repositories etc. We will use a **PRISMA** (Preferred reporting items for systematic reviews and Meta-Analysis)[12] flowchart to document the number of articles searched through different search strategies, and articles excluded or included from the study at various stages. A sample PRISMA flowchart for a systematic review titled "The impact of gender equity in agriculture on nutritional status, diets, and household food security: a mixed-methods systematic review"[13] is attached in **Appendix 1.** Another effective search strategy is to use a snowballing technique as suggested

[12] **PRISMA** is an **evidence**-based minimum set of items for reporting in systematic reviews and meta-analyses. PRISMA focuses on the reporting of reviews evaluating randomized trials, but can also be used as a basis for reporting systematic reviews of other types of **research**, particularly evaluations of interventions

[13] Harris-Fry H, Nur H, Shankar B, et al, The impact of gender equity in agriculture on nutritional status, diets, and household food security: a mixed-methods systematic review, BMJ Global Health 2020;5:e002173.

in the Cochrane handbook (Cochrane, 2004). Snowballing is the process of following up references from one article as a strategy to identify other relevant studies that can be considered for inclusion in the review. This helps to ensure that the search strategy has identified all potentially relevant studies and thereby provides a means of validating the electronic database search.

e. Study selection

The study selection stage helps identify relevant studies from search results. It is typically conducted in two rounds. In the first round, a title and abstract review helps eliminate results that do not fit the eligibility criteria as set by the study protocol. The studies shortlisted in this round undergo a full text review. It is recommended to have at least two independent reviewers (experts in the subject) review each result in both rounds of study selection. A thorough review is done at this stage, conforming to all the criteria of inclusion for the study, before moving to the next round of quality appraisal. At this stage, a lot of studies that do not fit the inclusion criteria typically get eliminated and we move to the next step with the selected list of studies.

f. Quality appraisal

Quality appraisal is the most crucial step in developing a systematic review. It is done to assess the quality of evidence that has been identified through the search process to determine how definitive of an answer the proposed analysis will be able to provide. One needs to use a validated quality appraisal tool to evaluate the quality of each included study.

The initial steps of question formulation and study selection criteria should describe the minimum acceptable level of inclusion criteria. Selected studies should be subjected to a more refined quality assessment by use of general critical appraisal guides and design-based quality checklists. There are well known quality appraisal tools that have been developed to provide a standardized guide for systematic reviews.[14] One such tool is Specialised Unit for Review Evidence SURE[15] that provides a checklist for quality assessment and can be adapted as per the study design (for qualitative,[16] quantitative studies[17] and mixed-method studies). These detailed quality assessments will be used for exploring heterogeneity and informing decisions regarding suitability of meta-analysis in the next steps. In addition, they help in assessing the strength of inferences and making recommendations for future research. It is important to populate the quality assessment forms by using a pilot sample of articles to ensure that multiple reviewers can consistently apply the appraisal criteria.

For a systematic review on "The impact of ICT-based tools for accessing information on women farmers' access to technical information and market" the evidence included will be from a broad range of studies from different disciplines (say agricultural science, Information and technology, management etc.). Hence one has to consider the type and volume of research likely to be available for a topic, leading to a strong inclusion criterion of inclusion of studies of any design (experimental study design, semi-experimental study design, descriptive study design etc.). After studies with an acceptable design have been selected through a rigorous quality appraisal, the in-depth assessment for the risk of various biases allows us to gauge the quality of the evidence in a more refined way.

There are broadly three types of biases that the review team needs to take into consideration:

1. Selection bias: Selection bias refers to the existence of systematic differences in baseline characteristics between the populations compared in a study. For instance, the studies analysing the impact of ICT-based tools for accessing information on women farmers to broaden their access to technical information and market may study different categories

[14] https://www.nhlbi.nih.gov/health-topics/study-quality-assessment-tools

[15] https://www.cardiff.ac.uk/__data/assets/pdf_file/0010/1142974/SURE-CA-form-for-Cross-sectional_2018.pdf

[16] https://www.cardiff.ac.uk/__data/assets/pdf_file/0006/212775/SURE_Qualitative_checklist_2015.pdf

[17] https://www.nice.org.uk/process/pmg4/chapter/appendix-f-quality-appraisal-checklist-quantitative-intervention-studies

of women farmers. They can be farmers from high, low or middle-income countries. They may also be large, small or marginal farmers, young or older farmers. For studies that have a control group, the control group farmers may be significantly different in characteristics than the treatment group farmers. A key point to minimise selection bias is to have a well-defined inclusion and exclusion criteria in the protocol.

2. Performance bias: Performance bias refers to a systematic difference between groups in terms of how they are treated, or differences in the behaviour of participants due to knowledge of the allocated interventions. In the above cited example of an ICT-based intervention, some groups may have been exposed to an intervention or program for a longer duration than the others. The intervention in itself can be different e.g. mobile phone-based application, radio, television, electronic money transfer etc for different groups.

3. Reporting bias: Outcome reporting bias occurs when published studies selectively report only a subset of measured outcomes. While reporting bias can be difficult to detect, it can be cross checked and avoided by using triangulation techniques such as having multiple reviewers code the data, review the findings with peers and validate findings with alternative data sources. For example, in the ICT-based tool interventions/programs for women farmers, the study may have additional findings besides the outcomes of interest like impact on health, employment and income. Rajni et. al (2012)[18] examine the extent of access to ICTs among female farmers, the use of ICTs by farm women, the determinants of farm women's access to ICTs and explore the impact of ICTs on farm productivity and women's empowerment. Access to ICTs has been found to improve the income of farm households and increase their participation in decision-making along with enhanced information on markets.

There are various tools that have been designed to address these biases like ROBINS-I,[19] Lockwood, Munn and Purrit.[20] However, while doing the review process the reviewer has to be made aware of the related biases and each of the included studies need to be appraised more than once by different reviewers. At least two reviewers should assess the quality of each study. Each reviewer reads the publication, assesses its quality and scores each article independently using the appropriate quality assessment checklist that can be developed for the review. If none of the reviewers select exclusion responses, the reference would pass to the next level. If the reviewers agree on at least one of the exclusion responses, then the reference will be excluded. However, if none of the above criteria are met then the reference will stay in a state of conflict. Conflicts should be resolved by consensus between the two reviewers and may also include a third reviewer to arrive at a final decision. Accordingly, the risk of bias can be categorised as high/low/unclear during the review process. For example, in case of reporting bias , a bias will be categorised as "low risk of bias" if all outcomes are clear and expected outcomes of interest are reported; and "high risk of bias" in cases where primary outcomes have not been reported or incompletely reported.

An illustrative table (table 1) to report the biases is shown below:

[18] https://ageconsearch.umn.edu/bitstream/204822/2/11-Rajni_ICT11_Final.pdf

[19] Sterne JA, Hernán MA,Reeves BC, et al. ROBINS-I: a tool for assessing risk of bias in non-randomised studies of interventions. BMJ 2016;355:i4919.doi:10.1136/bmj.i4919

[20] Lockwood C, Munn Z, Porritt K. Qualitative research synthesis: methodological guidance for systematic reviewers utilizing meta-aggregation. *Int J Evid Based Healthc* 2015;13:179–87.doi:10.1097/XEB.0000000000000062

TABLE 1: TYPE OF BIAS IN SYSTEMATIC REVIEW

Bias	Reviewers Judgement	Comment in support of Judgement
Selection Bias	High/Low/Medium	
Performance bias	High/Low/Medium	
Reporting bias	High/Low/Medium	

Based on the risk of bias categorised for each study, a risk of bias table will be developed that maps and summarises all the included studies against the risk of bias, using a traffic light colour scheme red-high, yellow-unclear, green-low. From this table, a risk of bias graph is generated showing each item presented as percentages across all the included studies.

TABLE 2: TYPE OF BIAS IN SYSTEMATIC REVIEW

	Selection Bias	Performance Bias	Reporting Bias
Study X			
Study Y			
Study Z			

The risk of bias in quantitative literature will be assessed using an adapted version of the Risk of Bias in Non-randomised Studies of Interventions (ROBINS-I) tool for quantitative studies. Quality of qualitative literature can be assessed across different domains, adapting the Lockwood, Munn and Porritt tool. This tool assesses appropriateness of research methodology, sampling, data collection, representation and analysis of data, interpretation of results, and conclusions. Each study will be given an overall assessment of 'high', 'low' or 'medium' quality and will be reported along with the findings.

The next step is quality evaluation. We will adopt explicit inclusion criteria on study quality to ensure that extracted estimates from quantitative studies and interpretations from qualitative studies are bias free. For quantitative studies (as well as the quantitative sections of mixed-method studies), we will follow Adu et al (2018) - "Systematic review of the effects of agricultural interventions on food security in northern Ghana" and classify retrieved documents' quality as (i) Good; (ii) Sufficient; or (iii) Insufficient. A document is classified as 'Good' if it is available in full, the research question is clear, the study population and sample are described, the intervention is well-defined and results are attributed to the intervention through a clear counterfactual analysis. A document is placed in the 'Sufficient' category if it is accessible in full but the counterfactual analysis has not been presented and it satisfies all the other criteria for this category. A document is classified 'Insufficient' if the intervention description is not clear, there are no results, the counterfactual analysis is missing or the source of the document is not traceable/reliable. Documents classified as 'Good' or 'Sufficient' will be marked for further screening.

We will base the classification of qualitative studies (and the qualitative component of mixed method studies) on Harden (2010) "Mixed-Methods Systematic Reviews: Integrating Quantitative and Qualitative Findings" and Harrison et al (2011) "Reviewing studies with diverse designs: The development and evaluation of a new tool". A document will be categorised 'Good' if it is available in full, the

research question is clear and the study setting is described, the theoretical framework is clear, the data collection procedure is articulated and the rationale for choice of data collection procedure is described. Further, there is a match between the research question, the data collection method and the method for analysis. A document is classified 'Sufficient' if it is accessible in full and only the data collection procedure is not described. All the other criteria of the 'Good; category are satisfied. A document is classified as 'Insufficient' otherwise. We will include documents classified as 'Good' or 'Sufficient' for further screening based on the content of the document, whereas documents classified as 'Insufficient' are rejected at this stage.

As an example, let us consider the Master's Theses "Exploring the Opportunities and Challenges of ICTs for Women Farmers in Kenya" by Tania Braimok (2017). The document is complete and very clearly articulates the research question, the study setting and the data collection procedure. However, we will classify the report under the 'insufficient' category due to the absence of a theoretical framework to analyse data as well as issues in sample selection and data interpretation.

The next assessment step is data extraction.

g. Data extraction

The data extraction process involves obtaining relevant data points from each of the studies. The data points refer to the sample size, study duration, population characteristics, intervention protocols, outcome measurement and statistical analysis. At this stage each of the studies is manually reviewed and relevant data points are documented. Here the reviewers should consider how much information they want to collect a priori. When deciding on the content of the form, reviewers should consider the information that will be needed to construct the requisite tables that summarize the studies included in the review and the data required from each study to perform the proposed analyses.

If the systematic review question looks into more than one outcome, the data extraction can be configured to capture data for all of the outcomes. As discussed previously, in the ICT-based tool interventions/programs for women farmers, the study may have additional findings besides the outcomes of interest (i.e., broader market for inputs/outputs/ Access to technical and market information) like impact on health, employment and income. If either type of data i.e. quantitative and qualitative data is potentially relevant to answer the systematic review question on the outcomes of interest, the data extraction form can be configured to capture data of both types. This will require the use of separate data extraction tables for the two or more potential outcomes (separate data extraction tables for impact of ICT based tools on access to market information, health, employment and income). Similarly, the data extraction should be well laid out for different study designs (qualitative studies and quantitative studies) using separate data extraction forms.

The data extraction process is conducted with the help of pre-designed forms (electronic or paper forms). The data extraction form should be tested by several reviewers on a sample of studies to ensure that the data entry follows a logical order and that the instructions are clear. The testing of the forms will identify data that are not needed or missing and coding instructions that are confusing. Testing the forms ensures that all of the required information is extracted in a uniform way (Cochrane, 2004; CRD, 2001). Data extraction should be performed independently by at least two reviewers and the data extracted by these reviewers should be compared to improve reliability. Any disagreements should be discussed and resolved either by consensus among reviewers or by the participation of an additional reviewer. If financial and time factors do not allow duplicate data extraction, a single reviewer can perform data extraction, with a second reviewer checking the first reviewer's work (CRD, 2001). It is advisable that a record is kept of any disagreements, and the changes made to address them, thus providing a historical record of the decisions and refinements that occur during the review (CRD, 2001). A sample data extraction form is enclosed in Appendix 2. The data extraction form should definitely include

general information, population characteristics, intervention protocols, outcome measurement, risk of bias documentation, statistical analysis, space for additional comments by the reviewers and a final decision regarding inclusion- exclusion of the study.

h. Data synthesis

Data synthesis will be done to utilize the data that is thus amassed to find definitive answers to the specific research question. The processes, methods and best practices for data synthesis vary substantially across qualitative and qualitative studies, intervention and cross-sectional studies, systematic reviews and meta-analysis.

Data synthesis through various methods will be used to summarise and combine results from the selected studies included in the review, through a descriptive synthesis and through a quantitative method using statistical techniques . While the qualitative summarization includes the tabulation of study characteristics (population, intervention and outcome) and results; the quantitative synthesis (meta-analysis) includes the use of statistical methods for assessing heterogeneity in results and for generating pooled results. Meta-analysis can only be used when the study designs and outcome definitions among studies are sufficiently homogenous to be combined into one pooled estimate. We propose to include both types of data synthesis since the included studies use qualitative, quantitative and mixed methods. We will extract the qualitative and descriptive information from the studies using qualitative methods and the qualitative analysis from studies with mixed methods, Whereas for quantitative studies we synthesize the findings with statistical methods (i.e., mean or median values) .

For synthesising data from qualitative studies, it is useful to use tabular and graphical representations of the results. The tabular summary should have descriptive elements of the study such as author information, study design, population etc. There can be multiple ways to present the descriptive summary say grouping the results by study design/ methods (Randomised Control Trials/ cross-sectional observations etc.) or intervention wise (say in the above example effect of training, innovation and new technology can be discussed in three different groupings).

We can synthesise the findings reported in the study and group them as either first order constructs or second order constructs. In first order constructs, we use quotes or testimonies from the participants in the qualitative studies, and the qualitative component of the mixed method studies. We then transform and integrate the first order construct to the second order construct by interpretations of the studies under various themes by the researchers in the review team. We then transform the findings from second order construct to the third order construct by summarising the findings into various themes and transforming the new findings to understandings of the phenomenon or outcome of interest.[21]

For quantitative synthesis, we extract the quantitative data from the quantitative and mixed-method studies. The data from the selected studies may sometimes be reported either as binary data (where each individual is classified in only one of two possible values) or continuous data (which may take any value within a defined range).The results are summarized as means, mean differences, or standardized means. In certain cases where data may not be standardised across the included studies it may be possible to transform and standardise the outcome measures. However, one needs to keep in mind that the data from multiple studies can be combined quantitatively only when the same outcome measure is used across studies. A graphical approach used to summarise the study results is Forest Plots.[22] A visual examination of the Forest plot gives an idea of the heterogeneity

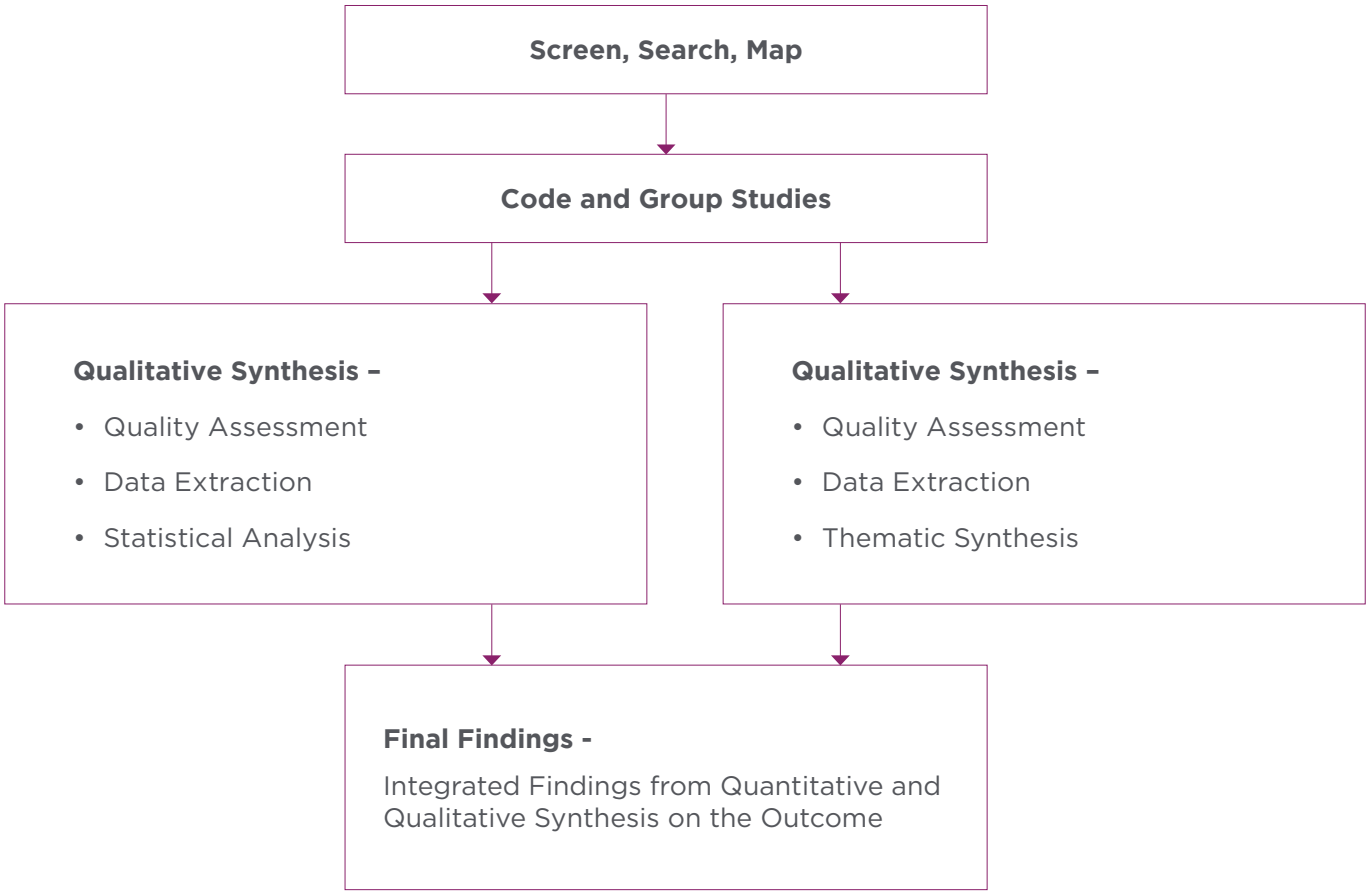
[21] Andrew Booth, Jane Noyes, Kate Flemming, Ansgar Gerhardus, Philip Wahlster, Gert Jan van der Wilt, Kati Mozygemba, Pietro Refolo, Dario Sacchini, Marcia Tummers, Eva Rehfuess,Structured methodology review identified seven (RETREAT) criteria for selecting qualitative evidence synthesis approaches, Journal of Clinical Epidemiology, Volume 99,2018 ISSN-0895-4356, https://doi.org/10.1016/j.jclinepi.2018.03.003.

[22] Forest plots use point estimates along with their confidence intervals and may help to reveal discernable patterns in the data among studies

of the results in the studies.

For quantitative data extracted for the review, depending on the statistical method used, data can be presented using different plots such as forest plot, Albatross plot,[23] Box whisker plot,[24] bubble plot,[25] Rankogram plots[26] etc. that may best suit the data analysis. In the final step we shall integrate the findings from the qualitative synthesis and quantitative synthesis to conclude on the final outcome of interest. The goal of using a mixed method systematic review is to produce an overall pooled estimate of the impact of a particular program/intervention on the outcome or phenomenon of interest. An important point to highlight in the proposed analysis using mixed-methods design is that it keeps the integrity of the findings of the different types of studies intact without converting qualitative findings into numbers or quantitative findings into words as in Bayesian methods. We use complementary frameworks for qualitative and quantitative research to preserve each method and report the findings. Figure 3 illustrates the triangulation process of quantitative and qualitative data in a mixed method systematic review.

FIGURE 2: TRIANGULATION OF QUALITATIVE AND QUANTITATIVE DATA



[23] Harrison, S., Jones, H. E., Martin, R. M., Lewis, S. J. & Higgins, J. P. T. The albatross plot: A novel graphical tool for presenting results of diversely reported studies in a systematic review. Res. Synth. Methods 8, 281–289. https://doi.org/10.1002/jrsm.1239 (2017).

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[26] Chaimani A, Caldwell DM, Li T, Higgins JPT, Salanti G. Chapter 11: Undertaking network meta-analyses. In: Higgins JPT, Thomas J, Chandler J, Cumpston M, Li T, Page MJ, Welch VA (editors). *Cochrane Handbook for Systematic Reviews of Interventions* version 6.2 (updated February 2021). Cochrane, 2021. Available from www.training.cochrane.org/handbook.

i. Draft Manuscript

This is the final step in compiling the systematic reviews. The manuscript should effectively and concisely summarise the methodology and findings of the systematic review, to disseminate the results. The manuscript would be a comprehensive document that summarizes the protocol. It should clearly lay out the context/ background, the aim/objective of the systematic review, what are the key questions it seeks to answer, the protocol, inclusion-exclusion criteria, method, data analysis, findings/discussions and conclusions. The method section should clearly lay out the search strategy and data analysis and synthesis including data extraction and analysis tools. For data analysed using mixed methods, the findings should be reported in three sections- a qualitative discussion with the findings (preferably theme-wise), a discussion of quantitative results and a final integrated findings from both types of data synthesis. The first table on findings can summarise the included studies (with bibliographic information, i.e., author and year) based on the demographic characteristics. The studies can be grouped based on the study design for easy visualisations by the reader. It should then provide summarised tables on the interventions and outcomes in the included studies before describing the main findings from data synthesis. Consider the systematic review on "The impact of gender equity in agriculture on nutritional status, diets, and household food security: a mixed-methods systematic review".[27] The findings reported in this review have been well presented with various thematic discussions with qualitative synthesis integrating it with quantitative synthesis. Also consider the systematic review titled "Role of Women's Empowerment in Child Nutrition Outcomes: A Systematic Review",[28] that uses a supplementary table to furnish additional details on study selection, risk of bias assessment and quality assessment. The manuscript should not only report the findings concisely with all relevant information but it should also clearly highlight the limitation/strength of the review in conclusion.

3. TEAM COMPOSITION AND TIMELINES

Systematic reviews should be undertaken by a team (Cochrane, Campbell, 2021). The team should ideally comprise of at least three individuals with expertise in the topic area under review, statistical expertise and an individual who has prior experience of conducting a systematic review.[29] Perspectives from different disciplines can help to keep the review balanced so that all aspects of the topic chosen are adequately covered and represented in the review. A team is recommended for systematic reviews as it not only helps distribute the effort, but ensures that tasks such as the selection of studies for eligibility, data extraction and rating the quality of the evidence will be performed by at least two people independently, minimizing the likelihood of errors.[30]

The team generally takes 9 to 12 months on average to complete a systematic review. A Gantt chart with a tentative timeline for a systematic review is presented in Appendix 2.

[27] The impact of gender equity in agriculture on nutritional status, diets, and household food security: a mixed-methods systematic review

[28] Marianne V Santoso, Rachel Bezner Kerr, John Hoddinott, Priya Garigipati, Sophia Olmos, Sera L Young, Role of Women's Empowerment in Child Nutrition Outcomes: A Systematic Review, Advances in Nutrition, Volume 10, Issue 6, November 2019, Pages 1138–1151, https://doi.org/10.1093/advances/nmz056

[29] Chandler J, Hopewell S. Cochrane methods – twenty years' experience in developing systematic review methods. Systematic Reviews 2013; 2: 76.

[30] Toby J Lasserson, James Thomas, Julian PT Higgins, chapter 1-starting a review, Cochrane Collaboration: Cochrane Reviewers' Handbook Version 6.2, 2021

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AHRQ (Agency for Healthcare Research Quality). West, S., King, V., Carey, T.S., Lohr, K.N., McKoy, N., Sutton, S.F. and Lux, L. (Research Triangle Institute University of North Carolina Evidence-based Practice Centre Research Triangle Park, North Carolina): Systems to Rate the Strength of Scientific Evidence. (2002) Evidence Report/Technology Assessment No. 47

CRD (Centre for Reviews and Dissemination) Report Number 4: Undertaking Systematic Reviews on Effectiveness. CRD'S Guidance for those carrying out or commissioning reviews. (2nd edition) (2001) NHS Centre for Reviews and Dissemination, University of York, York

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Cook, D.J., Mulrow, C.D., Haynes, R.B. Systematic reviews: Synthesis of best evidence for clinical decisions. Annals of Internal Medicine (1997), 126 (5) 376- 380.

Greenland, S. Meta-analysis. In: Modern Epidemiology. (1998) Rothman, J.K. and Greenland S eds, 2nd edition. Lippincott Williams & Wilkins pp 643-673

Higgins JPT, Savović J, Page MJ, Elbers RG, Sterne JAC. Chapter 8: Assessing risk of bias in a randomized trial. In: Higgins JPT, Thomas J, Chandler J, Cumpston M, Li T, Page MJ, Welch VA (editors). Cochrane Handbook for Systematic Reviews of Interventions version 6.2 (updated February 2021). Cochrane, 2021. Available from www.training.cochrane.org/handbook.

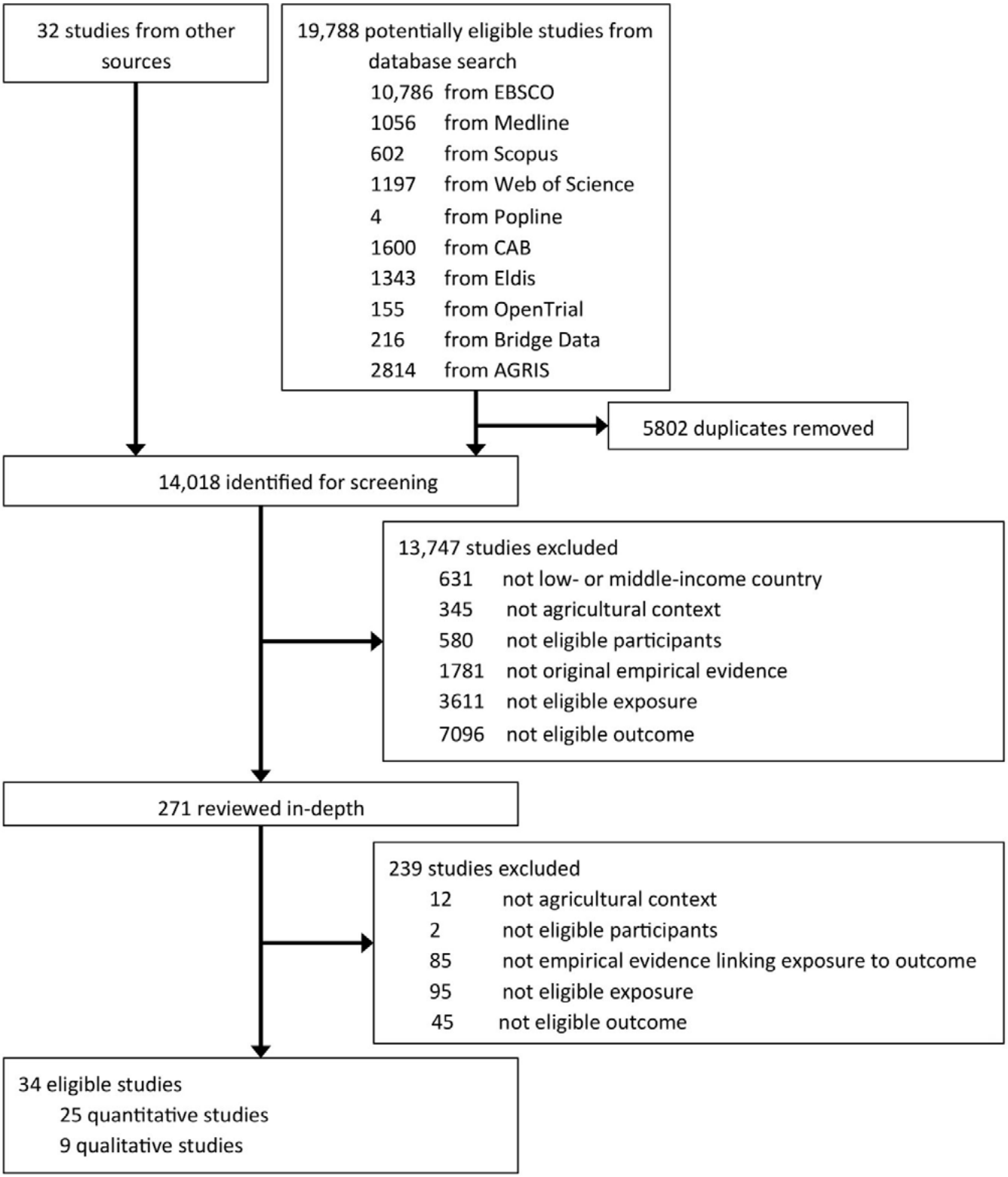
Higgins JPT, Thomas J, Chandler J, Cumpston M, Li T, Page MJ, Welch VA (editors). Cochrane Handbook for Systematic Reviews of Interventions version 6.1 (updated September 2020). Cochrane, 2020. Available from www.training.cochrane.org/handbook

Braimok, Tania, Exploring the Opportunities and Challenges of ICTs for Women Farmers in Kenya, 2017

Pearson, Alan AM, MSc, PhD, FCNA, FRCNA FAAN, FAAG1; White, Heath BSc1; Bath-Hextall, Fiona BSc(Hons) PhD2; Salmond, Susan BSN, MSN, EdD, FAAN3; Apostolo, Joao BSc4; Kirkpatrick, Pamela MA, BA, MSc5 A mixed-methods approach to systematic reviews, International Journal of Evidence-Based Healthcare: September 2015 - Volume 13 - Issue 3 - p 121-131 doi: 10.1097/XEB.0000000000000052

Sargeant, Jan & Amezcua, Maria & Waddell, Lisa. (2005). A Guide to Conducting Systematic Reviews in Agri-Food Public Health

APPENDIX 1: PRISMA FLOW CHART



APPENDIX 2: GANTT CHART OF TENTATIVE TIMELINE FOR SYSTEMATIC REVIEW

Task	Month 1	Month 2	Month 3	Month 4	Month 5	Month 6	Month 7	Month 8	Month 9	Month 10	Month 11	Month 12
Preliminary Search - Defining Research Question/Topic												
Design Search Strategy												
Develop Protocol for Systematic Review												
Conduct Initial Search to Refind Protocol												
Register Systematic Review in PROSPERO												
Complete Search and De-Duplicate												
Screening Title and Abstracts - Reviewer 1												
Screening Title and Abstracts - Reviewer 2												
Screening of Full Text Article												
Selection of Final List of Included Studies												
Data Extraction												
Synthesis- Identification of Initial Indicators/ Statistical Analysis												
Draft Manuscript												
Final Report												

APPENDIX 3: SAMPLE DATA EXTRACTION FORM

Notes on using a data extraction form:

- Be consistent in the order and style you use to describe the information for each report.
- Record any missing information as unclear or not described, to make it clear that the information was not found in the study report(s), not that you forgot to extract it.
- Include any instructions and decision rules on the data collection form, or in an accompanying document. It is important to practice using the form and give training to any other authors using the form.
- At the end of the form, the definition of the terms must be included.

Review title or ID	
Study ID (surname of first author and year first full report of study was published e.g. Smith 2001)	
Report ID	
Report ID of other reports of this study	
Notes:	

General information

Date form completed (dd/mm/yyyy)	
Name/ID of person extracting data	
Reference citation	
Study author (first author)	
Publication type (e.g. full report, abstract, letter)	
Notes:	

Study eligibility

Study Characteristics	**Eligibility criteria** *(Insert inclusion criteria for each characteristic as defined in the Protocol)*	**Eligibility criteria met?**			**Location in text or source** *(pg & ¶/fig/ table/other)*
		Yes	**No**	**Unclear**	
Type of study	Qualitative				
	quantitative				
	Mixed Methods				

Participants	*(In our example it would be Women from Low income countries)*				
Types of intervention	*(In our example it would be ICT-based tools for accessing information)*				
Types of comparison					
Types of outcome measures	E.g.: *(i) access to technical information* *(ii) access to market*				
INCLUDE			**EXCLUDE**		
Reason for exclusion					
Notes:					

Do not proceed if study is excluded at this stage.

Characteristics of included studies

Methods

	Descriptions as stated in report/paper	**Location in text or source** *(pg & ¶/fig/ table/other)*
Aim of study		
Design: *(E.g.:Impact evaluation, Quasi-randomised Controlled Trial, Randomised Controlled Trial, Case study, Observation, Interview)*	Method: Yes: No: Unclear:	
Data: *(What data collection methods were used? Was the data collection adequately described and rigorously conducted?*	Note on data: Yes: No: Unclear:	
Unit of allocation: *(by individuals, groups, HH)*	Unit: Yes: No: Unclear:	

Duration of study: *(if applicable)*	Duration: Yes: No: Unclear:	
Sample: *(What is the size of the sample and groups comprising the study?)*	Sample 1: Yes: No: Unclear:	
Notes:		

Participants

	Description *Include comparative information for each intervention or comparison group if available*	**Location in text or source** *(pg & ¶/fig/table/ other)*
Population description		
Setting *(including location and social context)*		
Inclusion criteria		
Exclusion criteria		
Age		
Race/Ethnicity		
Other relevant socio demographics		
Notes:		

Intervention groups

Copy and paste table for each intervention and comparison group

Intervention/program/treatment Group 1

	Description as stated in report/paper	**Location in text or source** *(pg & ¶/fig/table/ other)*
Group name		
Description *(include sufficient details on intervention /program)*		

Duration of treatment period		
Timing *(e.g. frequency, duration of each episode)*		
Delivery *(e.g. mechanism, medium, intensity, fidelity)*		
Providers *(e.g. no., profession, training, ethnicity etc. if relevant)*		
Co-interventions *(if the intervention was accompanied by a co-intervention)*		
Notes:		

Outcomes

Copy and paste table for each outcome.

Outcome 1

	Description as stated in report/paper		**Location in text or source** *(pg & ¶/fig/table/ other)*
Outcome name			
Outcome definition *(with diagnostic criteria if relevant)*			
Person measuring/ reporting			
Unit of measurement *(if relevant)*			
Is the outcome/tool validated?			
Imputation of missing data *(e.g. assumptions made for ITT analysis)*	Yes: No: Unclear:		
Power *(e.g. power & sample size calculation, level of power achieved)*			
Notes:			

Other

Study funding sources *(including role of funders)*		
Possible conflicts of interes *(for study authors)*		
Notes:		

Risk of bias assessment

Domain	Risk of bias			Support for judgement *(include direct quotes where available with explanatory comments)*	Location in text or source *(pg & ¶/fig/ table/other)*
	Low	High	Unclear		
(selection bias) *How was the sample selected? Were there any factors that influenced how the sample was selected (e.g. access, timescale issues)?*					
(performance bias)				Outcome group: All/	
Incomplete outcome data *(reporting bias)?*				Outcome group: All/	
Selective outcome reporting? *(reporting bias)?*					
Other bias					
Notes:					

Data and analysis

Copy and paste the appropriate table for each outcome, including additional tables for each time point and subgroup as required

For quantitative studies and quantitative component of mixed studies

Dichotomous outcome

	Description as stated in report/paper				Location in text or source *(pg & ¶/fig/table/ other)*
Comparison					
Outcome					
Subgroup					
Time point *(specify from start or end of intervention)*					
Results	Intervention		Comparison		
	No. with event	Total in group	No. with event	Total in group	
Unit of analysis *(by individuals, cluster/groups/ Village/County)*					
Statistical methods used and appropriateness of these *(e.g. adjustment for correlation)*					
Notes:					

Continuous outcomes

	Description as stated in report/paper	Location in text or source *(pg & ¶/fig/ table/other)*
Comparison		
Outcome		
Subgroup		
Time point *(specify from start or end of intervention)*		

Results	Intervention			Comparison			
	Mean	SD (or other variance, specify)	No. participants	Mean	SD (or other variance, specify)	No. participants	
Any other results reported *(e.g. mean difference, CI, P value)*							
Unit of analysis appropriateness of these *(individuals, cluster/ groups or body parts)*							
Statistical methods used and appropriateness of these *(e.g. adjustment for correlation)*							
Notes:							

Other outcomes

	Description as stated in report/paper				**Location in text or source** *(pg & ¶/fig/table/ other)*
Comparison					
Outcome					
Subgroup					
Time point *(specify from start or end of intervention)*					
No. participants	Intervention		Comparison		
	Intervention result	SE (or other variance)	Control result	SE (or other variance)	
	Overall results		Overall results		

Any other results reported		
No. missing participants		
Reasons missing		
No. participants moved from other group		
Reasons moved		
Unit of analysis *(by individuals, cluster/groups or villages etc.)*		
Statistical methods used and appropriateness of these		
Notes:		

Other information

	Description as stated in report/paper	**Location in text or source** *(pg & ¶/fig/table/ other)*
Key conclusions of study authors		
References to other relevant studies		
Correspondence required for further study information *(from whom, what and when)*		
Notes:		

For qualitative studies

	Description as stated in report/paper	**Location in text or source** *(pg & ¶/fig/table/ other)*
Key conclusions of study authors	*Draw together brief comments on the study as a whole and its strengths and weaknesses. Is further work required? What are its implications for policy, practice and theory, if any?*	
First order construct	*Quotes, statements*	
Second order construct	Researchers narrative	
Context *(Are the aims and purpose of the study clearly stated?)*	Yes: No: Unclear:	

Field work *(Is the process of fieldwork adequately described?)*	Yes: No: Unclear:	
Data Analysis *How are the data analysed? How adequate is the description of the data analysis? Is adequate evidence provided to support the analysis (e.g. use of original data, iterative analysis, efforts to establish validity and reliability)? Is the study set in context in terms of findings and relevant theory?*		
References to other relevant studies		
Correspondence required for further study information *(from whom, what and when)*		
Notes:		

Decision

Decisions	**Name of second reviewer**			
	Agreement with reviewer			
	Should this study be included in the final review?			
Second order construct	**Inclusion**	**Yes:** **No:** **Unclear:**	**Comments**	
	Date			

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