

Title page

Title: Making the most of what we already know: A three-stage approach to systematic reviewing

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Acknowledgements: This research was funded by the Foreign Affairs, Trade and Development agency in Canada with additional support from the International Initiative for Impact Evaluation (3ie) and the University of Johannesburg. We gratefully acknowledge the useful input of the Campbell Collaboration Methods Group at various stages of this review.

Structured abstract and keywords

Abstract

Background: Conducting a systematic review in social policy is a resource intensive process in terms of time and funds. It is thus important to understand the scope of the evidence-base of a topic area prior to conducting a synthesis of primary research in order to maximise these resources. One approach to conserving resources is to map out the available evidence prior to undertaking a traditional synthesis. A few examples of this approach exist in the form of gap maps, overviews of reviews, and systematic maps supported by social policy and systematic review agencies alike. Despite this growing call for alternative approaches to systematic reviews, it is still common for systematic review teams to embark on a traditional in-depth review only. *Objectives:* This paper describes a three-stage approach to systematic reviewing that was applied to a systematic review focussing in interventions for smallholder farmers in Africa. We argue that this approach proved useful in helping us understand the evidence-base. *Results:* By applying preliminary steps as part of a three-stage approach, we were able to maximise the resources needed to conduct a traditional systematic review on a more focused research question. This enabled us to identify and fill real knowledge gaps, build on work that had already been done, and avoid wasting resources on areas of work that would have no useful outcome. It also facilitated meaningful engagement between the review team and our key policy stakeholders.

Keywords

Systematic review, systematic map, three-stage approach, evidence, synthesis, smallholder farmers

Manuscript

Making the Most of What We Already Know: A Three-Stage Approach to Systematic Reviewing

Introduction

Systematic reviews have become an established standard in international development research. Questions of interest tend to be broader in scope than in the medical field where systematic reviews were pioneered (Langer & Stewart, 2014). Because of this, and given their importance in development, it has become paramount to maximise the funding and time resources that review teams have at their disposal particularly in social policy research where resources are scarce. We have found that undertaking preliminary stages in addition to a full systematic review is a useful approach for maximising funding and time resources effectively, particularly when attempting to answer a broad or disparate question: we term this a three-stage approach to completing a systematic review. A three-stage approach is the novel application of additional review scoping methods – such as gap maps and overviews of reviews – as preliminary steps to conducting a full evidence synthesis of effectiveness (traditional systematic review). Taking a three-stage approach to systematic reviewing allows review teams to understand the extent of a topic area’s evidence-base before they embark on a synthesis of the primary research in that field, as well as to refine broad research questions.

Alternative approaches to systematic reviewing are by no means new; a few examples of this kind of approach are present in the form of gap maps, overviews of reviews, and systematic maps. These various kinds of scoping and / or mapping exercises are typically supported by both social policy organisations and systematic review agencies. However, despite this increasing acceptance for multi-stage systematic reviews, review teams still focus on completing a traditional in-depth review only.

We applied a three-stage approach to a systematic review of the impact of new technology and innovation and training on the income and food security of African smallholder farmers. Our three-stage approach involved conducting an overview of reviews, followed by a systematic map, before completing a traditional, more focussed, systematic review of effectiveness. Not only did this approach enable our review team to maximise the funding and time resources at their disposal, but taking this three-stage approach to reviewing allowed us to achieve three additional things. Firstly, it resulted in us prioritising a topic area we knew was of interest to stakeholders. This opportunity for interaction with the review's stakeholders proved highly beneficial in refining our initially broad research question into one that was feasible and focused on work of interest to our funders. Secondly, this approach gave us the in-depth background knowledge of the evidence base necessary to build on reviews that had already been completed or that were ongoing at the time of our review. Finally, this approach allowed us to avoid attempting a systematic review that would not have been possible to complete due to a lack of existing impact evaluations. Importantly, this approach also encouraged and supported substantive interaction between our review team and the key policy stakeholders involved in this review.

Below, we provide a brief background and rationale for this approach before describing in detail the methods used by our review team. While we provide a very short summary of some of the review findings (Box 1), the focus of this paper is on discussing the advantages experienced by our review team of applying a three-stage approach to systematic reviewing. Finally, we conclude with a discussion on the relative benefits of applying a three-stage approach to systematic reviews compared with only conducting a traditional effectiveness review.

The Growing Recognition of Doing More than Just a Review

The most common purpose of doing a systematic review is to answer a question about impact (Gough, Oliver, & Thomas, 2012). However Gough and colleagues (2012) also describe a slightly broader remit of reviews as being able to discover evidence and engage with theory development, all in an effort to solve problems. To achieve these goals, teams of researchers conducting a traditional systematic review search for, identify, select, evaluate, and synthesise research in the evidence-base of a topic area (Gough et al., 2012). This is a resource intensive process, both in terms of the number of people required to adequately do a review and the time it takes to complete a review. Both of these factors have funding implications. Usually a systematic review requires a team of at least two people with varying expertise, and takes place – at minimum - over a period of 12 months. Due to the resource-intensive nature of conducting systematic reviews, we argue that it is important to understand the scope of the evidence-base prior to embarking on a traditional review in order to conserve funding and time resources.

Recently, our systematic review team based in Johannesburg, South Africa submitted a Campbell review on the impact of training and new technology and innovation interventions on the income and food security of African smallholder farmers (Stewart, Langer, Rebelo Da Silva, Muchiri, Zaranyika, Erasmus, Randall, Rafferty, Korth, Madinga, & de Wet, 2015). We use this review as an example of one way in which a review team can strive to understand the evidence-base of a topic area prior to beginning a systematic review. We argue that there are three ways in which a review team should understand the evidence-base before embarking on a systematic review. First, a review team must be aware of what the evidence gaps within a topic area are, prior to undertaking a systematic review. Second, researchers involved in a systematic review must be aware of existing primary and secondary research. Finally, systematic reviewers must understand when a systematic review is not

possible due to a lack of available primary research. It is advisable in our view for reviewers to try to answer these questions before commencing on an in-depth review in order to more effectively focus any later synthesis of evidence. As discussed above, there are already examples around the globe of review teams using alternative evidence scoping methods. Here we discuss three such examples: an overview of reviews, evidence gap map, and a systematic map.

Methods of scoping evidence

Conducting traditional systematic reviews especially in the international development field is increasingly recognised as both necessary but challenging (Hansen & Trifkovic, 2013; Langer & Stewart, 2014). Applying preliminary steps as part of a three-stage approach to systematic reviewing can address some of these challenges. These challenges include the need to refine a broad research question, understand the scope of the evidence base, and be aware of where there are gaps in the research. There are a variety of preliminary methods that can be used as part of a three-stage approach to systematic reviews. In the following section, we discuss three examples of some of these methods, before moving on to a description of the methods combined and used as part of our three-stage approach applied to the smallholder farmer systematic review.

The Cochrane Collaboration – the largest umbrella body overseeing the conduct of systematic reviews – advocates what it terms an ‘overviews of reviews’ (Becker & Oxman, 2008; Russell & Kiddoo, 2006). The Cochrane handbook describes the overall outcome of an overview of reviews as the production of a single document that is both user-friendly and easily accessible (Becker & Oxman, 2008). This document should provide the reader with an exhaustive list of the reviews covering similar interventions and outcomes, and it should

briefly summarise the results of each review for the relevant outcomes (Becker & Oxman, 2008). The reasons for conducting overviews, however, are varied, and include wanting to synthesise evidence from more than one review that looks at a) different interventions for the same problem; b) different outcomes for the same intervention; c) different populations, conditions, or problems for the same intervention; and d) various adverse effects. Another useful aspect of overviews of reviews listed by Becker and Oxman (2008) is that studies excluded from an original review but which may be relevant to a new question can be easily identified (these are often accessible in appendices) and included in a new synthesis of evidence.

A review team based in South Africa have published a paper (Young, Rohwer, Volmink, & Clarke, 2014) on the merits of conducting an overview of reviews, although they are by no means alone in recognising the usefulness of a preliminary step when conducting a systematic review (Becker & Oxman, 2008; Stewart & Oliver, 2003). An overview of reviews allows for the identification and appraisal of all reviews that have been published in order to describe and summarise the extent of the evidence-base. The overview of reviews method also allows for a comparison of review conclusions and their relative strengths because evidence at the review level is collected and evaluated in a systematic manner (Smith, Devane, Begley, & Clarke, 2011; Young et al., 2014). As with a traditional evidence synthesis, inclusion criteria for a review to be included in an overview of reviews are set according to study design, intervention, outcome, and intervention target population (Armstrong, Hall, & Doyle, 2011). An overview of reviews can also be valuable prior to a traditional synthesis of primary evidence because considerable overlap between included systematic reviews can be found by a review team, which would help review teams work with funders to avoid undertaking a systematic review that focuses on a question that has already been considered extensively (Young et al., 2014). Preliminary steps, such as an

overview of reviews, prior to conducting systematic reviews are also being advocated by international research and funding agencies, such as the International Initiative for Impact Evaluation (3ie) (Snilstveit & Gaarder, 2015; Snilstveit, Vojtkova, Bhavsar, & Gaarder, 2013). Funding agencies find preliminary steps, such as those applied in this three-stage approach, useful because it allows them to pinpoint their funding efforts towards areas where research evidence is lacking or nonexistent (Snilstveit & Gaarder, 2015).

Other types of pre-systematic review methods are becoming increasingly used. A World Bank working paper provides a useful explanation of a variety of pre-evidence synthesis processes, including evidence gap maps (also referred to here as gap maps) (Snilstveit et al., 2013). Evidence gap maps visually map out all the systematic reviews and primary studies – both ongoing and complete – within a topic according to a framework of policy significant interventions and outcomes (Snilstveit et al., 2013). They also provide brief but valuable summaries of included studies (Snilstveit et al., 2013). For example, Snilstveit and her colleagues (2013) provide a graphic representation of a gap map on HIV/AIDS, and within this paper Table 1 represents the gap map developed as part of our three-stage approach. Gap maps are particularly useful to policymakers: they conserve scarce research resources by guiding the development of refined research questions, and because they present a thematic overview of the evidence-base of interventions that work, they provide policymakers with useful tools to facilitate informed decision-making (Snilstveit et al., 2013; Langer & Stewart, 2014). Gap maps can however also be useful to researchers, since they tell us what knowledge we have and assist in identifying research gaps and areas suitable for future synthesis.

Gap maps differ from a similar method known as systematic mapping in that the focus of a gap map is to visually represent where there are gaps in the literature (Ranger, 2012). Systematic maps do not necessarily set out to answer a question but instead use a structured

evidence searching, inclusion, and collation process. This process provides an overview of the breadth and depth of the evidence-base relating to a topic area. Outputs can include summary reports with searchable databases of the included research and can be useful for policy, but typically no statistical synthesis or meta-analysis is carried out to calculate effect size, unless a subset of the research is later used to inform a more focussed systematic review (Donnison et al., 2013; Randall and Donnison 2014; Randall and James 2012).

Despite these examples of various pre-review exercises, it is still most common for systematic review teams to embark on just a synthesis of evidence of impact (Waddington et al., 2012). Still, there are limited examples of two stage reviews in other fields. For example, Randall and James (2012) combined a systematic map with a more focused systematic review synthesis within one project to inform agricultural conservation policy, but we know of no examples that have combined all these options within a single project. Thus, this paper discusses how a three-stage approach to a systematic review on smallholder farming interventions was useful in achieving the three aims mentioned earlier: understanding the scope of the evidence-base, maximising our available resources, and facilitating increased stakeholder engagement, which allowed a broad development question to be refined into one suitable for a traditional synthesis.

Method used for the three-stage review

Overviews of reviews, gap maps, and systematic maps have been described above as three of many preliminary methods reviewers can implement when taking a three-stage approach to systematic reviewing. The following section describes in detail the three-stage approach taken for a systematic review of the impact of training, new technology and innovation on the food security and wealth of African smallholder farmers. The focus of this

section is on how the three-stage approach was applied, with a very brief mention of some of the findings of our review.

We were commissioned to conduct a systematic review by the Foreign Affairs, Trade and Development Agency in Canada on a broad question. The original question we were commissioned to investigate was ‘what are the effects of interventions for smallholder farmers in Africa on outcomes’ (Stewart, Erasmus, Zaranyika, Rebelo Da Silva, Korth, Langer, Randall, Madinga, & de Wet, 2013). The interventions the funders wanted to investigate were: training, agricultural innovation / new technology, grants / subsidies, microfinance, insurance, extension, general agriculture interventions, policy interventions. The outcomes the funders were interested in were: agricultural investment, agricultural innovation, yields / productivity, income, food security / nutrition. To refine and answer this broad and diverse question with a systematic review, we took a three-stage approach. The first step of the three-stage approach was to determine what existing reviews there were on this topic by conducting an overview of reviews (Stewart, Erasmus, Zaranyika, Rebelo Da Silva, Korth, Langer, Randall, Madinga, & de Wet, 2014). Completing an overview of reviews involved steps similar to those of doing conventional evidence syntheses. First, we searched databases using search terms that covered the concepts relevant to our research question, such as ‘Africa’, ‘smallholder farmers’, and ‘training’, among others. After this, we screened systematic reviews – including completed reviews and those for which we could only identify a funding call, title registration, or protocol¹ – on title and abstract. At this stage, we used simple coding to describe the reviews in terms of the intervention/s, outcome/s, population, date, and region they covered. It should be noted at this point that older reviews would not have been included in the overview of reviews since a cut-off (1990) – established

¹ We followed up with the funders of the recent funding call to identify which questions had actually been commissioned.

through consultation with topic literature and the topic experts on our advisory group – was adhered to and applied when the reviews were coded. Additionally, the measurement of evidence quality and / or impact in our case occurred at the later stage of full synthesis where primary studies identified through the overview of reviews process were subjected to individual coding and quality appraisal. It is at this stage that any pre/post studies or research ill-suited to measuring impact would be gleaned from the pool of studies included in the final stage of the three-stage approach: a traditional systematic review.. After applying our simple coding to the reviews, we then gathered the studies conducted in Africa from each review, irrespective of whether the review had included or excluded these studies. Since our review question had yet to be refined, we were interested in all studies conducted in Africa and covering all relevant interventions and outcomes. Our overview of reviews allowed us to get a sense of what research had already been conducted in the topic area. This approach allowed us to build on the pre-existing search efforts of other review teams, which was particularly useful because of the broad nature of our initial research question. These African-based studies were then used as a starting point for the second stage of our three-stage approach to our systematic review.

The aim of the second step in our three-stage approach was to determine where the gaps and overlaps in the literature on interventions and outcomes for African smallholders were (Snilstveit et al., 2013). In order to accomplish this, we systematically mapped studies and reviews that were conducted in Africa (Stewart et al., 2014). As mentioned above, our starting point for the systematic map was the list of African studies developed from our completed overview of reviews. In addition to the studies identified in the overview of reviews, we conducted additional searches on various databases (Agricultural Science and Technology, AGRIS, Abdul Latif Jameel Poverty Action Lab, the British Library for Development Studies, International Food Policy Research Institute, IDEAS, and CAB

abstracts) and websites (IFAD, USAID, CGIAR) using the same search terms as in step one. We also consulted with our advisory group² as to whether they were aware of any completed or ongoing studies that we should take into consideration for the systematic map. Once we had amassed a set of primary studies on the topic of smallholder interventions and outcomes in Africa, we screened the results from these searches and the overview of reviews on title and abstract. We then did basic coding at the abstract level to populate our gap map of interventions and outcomes (see Table 1) (Stewart et al., 2014). We used this thematic framework to consult with our advisory group and funders about the narrowed focus for evidence synthesis, the third step of the three-stage approach.

<Insert table 1 here>

The third, and final, step of the three-stage approach aimed to answer the question ‘what does the available evidence say?’ (Stewart et al., 2014). To do this, we conducted a full ‘traditional’ systematic review of a subset of effectiveness studies (Stewart et al., 2015). In consultation with our advisory group, we used our thematic framework to discuss and prioritise interventions and outcomes of the field that were of interest to our stakeholders. Doing this allowed us to develop the following research question: What are the effects of training and new technology / innovation interventions on the food security and income of smallholder farmers in Africa? With this refined question, we conducted additional searches of databases and websites, and sought the full texts of 462 studies. Out of these 462 studies, we could not obtain six full texts. A total of 435 studies were excluded from the remaining 456 studies. Most of these did not meet our inclusion criteria in terms of research design, which required a rigorous experimental or quasi-experimental design to have been applied. We were thus left with 21 included studies, which were synthesised using meta-analysis and

² This multi-disciplinary group included representatives from academia, the not for profit sector and governments, all with experience of smallholder farming policy, practice and /or research.

narrative synthesis. For more details on the full review, our quality appraisal methods, and the outcome of the review please consult the full systematic review published by the Campbell Collaboration (Stewart et al., 2015).

Typically, a traditional systematic review only involves the third step of the three-stage approach which has the goal of synthesising the available evidence of effectiveness of an intervention on an outcome. However, we have reflected on our three-stage methodology and considered the value of each step in the following section.

Findings

The three-stage approach to systematic reviews is different from traditional evidence synthesis methods (Snilstveit 2012). The original question that we were commissioned to answer was broad and would have taken considerable resources to address in full. In addition, broad questions are often unsuitable for systematic review synthesis due to the likely level of heterogeneity across interventions, outcomes, and study design. Therefore, we had to consider which approaches could help us investigate the full spectrum of evidence whilst also focusing the review on questions of importance to our stakeholders.

Through using this approach, we identified a number of overlaps and gaps in the African smallholder farmer literature. There were no systematic reviews, and limited impact evaluations, that evaluated the impact of training, innovation and new technology, or agriculture infrastructure on the outcomes of agricultural investment and adoption of innovations (Stewart et al., 2015). One exception was the relatively high number of impact evaluations that measured the impact of training on the adoption of innovations. Another gap

that was identified was the small number of systematic reviews, which focused on the impact of financial wealth and food security (Stewart et al., 2015).

There were many advantages to using this three-stage approach. Employing it enabled us to identify 21 reviews and 462 studies on impact in the African smallholder farming literature related to our broad range of interventions and outcomes (Stewart et al., 2015). Identifying and mapping the overlaps and gaps within these reviews and studies meant that we were able to better understand the state of the smallholder farming evidence-base (Arksey, & O'Malley, 2005; Bates, Clapton & Coren 2007; Bragge, Clavisi, Turner, Tavender, Collie, & Gruen, 2011; Gough et al., 2012). In relation to the African studies, we were able to understand the evidence-base in terms of the interventions and outcomes, and the relationships between them. A more thorough understanding of the scope of the evidence allowed us to identify which populations and countries were already covered by the conducted research. And finally, through this approach, we now have a clear idea of the scope of ongoing and as-yet-unpublished reviews which should make updating this African smallholder farming review a manageable task.

Being aware of these gaps and overlaps prior to conducting an in-depth review allowed us to actively engage with key stakeholders and refine the research question. A wider understanding of the evidence-base also allowed us to focus on a question of importance to our stakeholders (Snilstveit et al., 2013), and to conduct an in-depth review in a realistic timeframe. The usual workload at the beginning of any review was somewhat eased by conducting the two preliminary steps of the three-stage review since we had the search results from the overview of reviews and systematic map (Stewart et al., 2014).

<Insert box 1 here >

Discussion

There are three ways in which a three-stage approach to systematic reviews is useful: It highlights research that needs to be done, it builds on research that has already been done, and it avoids attempting a systematic review that cannot be done. Each shall be addressed in turn below.

The first major advantage we found to using this approach is that it highlights work that needs to be done. For the smallholder farming review, we engaged with advisory group members and funders during the overview of reviews and systematic map stages of our three-stage approach. This early engagement enabled our stakeholders to make better-informed decisions regarding the later focus of the traditional systematic review because they were able to tell us what work was a priority to them. Thus the three-stage approach allowed key stakeholder engagement to direct the focus of the work towards work that was needed; that is, work that is relevant and important to our stakeholders.

The second major advantage of this approach to completing systematic reviews is that it allows teams to build on work that has already been done. At the time of setting the refined research question, a systematic review of a training intervention of interest to us (farmer field schools) (Waddington, Snilstveit, Garcia Hombrados, Vojtkova, Anderson, & White, 2012) had already been conducted. This systematic review gave us a starting point when searching for studies covering training because we were able to adapt and use their search strings, and review their included and excluded studies (Stewart et al., 2014). Being able to use their work as a starting point for our own prevented us from spending time and manpower resources on duplicating the efforts made by another review team.

A three-stage approach to reviews also allows work to be built on in the other direction: it facilitates other researchers building on the work that we have already done.

Overview of reviews, evidence gap maps, and systematic maps can be starting points for future teams of systematic reviewers interested in the topics covered by those overviews of reviews and maps (Gough, Kiwan, Sutcliffe, Simpson, & Houghton, 2003). Indeed, these pieces of work can also be streamlined into tools for policymakers in the field to use when trying to engage in research. For example, our systematic map has already been shared with policy-makers in South Africa.

Finally, a three-stage approach to systematic reviews allows review teams to avoid wasting time on systematic review work that cannot be completed because there are an insufficient number of studies to include in the review. By thoroughly understanding the scope of the primary and secondary research in the evidence-base, we could avoid embarking on a review that would yield no results (an ‘empty’ review) (Yaffe, Montgomery, Hopewell, & Shepard, 2012). Although an ‘empty’ review can in its own way be a useful finding, it does not help answer questions of impact that are often of particular interest to decision-makers. This was the experience of a team who conducted a systematic review on urban agriculture (Korth, Stewart, Langer, Madinga, Rebelo Da Silva, Zaranyika, van Rooyen, & de Wet, 2014).

Although a three-stage approach had many advantages, it was not without its own challenges. Our proposed three-stage review approach does not easily fit within the scope of review organisations that have existing templates, set standards, and peer review systematic reviews. The three-stage approach to reviews we used was different from the approach taken by our review organisation. As a result of this difference, only our in-depth systematic review – the third stage of our three-stage approach – was accepted, and is being published, by our review organisation. However, in other fields multi-stage reviews are beginning to become more recognised. For example, the Collaboration for Environmental Evidence, which supports environmental systematic reviews, now openly promotes systematic maps as either

stand-alone review products or as a stage within a larger review project (Randall & Donnison 2014).

Although the preliminary stages of the three-stage approach are resource intensive, they proved invaluable to our review. These early stages were invaluable because they enabled us to focus our very broad topic into a prioritised focused question that filled a real research gap. However, had we already understood the existing evidence-base we arguably could have skipped the first two stages. It could therefore be argued that this multi-stage approach is particularly valuable for some questions in some circumstances, but not necessarily for all reviews.

Conclusion

There are an increasing number of research teams conducting, and an increasing demand for, systematic reviews particularly in the field of social development, including those funded by the UK Department for International Development (DFID) and the 3ie (Walker, Bergh, Page, & Duvendack, 2013). However this is in the context of limited, but growing, capacity to do reviews (Bangpan, Stansfield, Vigurs, & Oliver, 2013). As such, review teams have an obligation to understand the evidence-base prior to undertaking a full evidence synthesis to avoid wasting resources of time and funds. We propose the three-stage approach to systematic reviews, exemplified by the African smallholder farming review, as one method for review teams to begin fulfilling this obligation. This three-stage approach can be a useful tool in aiding review teams to know what work needs to be done, build on work that has been done, and avoid work that cannot be done.

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Table 1: Thematic framework showing a summary of the evidence-base

OUTCOMES	INTERVENTIONS								
		Training / Knowledge transfer		Innovation & new technology		Agricultural infrastructure		Agricultural finance	
		<i>Systematic reviews</i>	<i>Impact studies</i>	<i>Systematic reviews</i>	<i>Impact studies</i>	<i>Systematic reviews</i>	<i>Impact studies</i>	<i>Systematic reviews</i>	<i>Impact studies</i>
Investment	GAP IN SYSTEMATIC REVIEW EVIDENCE	2 impact studies	GAP IN SYSTEMATIC REVIEW EVIDENCE	3 impact studies	GAP IN SYSTEMATIC REVIEW EVIDENCE	5 impact studies	GAP IN SYSTEMATIC REVIEW EVIDENCE	10 impact studies	
Innovation	GAP IN SYSTEMATIC REVIEW EVIDENCE	27 impact studies	GAP IN SYSTEMATIC REVIEW EVIDENCE	8 impact studies	GAP IN SYSTEMATIC REVIEW EVIDENCE	4 impact studies	1 systematic review	3 impact studies	
Yield / Productivity	1 systematic review	27 impact studies (yield) 18 impact studies (productivity)	5 systematic reviews	186 impact studies (yield) 45 impact studies (productivity)	3 systematic reviews	13 impact studies (yield) 12 impact studies (productivity)	2 systematic reviews	15 impact studies (yield) 7 impact studies (productivity)	
Income / household economics	1 systematic review	29 impact studies	1 systematic review	80 impact studies	GAP IN SYSTEMATIC REVIEW EVIDENCE	20 impact studies	5 systematic reviews	28 impact studies	
Food security / nutrition	GAP IN SYSTEMATIC REVIEW EVIDENCE	13 impact studies	5 systematic reviews	27 impact studies	GAP IN SYSTEMATIC REVIEW EVIDENCE	8 impact studies	1 systematic review	8 impact studies	

Box 1: What are the impacts of training and new technology and innovation on African smallholders' income and food security?

In the case of smallholder farming in Africa, during the third stage of our three stage approach (evidence synthesis) we were able to conduct a meta-analysis of 19 studies. The meta-analyses yielded no definitive answer regarding the impact of training and new technology/innovation on food security and income due to the large amount of heterogeneity in study designs as well as the absence of rigorous research. However, a qualitative analysis of the literature noted two trends: training interventions typically focused on increasing yield and thus improving income, while innovation and new technology interventions typically targeted food security outcomes. For a detailed discussion of the findings of this review, please refer to the full review available on the website of the Campbell Collaboration (Stewart et al., 2015).