



# Evidence on Output to Outcome for Food and Nutrition Security Interventions

Simone van Vugt, Haki Pamuk and Marrit van den Berg



**WAGENINGEN**  
UNIVERSITY & RESEARCH



# Evidence on Output to Outcome for Food and Nutrition Security Interventions

Simone van Vugt<sup>1</sup>, Haki Pamuk<sup>2</sup> and Marrit van den Berg<sup>3</sup>

1 Wageningen Centre for Development Innovation

2 Wageningen Economic Research

3 DMW

This study was carried out by Wageningen Centre for Development Innovation, Wageningen Economic Research and DMW of the Social Sciences Group.

Wageningen Centre for Development Innovation  
Wageningen, February 2023

---

Report WCDI-23-233

---

Van Vugt, S., H. Pamuk, M. van den Berg, 2023. *Evidence on Output to Outcome for Food and Nutrition Security Interventions*. Wageningen Centre for Development Innovation, Wageningen University & Research. Report WCDI-23-233. Wageningen.

This study was conducted with the support of the Food & Nutrition Security (FNS) Support Facility. The FNS Support Facility is financed through the Ministry of Foreign Affairs of the Netherlands and supports the Netherlands Embassies and Ministry in innovation and learning trajectories that contribute to the achievement of their policy ambitions in the context of FNS and food systems. The Facility is jointly coordinated by the Netherlands Food Partnership (NFP) and Wageningen Centre for Development Innovation (WCDI), part of Wageningen University & Research.



Ministry of Foreign Affairs of the  
Netherlands



This report can be downloaded for free at <https://doi.org/10.18174/590396> or at [www.wur.eu/wcdi](http://www.wur.eu/wcdi) (under knowledge products).



© 2023 Wageningen Centre for Development Innovation, part of the Stichting Wageningen Research. P.O. Box 88, 6700 AB Wageningen, The Netherlands. T + 31 (0)317 48 68 00, E [info.cdi@wur.nl](mailto:info.cdi@wur.nl), [www.wur.eu/wcdi](http://www.wur.eu/wcdi).



The Wageningen Centre for Development Innovation uses a Creative Commons Attribution 4.0 (Netherlands) licence for its reports.

The user may copy, distribute and transmit the work and create derivative works. Third-party material that has been used in the work and to which intellectual property rights apply may not be used without prior permission of the third party concerned. The user must specify the name as stated by the author or licence holder of the work, but not in such a way as to give the impression that the work of the user or the way in which the work has been used are being endorsed. The user may not use this work for commercial purposes.

The Wageningen Centre for Development Innovation accepts no liability for any damage arising from the use of the results of this research or the application of the recommendations.

Report WCDI-23-233

Photo cover: David Brazier

---

# Contents

<b>1</b>	<b>Introduction</b>	<b>5</b>
	1.1 Towards an improved food & nutrition programme with more effective impact	5
	1.2 Linking the Food & Nutrition programme to FNS results: five research questions	5
	1.3 Reading guide	5
<b>2</b>	<b>From reliable studies to reliable evidence</b>	<b>6</b>
<b>3</b>	<b>Evidence on the link of outputs with outcomes and impact</b>	<b>8</b>
	3.1 Undernourishment	8
	3.2 Agricultural productivity and income	10
	3.3 Women’s empowerment	13
	3.4 Resilience	16
<b>4</b>	<b>Conclusions and recommendations</b>	<b>18</b>
	4.1 Conclusions	18
	4.2 Recommendations	19
	<b>References</b>	<b>20</b>
	<b>Appendix 1 FNS results and indicator framework</b>	<b>22</b>
	<b>Appendix 2 Matched MFA and FNS outcome indicators and the list of interventions</b>	<b>23</b>

---

---

# 1 Introduction

## 1.1 Towards an improved food & nutrition programme with more effective impact

Since 2015, the aggregated results of the MFA Food & Nutrition programme have been reported annually to parliament and the public. So far, reporting has been successful in terms of broad outputs and reach of programme activities but less so in terms of reporting of outcomes and impacts of interventions in the programme. The step from programme output to outcome and impact level is crucial, not only for accountability but also for learning and the ability to adopt and steer the portfolio. This study aims to identify gaps between outputs and outcomes to contribute to a culture of reflection, learning and adaptive management in order to contribute to improved implementation with more effective impact. Depending on the results, this study will provide input to the staff of the Ministry of Foreign Affairs (MFA), who support the embassies on the food and nutrition security (FNS) result frameworks. Such a reflective culture will enable policy development based on the joint generation of empirical evidence on the one side and, on the other side, adapted insights of different stakeholders' groups involved.

## 1.2 Linking the Food & Nutrition programme to FNS results: five research questions

This study explores how the MFA Food & Nutrition programme and its outputs can be linked to FNS results at the outcomes and impact level. The study aims to answer the following research questions:

1. What are the key output and outcome indicators of the programmes? To what FNS outcomes do the programmes contribute?
2. What is the reliable evidence in the literature that evaluates the effects of those outputs on the outcomes?
3. What evidence is missing?
4. Which (action) research studies can fill in the evidence gap?
5. What are the policy implications of the evidence in the literature? What does the evidence gap imply for policymaking processes?

## 1.3 Reading guide

The study is organised as follows. Section 2 introduces key outputs and outcome indicators of the MFA programme, provides reliable evidence definitions in this study and explains our method to answer the research questions. Section 3 summarises the evidence for reliable evidence in the literature, and Section 4 proposes a decision tree to identify the research studies that can fill in the evidence gaps. Section 5 concludes with a discussion on policy implications.

---

## 2 From reliable studies to reliable evidence

### **The study focusses on the FNS results framework shared by the MFA to answer the research questions.**

The framework includes eight output indicators, defined as the participation of programme beneficiaries in various programme activities that we grouped into five categories (see Appendix 1 for the FNS results framework):

#### *Undernourishment:*

1. Number of people with a more diverse and adequate diet.
2. Number of people whose nutritional situation became more resilient to shocks.

#### *Agricultural productivity and income:*

3. Number of small-scale food producers who progressively realise a living income.
4. Number of small-scale producers who progressively decrease the yield gap.

#### *Women's empowerment*

5. Number of female small-scale food producers who are progressively empowered.

#### *Resilience*

6. Number of small-scale food producers whose livelihood became more resilient to shock.

#### *Agricultural sustainability*

7. Number of hectares of farmland under >2 conservation practices.
8. Number of hectares of farmland that agro-ecologically became more resilient to shocks: soil and biodiversity indicators.

### **This study uses reliable studies in the literature linking outputs to outcomes.**

In this study we map the existing reliable studies in the literature, linking outputs, defined as participation in FNS-related interventions, to these eight FNS outcomes. For this purpose, we define a **reliable study** as a study that uses high-quality experimental or high-quality quasi-experimental methods to measure the effect of outputs on outcome (please see Text Box 1 for the definition of high-quality experimental and high-quality quasi-experimental studies). In our review, we identify the following:

- **Some evidence** linking outputs and outcomes if there is at least one reliable study testing the effect of an intervention on an FNS output and outcome.
- **Much evidence** linking FNS outputs and outcomes if there are at least two studies testing the effect of similar interventions on similar outputs and outcomes, and at the same time providing evidence from at least four countries.

#### **Box 1: High-quality experimental or high-quality quasi-experimental methods**

The golden standard for impact assessment is the randomized controlled trial (RCT). In an RCT, the intervention is assigned to (groups of) beneficiaries who are randomly selected from a pool of eligible people. Post-intervention outcomes of these beneficiaries are compared with outcomes of random eligible non-beneficiaries from the same pool. Due to the random assignment, the only difference between the two groups is the intervention, and all differences in average outcomes can be attributed to the intervention (provided that the groups are large enough).

Quasi-experimental methods aim to mimic RCT without randomisation by eliminating non-intervention-related differences between beneficiaries and non-beneficiaries. Examples include matching to eliminate differences in observed characteristics and comparing trends to eliminate time-invariant differences. A combination of methods is needed to achieve sufficient credibility.



---

**The point of departure for this study is a comprehensive systematic review on food systems and nutrition conducted by 3ie.**

We searched for this reliable evidence using a comprehensive systematic review conducted by 3ie (<https://gapmaps.3ieimpact.org/evidence-maps/food-systems-and-nutrition-evidence-gap-map>), mapping the studies on 58 food and nutrition security interventions and 73 outcomes. For this search, we first matched the MFA outcomes with the outcomes of the 3ie study (see *Appendix 2 for the table linking the two*) and focused on the evidence concerning the 12 intervention types that MFA programme activities cover (see *Appendix 2 for the subset of interventions*).

We analyse the evidence linking those interventions with the outcomes of MFA of the 3ie systematic review using the following method. These include the use of experimental or quasi-experimental methods, the countries involved, outcome indicators used, the direction of the relationship between outputs and outcomes and the presence of quantitative estimates.

The 3ie systematic review includes a considerable number of studies for most intervention-outcome pairs, including reviews of the literature and individual studies. Examining the evidence from all those literature reviews and individual studies for each intervention-outcome pair is not within the scope of this study. Instead, we use the following strategy: If the systematic review includes evidence from a literature review, then evidence from that literature review is used, especially in reviews considered 'high confidence' by 3ie. If there is no review of the literature, then the evidence from all individual studies is analysed.

The full list of all studies that we identified through the 3ie literature review is given in the reading list at the end of this report. To determine whether there are enough reliable studies in the literature using the same indicators and providing evidence from enough countries, we use our expert knowledge as a subjective criterion and explain it in the next section.

---

## 3 Evidence on the link of outputs with outcomes and impact

This section highlights the evidence, as well as the evidence gaps that we identified regarding food systems interventions and their effect on FNS outcomes. The main results of the analysis are summarised in two tables in each section. Table 1 introduces the overall availability for reliable studies by outcome, reporting on the number of reliable studies, use of similar outcome variables and countries covered. Tables 2 to 4 summarise the qualitative and quantitative relationships that reliable studies detected between the FNS output and outcomes indicators. The main findings are twofold:

**There is ample evidence on nutrition, but evidence on agricultural productivity, income and sustainability outcomes is more limited.**

Our review detected reliable evidence for the positive effect of participation in FNS interventions on nutrition outcomes in a large range of countries, indicating high external validity and the possibility to draw general conclusions, including questions that need further research. However, for the effect of FNS interventions' outputs on agricultural productivity and income, there are either few reliable studies or a moderate number of reliable studies that provide evidence from only a few countries. For agricultural sustainability, we have not found any reliable studies in the 3ie evidence map (see Tables 1a, 2a, 3a and 4a).

**Most of the reliable existing studies show that participation in FNS interventions improves FNS in food FNS or intermediate outcomes.**

Reliable studies only did not detect a positive effect of participation in agricultural training given in a non-FFS context (Farmers' Field Schools) and microfinance with group liability on agricultural productivity and income (see Tables 1b, 2b, 3b and 4b).

**The remainder of this section summarises evidence on undernourishment and agricultural productivity and income, as well as empowerment and resilience.**

The rest of the section is organised as follows. Section 3.1 summarises the findings concerning two outcome variables on undernourishment: the number of people with improved iron intake through fortification and the number of people with exclusive breastfeeding. Section 3.2 introduces our results on agricultural productivity and income. Section 3.3 summarises the findings on outcomes related to women's empowerment. We do not have a detailed section on agricultural sustainability, as the 3ie evidence map did not cover reliable studies on this topic (Section 3.4).

### 3.1 Undernourishment

**A wide range of intervention types aim to improve nutrition outcomes.**

This section highlights some of the evidence (gap) that 3ie identified regarding undernourishment and food systems interventions. Studies of primary concern for this section include systematic reviews on interventions that seek improvement in nutrition (outcomes), including the quality, adequacy, affordability and availability of diets and their use, both direct and indirect. Interventions considered in the reviews include innovations in agricultural inputs such as orange-fleshed sweet potatoes, agriculture training programmes, contract agriculture, food fortification, biofortification, dietary advice during pregnancy, energy and protein supplementation, breastfeeding promotion interventions, nutrition education, behaviour change, complementary food provision with or without education and health information delivery using ICT.

**Table 1a** Overall availability of reliable evidence for undernourishment.

Outcome	Output	Number of reliable studies	Use of similar outcome variables by reliable studies	Countries that the reliable studies cover
Number people with improved iron intake via fortification	Provision or use of supplements and fortification	1 systematic review based on 60 experiments	Haemoglobin (54), anaemia and serum ferritin, (33), iron deficiency (21)	Asia (41), Africa (13), South America (14), Europe (9), Australia (1), North America (7)
Number of people with exclusive breastfeeding (EBF)	Peer support/counsellors	1 systematic review based on 11 experiments	6 (EBF duration past the neonatal period)	Philippines (1), Bangladesh (1), Brazil (3), Burkina Faso, South Africa, Uganda (1)

**Nine systematic 'high confidence reviews' were considered, two studies of which provide the most reliable evidence.**

The nine reviews used mainly experimental and quasi-experimental studies, but a few of them also included mixed-method studies.<sup>1</sup> Due to quality issues in the underlying studies, reliability of findings is not the same in the reviews mentioned above. Several issues cast doubt on the reliability of the evidence: the number of studies included in the review being small; the quality of trials being low, or of poor methodological quality; the risk of bias in the review being high or unknown; or the original studies were heterogeneous and hence could not help to draw generalisations. Among the nine systematic reviews described above, the risk of bias for two reviews was low to moderate. These two reviews were based on experimental and quasi-experimental studies from multiple countries (Table 1b below). Hence, the evidence from these two studies could be reliable.

**Table 1b** Results from reliable studies on undernourishment.

Outcome	Theory of change	Qualitative summary of results	Range of quantitative effect size (if available)	Reference studies (see the reading list numbers)
Number of people with improved iron intake via fortification	Consuming iron-fortified foods leads to improvement in iron deficiency, anaemia and biological outcomes including infections, physical growth and mental and motor development, but it also causes zinc depletion as iron and zinc compete for absorptive pathways at the enterocyte level	Iron fortification of foods resulted in a significant increase in haemoglobin and serum ferritin, a reduced risk of anaemia and iron deficiency and improvement in other indicators of iron nutriture, but there was no evidence of an effect on zinc concentrations, infections, anthropometric measures or mental and motor development	Significant increase in haemoglobin (0.42 g/dL; 95% CI: 0.28, 0.56; P < 0.001), and serum ferritin (1.36 µg/L; 95% CI: 1.23, 1.52; P < 0.001), a reduced risk of anaemia (RR: 0.59; 95% CI: 0.48, 0.71; P < 0.001), and iron deficiency (RR: 0.48; 95% CI: 0.38, 0.62; P < 0.001)	Gera et al. (2012)
Number of people with exclusive breastfeeding (EBF)	Provision of emotional, appraisal and informational assistance by peers leads to improved duration of EBF especially in resource limited settings where capacity of breastfeeding support in primary healthcare clinics is limited	Peer support significantly decreased the risk of discontinuing EBF as compared to control, but the effect appears to be reduced in the formula feeding cultures. No evidence of effect modification was observed due to inclusion of low birth weight infants or timing of peer support at four versus six months postpartum	Peer support significantly decreased the risk of discontinuing EBF compared to control (RR: 0.71; 95% CI: 0.61–0.82; I <sup>2</sup> = 92%). The effect of peer support was significantly reduced in settings with >10% community prevalence of formula feeding compared to settings with <10% prevalence (p = 0.048)	Sudfeld et al. (2012)

<sup>1</sup> To be specific: three of the reviews were based only on experimental (RCT) studies; four reviews used a mix of RCT and quasi-experimental studies; and two reviews included mixed methods studies, including experimental, quasi-experimental and econometric analysis.

**Both reviews show that evidence on nutrition-related output-outcome linkages is in place and externally valid at the global level, but further research is needed.**

One of these two reviews was based on 60 trials across all inhabited continents (Asia (41), Africa (13), South America (14), Europe (9), Australia (1) and North America (7)) on the effect of iron-fortified foods on haematologic and biological outcomes. Subjects in the intervention and control groups received foods fortified with iron and similar foods without iron fortification, respectively. The meta-analysis showed a significant increase in haemoglobin and serum ferritin, a reduced risk of anaemia and iron deficiency and improvement in other indicators of iron nutriture, but there was no effect on serum zinc concentrations, infections, physical growth, mental health or motor development. Dose effect and data limitation are the hypothesised reasons for the absence of the effect of fortification on mental development in older children and call for further research/ high-quality data. However, since coverage of the underlying studies spans across continents, albeit with differences in the number of studies from each continent, the findings can be considered generalisable.

The second review was based on thirteen trials from ten low- and middle-income countries (LMICs). The subjects in the intervention group were home visited by peer counsellors. Peer counsellor training methods and peer visit schedule differ across studies. The results suggest that peer support interventions significantly decreased the risk of discontinuing exclusive breastfeeding compared to the control group. However, the effect appears to be reduced in formula feeding cultures (i.e. in settings with >10% community prevalence of formula feeding compared to settings with <10% prevalence). Optimal timing of peer visits, how best to integrate peer support into packaged intervention strategies, and the effectiveness of supplemental interventions to peer support in formula feeding cultures are some of the questions implied in this review and need further investigation. However, the results found can be generalisable for poor resource settings where the capacity of the primary health care system is limited and the commercial marketing of infant formula and cultural preferences for formula feeding are minimal.

**In summary: Results of reliable studies on agricultural productivity and income.**

Nb	Outputs	Description of positive effect	Description of no or mixed effect	Score
1	Provision or use of supplements and fortification	Iron fortification of foods resulted in a significant increase in haemoglobin and serum ferritin, a reduced risk of anaemia and iron deficiency, improvement in other indicators of iron nutriture	The studies did not detect an effect on zinc concentrations, infections, anthropometric measures, or mental and motor development	
2	Peer support/counsellors	Peers support significantly decreased the risk of discontinuing EBF as compared to control, but the effect appears to be reduced in formula feeding cultures	Studies did not detect an effect was observed due to the inclusion of low birth weight infants or the timing of peer support at four versus six months postpartum	

Legend: **Red** – no evidence in literature; **Orange** – some evidence; **Green** – much evidence

### 3.2 Agricultural productivity and income

**We found four systematic reviews, of which three include reliable evidence on the effect of FNS interventions on agricultural productivity and income.**

These interventions are improved crop varieties, fertiliser and seed subsidies and agricultural training. Agricultural training can be divided into Farmer Field Schools (FFS) and other forms of training. All reviews covered experimental and quasi-experimental studies, but only a few of the studies covered had low risk of bias. One systematic review focuses on FFS and finds 92 impact evaluations, but none with low risk of bias. A slightly more recent review on the effects of training, innovation and new technology on smallholder farmers found nineteen relevant studies, but only part of these had low risk of bias. A review targeting CGIAR seeds found twenty-one studies, of which four had low risk of bias. The fourth systematic review focusses on agricultural input subsidies. They found fifteen experimental and quasi-experimental studies, three of which

had a low risk of bias. Finally, we found a review study on the influence of market support interventions, but this study did not cover any reliable studies. The systematic reviews did not provide evidence on the effects of microfinance, but we found three reliable studies on this topic.

Taken together, most (but not all) reliable studies seem to find a positive effect of improved varieties on farmer production, income or expenditures. However, all evidence was from Eastern Africa.

**Table 2a** Overall availability of reliable evidence for agricultural productivity and income.

Outcome	Output	Number of reliable studies	Use of similar outcome variables by reliable studies	Countries that the reliable studies cover
<i>Ag productivity and income</i>				
The number of small-scale food producers who progressively realise a living income/decrease the yield gap	Improved varieties	2 systematic reviews based on a total of 24 (quasi-) experimental studies, only 10 with low risk of bias	Poverty (4), income (6), expenditures (2), production (1)	Kenya (2), Ethiopia (2), Uganda (2), Tanzania (1), Mexico (1), South Africa (1)
	Fertiliser & seed subsidies	1 systematic review based on 15 (quasi) experimental studies, only 3 with low risk of bias	Production value/ha (1), Yields (kg/ha) (2), fertiliser/seed use (kg/ha) (1)	India (1), Mozambique (1), Malawi (1)
	Pesticides/herbicides	No studies found		
	Training (non-FFS)	1 systematic review found, 1 low risk of bias study	Income (1)	Uganda (1)
	Farmer Field Schools (FFS)	2 systematic reviews found 1 low risk of bias study	Income (1)	Ethiopia (1)
	Market support	1 review finding no reliable studies		
	Agricultural credit/savings	3 studies	Technology adoption (1), productivity (1), production (1), farm income (1), input use (1), output (1), expenditures (1)	Tanzania (1), India (1), Malawi (1)

**Existing evidence on the impact of FFS is predominantly positive, but we found only one study with low risk of bias.**

The only low-bias study on FFS found a substantial positive effect on income for farmers in Ethiopia. The study also observed direct effects on technology adoption: FFSs increased the adoption of modern seeds and the use of an improved seeding method, but surprisingly decreased the likelihood of using manure / compost, using fertilisers properly and applying weeding. These puzzling results could be the consequence of lack of reliable data. Reliable evidence for other training modalities is equally scarce: we found one study for Uganda where the effects on income were not significant, although the trainings did increase farmers' knowledge.



**In summary: Results of reliable studies on agricultural productivity and income.**

Nb	Outputs	Description of effect	Description of no or mixed effect	Score
1	Improved varieties	Adoption of improved varieties have positive effect on production/income	Studies did not find a significant effect on poverty	Green
2	Fertiliser and seed subsidies	Fertiliser and seed subsidies lead to increased adoption and thus higher yields and revenue		Orange
3	Pesticides / herbicides	X		Red
4	Training Non-FFS	Agricultural training increased knowledge	Agricultural training did not increase adoption, yields and income	Orange
5	Farmer Field Schools (FFS)	FFS increased income	FFS effects on technology adoption were mixed (positive and negative), possibly due to data limitations	Orange
6	Market support	X		Red
7	Agricultural credit/savings	Access to individual-liability credit and savings increased production and income	Access to joint liability credit did not increase production and income	Orange

Legend: **Red** – no evidence in literature; **Orange** – some evidence; **Green** – much evidence.

**We found only little evidence for outcomes of microfinance interventions.**

The small evidence base for microfinance interventions suggests that credit with individual liability (India) and savings opportunities (Malawi) are effective in increasing production and income, but credit with joint liability is not (India, Tanzania). However, this conclusion is based only on three studies in total, one or two per intervention, so generalisation is not warranted.

### 3.3 Women’s empowerment

**We detected fourteen studies, of which only four provide reliable evidence of the empowerment of women farmers.**

We have detected fourteen studies investigating the effect of FNS interventions on women’s empowerment. These interventions concern various activities: improved seeds, education/information dissemination through Farmer Field Schools, agricultural extension programmes, provision or use of supplements, assets (e.g., livestock distribution to women) and peer support/counsellors, finding a positive relationship between participation in FNS interventions and women’s empowerment.

Among these fourteen studies, only four use high-quality experimental and quasi-experimental studies that investigate the effect of the intervention on women’s empowerment. Most other studies use other experimental methods (i.e. ex-pot matching or difference-in-differences not well implemented) that are not robust. This indicates that reliable evidence in the literature linking FNS interventions with women’s empowerment is limited for many output-outcome linkages.

**Table 3a** Overall assessment for availability of reliable evidence for women’s empowerment.

Outcome	Output	Number of reliable studies	Use of similar outcome variables by reliable studies	Countries that the reliable studies cover
Number of female small-scale food producers that are progressively empowered	Seed distribution	2 reliable study	Women’s asset ownership Opinions on women’s land ownership, ability to use land and control over production	Burkina Faso (1)
	Asset distribution and training (other than Farmers’ Field Schools)	2 reliable studies, (1 is large scale in multiple countries)	Women’s control over or ownership of resources, production Decision-making power in food, education, home expenditures Decision-making power in business management	Bangladesh (1), Ethiopia (1), Ghana (1), Honduras (1), India (1), Pakistan (1), and Peru (1)
	Information guidance	1 reliable study	Number of crops grown by women	Niger (1)

**There is reliable evidence on the asset distribution and female farmers’ empowerment with mixed results on output-outcome linkage.**

We detected one large-scale experimental study and another country-specific study that investigate the effect of asset distribution on women’s empowerment. Studies using similar outcome variables found a mixed effect on the effect of participation in asset distribution programmes (output) on women’s empowerment (outcome). Only one study focused on Burkina Faso and a significant effect of asset distribution on women’s empowerment. The other study providing evidence from six other countries did not detect such an output-outcome linkage.

**Table 3b** Results from the reliable studies on women’s empowerment.

Outcome	Theory of change	Qualitative summary of the results	Range of quantitative effect size (if available)	Reference studies (see the reading list numbers)
Number of female small-scale food producers that are progressively empowered	Agricultural extension Home garden intervention targeting women with three components, including nutrition gardening and distribution of quality seeds, equipment and chickens	The distribution of seeds, equipment, and chickens increased the number of assets controlled by women	16-point increase in the fraction of high adopters; 70% increase in the livestock percentage points increase in the livestock income; 10% increase in the number of agricultural assets owned by women; 50% increase in the number of small livestock owned by women	Van den Bold et al. (2013)
	Agricultural extension: Home garden intervention, including nutrition training, gardening training, and seed distribution, will have an indirect effect on female empowerment through increased skills and abilities of women	Women are able to control their gardens and use of the products and be able to manage the income generated from their gardens. Furthermore, women living in intervention villages also experienced a notable increase in their decision-making power over goats, although men remained largely in charge of these animals of higher value	30% increase in self-perceived empowerment score 28% increasing self-reported decision-making power over the home garden	Baliki et al. (2019)



Outcome	Theory of change	Qualitative summary of the results	Range of quantitative effect size (if available)	Reference studies (see the reading list numbers)
	A big push involving aquaculture or animal of choice are provided to the women, together with training support related to the given animal, as well as general life skills coaching, weekly consumption support for some fixed period, and typically access to savings accounts and health information or services will empower women	No statistically significant effect was found, except in Bangladesh, where the intervention had negative effects on women's empowerment	No significant or negative effect	Banerjee et al. (2015) (covering Ethiopia, Ghana, Honduras, India, Pakistan, and Peru), Roy et al. (2015) (covering Bangladesh)
	Information guidance through free mobile phone distribution and how to use mobile phone increase the number, amount of crops grown, total agricultural sales and income	The study found that the mobile phone intervention increased the number of crops grown by women but this did not translate into increased agricultural sales and income	4% increase in the average number of crops grown	Aker and Ksoll (2016)

**The external validity of the linkages on female farmer empowerment is limited, as studies are country-specific and focus on different measures.**

The external validity of the studies is limited, as the studies in the literature provide evidence from case studies from different studies. There is no detailed literature review or meta-analysis on the subject. The evidence from these studies to conclude that the same FNS interventions will empower women in a different country context. Furthermore, studies use different measures of empowerment of women. The effect of the number of small-scale food producers cannot be aggregated using those different indicators.

**In summary: availability of reliable evidence for women's empowerment.**

Nb	Outputs	Description of positive effects	Description of no effect or mixed effect	Score
1	Seed distribution	The distribution of seeds, equipment, and chickens increased the number of assets controlled by women		Orange
2	Asset distribution and training (other than Farmers' Field Schools)		Asset distribution and training did not improve women's empowerment except in Bangladesh where there were negative effects of the intervention on women's empowerment	Green
3	Information guidance	The mobile phone intervention increased the number of crops grown by women	Mobile phone intervention did not increase agricultural sales and income	Orange

Legend: **Red** – no evidence in literature; **Orange** – some evidence; **Green** – much evidence.

## 3.4 Resilience

### There is no consensus on indicators to be used to measure resilience.

The literature does not provide consensus on resilience indicators, and there are no systematic reviews on the subject. Therefore, our research in the literature on resilience therefore relies on individual studies that are in the 3ie review and use ownership of household or agricultural assets, the likelihood of experiencing shocks, the amount of savings, social capital and access to help from others in the social network as proxies for resilience indicators.

**Table 4a** Overall assessment for availability of reliable evidence by outcomes.

Outcome	Output	Number of reliable studies	Use of similar outcome variables by reliable studies	Countries that the reliable studies cover
Number of small-scale food producers whose livelihood became more resilient to shock	Asset distribution	1 study	Asset (livestock ownership)	Guatemala (1)
	Access to insurance	2 studies	Insurance take-up	India (1)
	Agricultural extension programmes	1 study	Asset ownership, better coping with shocks	Uganda (1)
	Agricultural credit/savings	1 study	Savings amount	Uganda (1)
Number of hectares of farmland under >2 conservation practices		0	N/A	N/A
Number of hectares of farmland that agro-ecologically became more resilient to shocks: soil and biodiversity indicators		0	N/A	N/A

**Table 4b** Results from reliable studies on resilience.

Outcome	Theory of change	Qualitative summary of the results	Range of quantitative effect size (if available)	Reference studies (see the reading list numbers)
Number of small-scale food producers whose livelihood became more resilient to shock	Asset distribution (chickens) and poultry training increase available livestock assets (chicken ownership), providing alternative food source (consumption of eggs) in case of drought or high temperature shock	Households that were exposed high temperature were likely to offset the effects of the temperature consuming more eggs	For every ten additional days with maximum temperatures above 30°C, there is a 3% increase in calories per day and a 19% increase in protein calories per day	Mullaly (2018)
	Price discounts for the insurance offered and training provision (through Farmer Field Schools) to all farmers being offered the insurance product increases the insurance uptake	Training by Farmer Field Schools increased the insurance take-up rate; there was no evidence on the effect insurance when farmers are exposed to shocks	Take-up is 5 percentage points higher among those who participated in Farmer Field Schools training in India and 15 points higher in China	Robles and Butler (2016) Cai et al. (2014)

Outcome	Theory of change	Qualitative summary of the results	Range of quantitative effect size (if available)	Reference studies (see the reading list numbers)
	Agricultural extension programme involving promotion of improved basic cultivation methods and the usage of HYV seeds, primarily maize and other inputs. The adoption of technologies is expected to improve the productivity of smallholder women farmers, leading to resilience to shocks	Agricultural extension increased the adoption rate of better agricultural practices (manure, intercropping, crop rotation and irrigation). This decreased the likelihood of reducing consumption and selling assets in the case of shock covariate shocks, for the households experienced at least one shock covariant shock (drought, flood, pest attack, livestock epidemic, fire or poor quality seeds)	9, 6, 8 and 3 percentage points more likely to adapt manure, intercropping, crop rotation and irrigation, respectively. 8.3 percentage points more likely to reduce consumption, but 4.9 percentage points less likely to sell assets in the face of covariate shocks compared to ineligible households. (No information on productivity changes)	Pan et al. (2018)
	The programme on assistance in setting up direct deposit in savings accounts increases the take-up rate of the deposit account in banks and the savings rate	Participation in the agricultural savings (instrument) programme increased the use of a deposit account and the savings rate in that account	19% increase in deposit account take-up and 12.8% increase in three monthly savings	Brune et al. (2016)

**Only a few studies exist that provide reliable evidence on the relationship between resilience indicators and FNS interventions, with no external validity.**

We have detected only four reliable studies investigating the effect of FNS interventions on these proxy indicators, including improved seed distribution, education/information dissemination through Farmer Field Schools, agricultural extension programmes and agriculture credits/savings projects. They find a positive relationship between FNS interventions and resilience indicators. Three of those studies use robust randomised controlled studies. The fourth uses a quasi-experimental technique (i.e. difference-in-differences techniques).

**In summary: Results from the reliable studies on resilience.**

Nb	Outputs	Description of effect	Description of no effect or mixed effect	Score
1	Asset distribution	Households that were exposed high temperature were likely to offset the effects of the temperature by consuming more eggs		
2	Access to insurance	Training by Farmer Field Schools increased the insurance take-up rate; there was no evidence on the effect on insurance when farmers are exposed to shocks		
3	Agricultural extension programmes	Agricultural extension increased the adoption rate of better agricultural practices (manure, intercropping, crop rotation, and irrigation). This decreased the likelihood of reducing consumption and selling assets in the case of shock covariate shocks, for the households experienced at least one covariant shock (drought, flood, pest attack, livestock epidemic, fire or poor quality seeds)		
4	Agricultural credit/savings	Participation in the agricultural savings (instrument) programme increased the use of a deposit account and the savings rate in that account		

Legend: **Red** – no evidence in literature; **Orange** – some evidence; **Green** – much evidence.

---

## 4 Conclusions and recommendations

### 4.1 Conclusions

**There is reliable evidence of the effect of FNS interventions on preventing undernutrition, but there is less evidence for other related output-outcome linkages.**

There are reliable studies on the output and agricultural productivity and income linkages; however, the number of those is limited for many output-outcome linkages. These include the outcomes of FNS interventions, in relationship to outcomes related to agricultural productivity and income, women's empowerment, resilience and sustainability. However, please note that most existing reliable studies on agricultural productivity and income show a positive link between the outputs of FNS interventions and the agricultural productivity and income outcomes of the same interventions, which is promising for the investments of the Ministry on this linkage.

Regarding women's empowerment, there is only reliable evidence on its connection with asset distribution. However, these studies provide mixed findings, while evidence is lacking for the linkages between other FNS outcomes and women's empowerment outcomes. The evidence on the link between FNS interventions' outputs and the resilience outcomes is not satisfactory either, although existing reliable studies indicate a positive relationship between the output-outcome linkage.

Finally, we note that we have not detected reliable studies for output-outcome linkages in terms of agricultural sustainability. This indicates that much more research should be conducted on that topic.

**Reliable evidence gaps grow larger as the output-outcome linkages for FNS interventions become less obvious and harder to detect, which should be taken into account when formulating new research questions.**

The relatively large evidence gaps on agricultural productivity and income, women's empowerment and resilience, and agricultural sustainability, as opposed to undernourishment, might not come as a surprise. Participation in FNS interventions might have an obvious (or more measurable) effect on nutrition, while these interventions might have a more indirect (or more difficult to measure) effect on other outcomes. In a similar vein, we find more evidence (although not reliable) for agricultural productivity and income than for women's empowerment, resilience and sustainability outcomes, which might be more indirect and difficult to measure. One may also argue that this is because the impact pathways towards agricultural productivity and income outcomes are shorter than the pathways toward women's empowerment, resilience and sustainability outcomes.

The above indicates that there might be a bias on the selection of research questions toward more measurable and direct outcomes, at the cost of those outcomes that are harder to measure and with a longer result chain. Although it might be attractive to choose the more obvious output-outcome linkages for impact evaluation studies, we believe that these should change in favour of less measurable and more indirect effects.

---

## 4.2 Recommendations

What are the policy implications of the evidence in the literature? What does the evidence gap imply for policymaking processes?

### **Methodology and approaches of studies:**

- It is recommended to focus on impact monitoring and research on areas where evidence gaps are identified or where evidence points to mixed results.
- Align with approaches and methods that are seen as reliable and combine with participatory food system approaches.
- Look into more longitudinal studies and take time to really understand the changes and the contribution link with interventions.
- Use the systems lens.

### **Undernourishment:**

- Food fortification/biofortification with iron increases haematologic outcomes including haemoglobin and serum ferritin, as well as a reduced risk of anaemia and iron deficiency and improvement in other indicators of iron nutriture. Given the importance of mental development in children, further research is needed on the effect of fortification.
- Peer support increases the duration of exclusive breastfeeding in LMICs; however, the effect appears to be reduced in formula feeding cultures. Therefore, more research is needed to determine the optimal timing of peer visits, how best to integrate peer support into packaged intervention strategies and the effectiveness of supplemental interventions to peer support in formula feeding cultures.

### **Agricultural productivity and income:**

- Improved seeds increase production and income in East Africa, but reliable evidence on their impact in other parts of the world is lacking. Research in other parts of the world is needed to see whether these results can be extrapolated.
- There is a need for reliable evidence on farmer training. Although existing evidence seems to indicate that FFS interventions are effective and other training forms are not, reliable evidence is surprisingly scarce.
- Although microfinance remains a popular method to improve production and income, there is a lack of evidence displaying success or lack thereof. Individual-liability loans and savings seem the most promising, but policy would benefit from new pilot studies that test such interventions in different contexts.

### **Women empowerment:**

- For a new FNS project that claims to empower women small-scale farmers, it is essential to collect reliable data on empowerment outcomes, as there is limited robust evidence and the validity of existing evidence in different contexts is limited. In addition, robust studies, preferably using RCTs, should investigate the effect of participation in FNS interventions and women's empowerment interventions.

### **Resilience:**

- For a new FNS project that claims to improve resilience, it is essential to request evaluation studies, as there is minimal evidence on FNS and resilience. Furthermore, robust studies, preferably using RCTs, should investigate the effect of participation in interventions and the resilience of farmers.

### **Agricultural sustainability:**

- We need high-quality experimental and quasi-experimental studies in a wide range of countries examining the linkage between participation in FNS programmes and agricultural sustainability measured by adopting conservation practices and soil and biodiversity indicators.

---

# References

- Aker and Ksoll (2016): Aker, J. C., & Ksoll, C. (2016). Can mobile phones improve agricultural outcomes? Evidence from a randomized experiment in Niger. *Food Policy*, 60, 44-51.  
<https://www.sciencedirect.com/science/article/pii/S0306919215000330?via%3Dihub>.
- Banerjee et al. (2015): Banerjee, A., E. Duflo, N. Goldberg, D. Karlan, R. Osei, W. Pariente, J. Shapiro, B. Thuysbaert, and C. Udry. 2015. "A Multifaceted Program Causes Lasting Progress for the Very Poor: Evidence from Six Countries." *Science* 348 (6236):1260799. doi:10.1126/science.1260799  
<https://www.science.org/doi/abs/10.1126/science.1260799>.
- Brune et al. (2016): Brune, L., Giné, X., Goldberg, J., & Yang, D. (2016). Facilitating savings for agriculture: Field experimental evidence from Malawi. *Economic Development and Cultural Change*, 64(2), 187-220: <https://www.journals.uchicago.edu/doi/abs/10.1086/684014?journalCode=edcc>.
- Cai, J, de Janvry, A and Sadoulet, E, 2014. A randomised evaluation of the effects of an agricultural insurance programme on rural households' behaviour: evidence from China, *3ie Impact Evaluation Report 19*. New Delhi: International Initiative for Impact Evaluation (3ie).
- Garbero, A., Marion, P., & Brailovskaya, V. (2018). IFAD Research Series No. 33-The Impact of the Adoption of CGIAR's Improved Varieties on Poverty and Welfare Outcomes: A Systematic Review. *IFAD Research Series*, 33.
- Gera, T., Sachdev, H. S, & Boy, E. (2012). Effect of iron-fortified foods on hematologic and biological outcomes: systematic review of randomized controlled trials. *Am J Clin Nutr*. Volume 96, Issue 2, August 2012, Pages 309–324, <https://doi.org/10.3945/ajcn.111.031500>.
- Hemming, D. J., Chirwa, E. W., Dorward, A., Ruffhead, H. J., Hill, R., Osborn, J., ... & Phillips, D. (2018). Agricultural input subsidies for improving productivity, farm income, consumer welfare and wider growth in low-and lower-middle-income countries: a systematic review. *Campbell Systematic Reviews*, 14(1), 1-153.
- Mullaly, C. (2018). The Impact of Climate-Resilient Livestock Transfers: Evidence from a Randomized Evaluation  
[http://ageconsearch.umn.edu/record/274252/files/Abstracts\\_18\\_06\\_05\\_10\\_47\\_12\\_51\\_128\\_227\\_144\\_17\\_0.pdf](http://ageconsearch.umn.edu/record/274252/files/Abstracts_18_06_05_10_47_12_51_128_227_144_17_0.pdf).
- Nakano et al. (2018): Nakano, Y., Tsusaka, T. W., Aida, T., & Pedde, V. O. (2018). Is farmer-to-farmer extension effective? The impact of training on technology adoption and rice farming productivity in Tanzania. *World Development*, 105, 336-351.  
[https://www.sciencedirect.com/science/article/pii/S0305750X17304060?casa\\_token=Q22\\_avasZAAAAAAAs9OztU\\_tqNCNeHbbGEwL5vN4lg26oLFokxcGuTIA7gB3VEdHvAkVFpj8huk30x5TtZVF4Yq\\_bvLI](https://www.sciencedirect.com/science/article/pii/S0305750X17304060?casa_token=Q22_avasZAAAAAAAs9OztU_tqNCNeHbbGEwL5vN4lg26oLFokxcGuTIA7gB3VEdHvAkVFpj8huk30x5TtZVF4Yq_bvLI).
- Pan, Y., Smith, S. C., & Sulaiman, M. (2018). Agricultural extension and technology adoption for food security: Evidence from Uganda. *American Journal of Agricultural Economics*, 100(4), 1012-1031.  
[https://onlinelibrary.wiley.com/doi/full/10.1093/ajae/aay012?casa\\_token=QVzjNoQYem4AAAAA%3AgUmEP-jLXcKOaM6I7iWtDGhPI4nF3TgttaBbtRUvVknq6MAMLg8DA9G9uXtoCuYYLeQe0S57IIEVI4ZNGg](https://onlinelibrary.wiley.com/doi/full/10.1093/ajae/aay012?casa_token=QVzjNoQYem4AAAAA%3AgUmEP-jLXcKOaM6I7iWtDGhPI4nF3TgttaBbtRUvVknq6MAMLg8DA9G9uXtoCuYYLeQe0S57IIEVI4ZNGg).
- Robles, M., & Butler, A. (2015). Smallholder access to weather securities in India.  
[https://www.3ieimpact.org/sites/default/files/2019-01/ie28-smallholder\\_access\\_to\\_weather\\_securities\\_in\\_india\\_2.pdf](https://www.3ieimpact.org/sites/default/files/2019-01/ie28-smallholder_access_to_weather_securities_in_india_2.pdf).
- Roy, S., Ara, J., Das, N., & Quisumbing, A. R. (2015). "Flypaper effects" in transfers targeted to women: Evidence from BRAC's "Targeting the Ultra Poor" program in Bangladesh. *Journal of Development Economics*, 117, 1-19:  
<https://www.sciencedirect.com/science/article/pii/S0304387815000656?via%3Dihub>.
- Stewart, R., Langer, L., Da Silva, N. R., Muchiri, E., Zaranyika, H., Erasmus, Y., ... & de Wet, T. (2015). The Effects of training, innovation and new technology on African smallholder farmers' economic outcomes and food security: a systematic review. *Campbell Systematic Reviews*, 11(1), 1-224.
- Sudfeld, C. R., Fawzi, W. W., & Lahariya, C. (2012). Peer Support and Exclusive Breastfeeding Duration in Low and Middle-Income Countries: A Systematic Review and Meta-Analysis. *Plos One*.  
<https://doi.org/10.1371/journal.pone.0045143>.

---

van den Bold, Mara; Pedehombga, Abdoulaye; Ouédraogo, Marcellin; Quisumbing, Agnes R. and Olney, Deanna K. 2013. Can integrated agriculture-nutrition programmes change gender norms on land and asset ownership? Evidence from Burkina Faso. IFPRI Discussion Paper, <https://www.sciencedirect.com/science/article/pii/S0304387815000656?via%3Dihub>.

Waddington, H., Snilstveit, B., Hombrados, J., Vojtkova, M., Phillips, D., Davies, P., & White, H. (2014). Farmer field schools for improving farming practices and farmer outcomes.

# Appendix 1 FNS results and indicator framework

FNS RESULTS AND INDICATOR FRAMEWORK 2021		
<b>Outcomes</b> (= NL reasonable share in SDG-2 targets 2030)		
<b>32 million people<sup>1</sup> lifted out of undernourishment</b>	<b>8 million small scale food producers<sup>2</sup> doubled productivity and income</b>	<b>8 million hectares of farmland<sup>3</sup> converted to sustainable use</b>
<b>outcome indicators</b> (cumulative, proxies for contribution to target)		
A.1. Number of people with a more diverse adequate diet: <i>MAD<sup>4</sup>, MDD-W<sup>5</sup>, other</i>	B.1.a. Number of small scale food producers that progressively realize a living income. <sup>9</sup> B.1.b. Number of small scale producers that progressively decrease the yield gap. <sup>10</sup> B.1.c. Number of female small scale food producers that progressively empower: <i>WEAI<sup>11</sup></i>	C.1. Number of hectares of farmland under >2 conservation practices: <i>CRA, other</i>
A.2. Number of people whose nutritional situation became more resilient to shocks: <i>HFIAS<sup>6</sup>, MHAFP<sup>7</sup>, FIES<sup>8</sup>, other</i>	B.2. Number of small scale food producers whose livelihood became more resilient to shocks: <i>PPI<sup>12</sup>, RHoMIS<sup>13</sup>, CRA<sup>14</sup>, other (see overview by ODI<sup>15</sup>)</i>	C.2. Number of hectares of farmland that agro-ecologically became more resilient to shocks: <i>Soil and Biodiversity indicators<sup>16</sup></i>
<b>Outputs</b>		
<b>Undernourished people benefitting from activities to improve nutrition</b>	<b>Small scale food producers benefitting from activities to improve performance</b>	<b>Farmland<sup>3</sup> benefitting from activities to strengthen ecological sustainability</b>
<b>Output indicators</b> (non-cumulative)		
A.x.1.1. Number of people directly reached with activities to improve nutrition ( <i>MVT BHOS indicator<sup>17</sup></i> ) A.x.1.2. Number of people indirectly reached A.x.1.3. Number of people for whom adequately fortified food became available	B.x.1.1. Number of small scale food producers directly reached with activities to increase productivity/income ( <i>MVT BHOS indicator<sup>18</sup></i> ) B.x.1.2. Number of small scale food producers indirectly reached	C.x.1.1. Number of hectares of farmland directly reached with activities to improve eco-efficiency ( <i>MVT BHOS indicator<sup>19</sup></i> ) C.x.1.2. Number of hectares of farmland indirectly reached

**Figure A.1** FNS results and indicator framework 2021.



## Appendix 2 Matched MFA and FNS outcome indicators and the list of interventions

**Table A2.1** Matched MFA outcomes and 3ie outcomes.

MFA outcomes	3ie outcomes
<u>Undernourishment</u>	
Number of people with more diverse adequate diet (improved nutrient intake)	Diet quality and adequacy group
Number of people whose nutritional situation became more resilient to shocks (exclusive breastfeeding (EBF))	Affordability and availability group
<u>Ag productivity and income</u>	
Number of small-scale food producers who progressively realise a living income	Economic and SES indicators group: income received, profit
Number of small-scale producers who progressively decrease the yield gap	Agricultural: plant/crop production
Number of female small-scale food producers who progressively empower	Women's empowerment group
Number of small-scale food producers whose livelihood became more resilient to shock	Women's empowerment group
<u>Agro-sustainability</u>	
Number of hectares of farmland under >2 conservation practices	Economic and SES indicators group: other
Number of hectares of farmland that agro-ecologically became more resilient to shocks: soil and biodiversity indicators	Agricultural: plant/crop production, land-related
	Agricultural: land-related

### List of interventions in the 3ie systemic review that this study focusses on:

1. Improved seeds
2. Fertiliser access
3. Pesticide/herbicide access
4. Education/information Farmer Field Schools
5. Education/information: Agricultural extension programmes
6. Education/information-information guidance
7. Market support
8. Agriculture credit/savings
9. Fortification
10. Provision or use of supplements
11. Women's empowerment efforts
12. Peer support/counsellors

---

Wageningen Centre for Development  
Innovation  
Wageningen University & Research  
P.O. Box 88  
6700 AB Wageningen  
The Netherlands  
T +31 (0)317 48 68 00  
[wur.eu/cdi](http://wur.eu/cdi)

---

Wageningen Centre for Development Innovation supports value creation by strengthening capacities for sustainable development. As the international expertise and capacity building institute of Wageningen University & Research we bring knowledge into action, with the aim to explore the potential of nature to improve the quality of life. With approximately 30 locations, 7,200 members (6,400 fte) of staff and 13,200 students, Wageningen University & Research is a world leader in its domain. An integral way of working, and cooperation between the exact sciences and the technological and social disciplines are key to its approach.

Report WCDI-23-233





To explore  
the potential  
of nature to  
improve the  
quality of life



---

Wageningen Centre for Development Innovation  
Wageningen University & Research  
P.O. Box 88  
6700 AB Wageningen  
The Netherlands  
T +31 (0) 317 48 68 00  
[wur.eu/wdci](http://wur.eu/wdci)

Report WCDI-23-233

The mission of Wageningen University & Research is "To explore the potential of nature to improve the quality of life". Under the banner Wageningen University & Research, Wageningen University and the specialised research institutes of the Wageningen Research Foundation have joined forces in contributing to finding solutions to important questions in the domain of healthy food and living environment. With its roughly 30 branches, 7,200 employees (6,400 fte) and 13,200 students and over 150,000 participants to WUR's Life Long Learning, Wageningen University & Research is one of the leading organisations in its domain. The unique Wageningen approach lies in its integrated approach to issues and the collaboration between different disciplines.

