Limestone analytics

The Impacts and Cost-Effectiveness of THRIVE

Meta-analysis and value-for-money analysis of World Vision's Transforming Household Resilience in Vulnerable Environments (THRIVE) program

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Authors & Acknowledgements

Limestone Analytics

Limestone Analytics (Limestone) specializes in evaluating public policy, social programs, and international development projects. The firm is recognized for combining academic rigor, state-of-the-art methods, and real-world expertise to provide customized evaluation and economic analysis services and to help clients improve the design, financing, and implementation of their projects. Information about our current and past projects can be found at limestone-analytics.com.

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Acronyms

BC&P	Benefits Costs and Perspectives
BCR	Benefit-Cost Ratio
BSL	Building Secure Livelihoods
CBA	Cost-Benefit Analysis
CBDRM	Community-Based Disaster Risk Management
CI	Confidence Interval
CO_2	Carbon dioxide
CPI	Consumer Price Index
DiD	Difference-in-Differences
DRR	Disaster Risk Reduction
EWV	Empowered Worldview
HDDS	Household Dietary Diversity Score
HFIAS	Household Food Insecurity and Access Scale
HoH	Head of Household
LMIC	Low- and Middle-Income Countries
MCC	Millenium Challenge Corporation (US government agency)
NPV	Net Present Value
NRM	Natural Resource Management
PPI	Poverty Probability Index
S4T	Savings for Transformation
SD	Standard Deviation
SSA	Sub-Saharan Africa
THRIVE	Transforming Household Resilience in Vulnerable Environments
UCBA	Unified Cost Benefit Analysis
USD	United States Dollar
VfM	Value-for-Money
WV	World Vision
WVUS	World Vision United States

Executive Summary

Limestone Analytics conducted an impact evaluation meta-analysis and a Value-for-Money (VfM) analysis of World Vision's **Transforming Household Resilience in Vulnerable Environments (THRIVE)** program. The THRIVE program targeted small-holder farmers in Honduras, Malawi, Rwanda, Tanzania, and Zambia, directly impacting an estimated 74,523 households between 2017 and 2023.

Impact evaluations conducted in the five countries estimate the project's effect on participants relative to comparison groups and changes in well-being over time. World Vision commissioned this new meta-analysis and Value for Money (VfM) analysis to enable the organization to understand better and communicate the **overall impact and cost-effectiveness of the program model across all five countries**. The findings were needed for accountability to stakeholders or supporters of the program and learning.

The meta-analysis used the inverse variance, which combines the estimates from all five countries to determine the overall impact. This approach weights each study based on how large its standard errors are and gives more weight to the studies where there is the most certainty. The results support the conclusion drawn from individual country evaluations that THRIVE is an effective program across many outcome dimensions, including the program's key target outcomes—household income, food security, the well-being of children, reduction in the rate of poverty, and resilience of households. The average THRIVE participant experienced a **53.4% increase in household income** compared to their projected income without the program. THRIVE led to an **18.7% increase in households reporting they can provide for their children without external support**, and an additional 13% of households reporting being fully prepared for a shock. THRIVE is also associated with a 6.4% reduction in households living below the poverty line.

The analysis shows that the effect on income was significant and positive in all four African countries. The impact on income in Honduras was not significant, although the impact on other measures of well-being was positive.

The Value-for-Money (VfM) analysis utilizes Limestone's UCBA framework for impact accounting to rigorously define and systematically compare the value of the program's costs and benefits to society. This includes accounting for the financial and non-financial costs and benefits to donors, beneficiaries, and society more broadly.

THRIVE cost nearly $55 million across the five countries since its inception. We estimate that over 90% of these costs were incurred since 2017. After adjusting for inflation, we estimate that the program cost approximately $48 million, resulting in an estimated $388 million in total benefits (2020 USD). On average, each direct beneficiary experienced $2,805 in increased income and gains associated with increased financial or income stability.

A net present value analysis estimates the benefits and costs from the perspective of 2017 going forward. THRIVE cost $38 million in time-value adjusted dollars, resulting in $254 million in benefits. This includes an average net **benefit of $3,375 per household** participating in the program, values that reflected income, and economic resilience increases. It also reflects an aggregate **environmental benefit equal to approximately $2.1 million** due to improved agricultural practices that led to the **sequestration of 15.7 million tons of carbon**.

Overall, **every $1 in costs resulted in $6.68 in benefits to society**. Figure ES.1 shows the benefit-cost ratio (BCR) for each county and in aggregate for all five countries and the four African implementations.

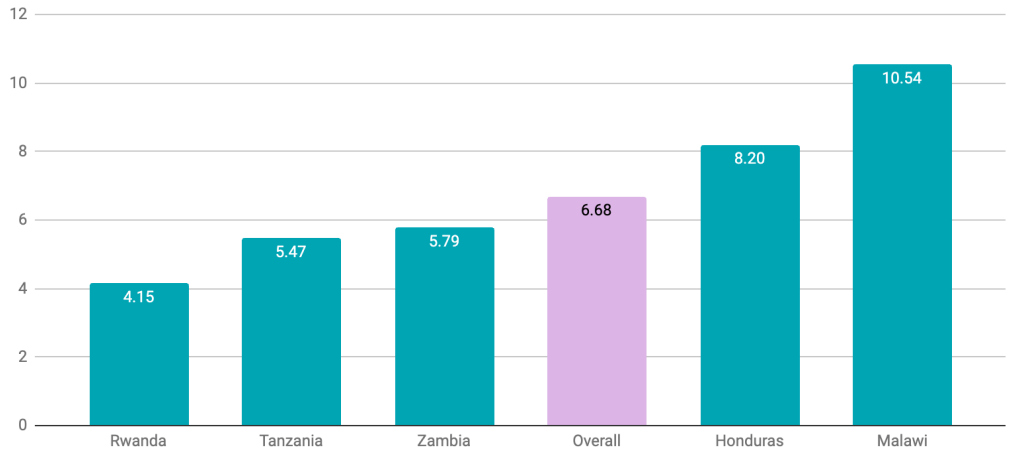

Figure ES.1 Benefit-Cost Ratio of THRIVE implementations

Although the social benefits outweigh the program's financial and non-financial costs in all five countries, there is variation across the countries, which may suggest differences in

program effectiveness, the economic gains associated with improved farming practices or potential for improving program cost-effectiveness across locations.

The report conducts a sensitivity analysis to understand how robust the conclusions are to alternative methodological approaches, showing no substantial change in the general results and conclusions. The report also discusses the limitations of the analysis and data, providing recommendations to improve monitoring and evaluation data to increase the accuracy and granularity of the analysis.

We also discuss how the results for THRIVE compare to those of other development interventions that have been evaluated similarly. Overall, we conclude that **THRIVE is a cost-effective program that has a meaningful impact on the lives of its beneficiaries**, suggesting that the project represents money well spent.

1. Introduction

World Vision US engaged Limestone Analytics (Limestone) to conduct an impact evaluation meta-analysis and Value for Money (VfM) analysis of its Transforming Household Resilience in Vulnerable Environments (THRIVE) program implemented from 2017 to 2023 across five countries, including Tanzania, Malawi, Zambia, Rwanda, and Honduras. The goal of the THRIVE program was to build improved and resilient livelihoods, measured by improvements in the following key outcomes: household incomes, food security, the well-being of children, movement out of extreme poverty, asset ownership livelihood diversification, financial inclusion, disaster risk preparedness, and coping abilities.

This report presents the results of the meta-analysis and VfM analysis of THRIVE. The meta-analysis builds on impact evaluations conducted for World Vision across the five countries by TANGO International. Limestone was contracted to conduct a meta-analysis and a VfM analysis to enable World Vision to understand the overall or average cost/effectiveness of the THRIVE model for each country and, in aggregate, given the available data. The meta-analysis aimed to address the following specific objectives:

- How effective was THRIVE in improving livelihood and resilience outcomes? What outcomes did THRIVE impact most?
- Are there differences in effect size by country? Are there contextual factors that explain these differences?
- How did different intervention activities contribute to the overall impact of THRIVE on livelihood outcomes?

The VfM aimed to answer the following questions:

- Accounting for the benefits and costs of the program, what was THRIVE's net value for individual beneficiaries and for society as a whole?
- Was THRIVE a cost-effective use of funding in each country and in aggregate?
- What were the costs per beneficiary and return on investment per country and on average?

In the next section, we provide a brief overview of the THRIVE program and methodology used to evaluate it. Next, we provide an overview of context in which projects were implemented and conduct literature review on success and challenges of programs similar to THRIVE. Next, we discuss our meta-analysis and VfM analysis methodologies and the findings of each part of the analysis.

2. Background

2.1 Overview of THRIVE

Rural families in developing countries often depend on agriculture as their primary source of food and income. Unforeseen agricultural shocks, including economic downturns, family misfortunes, or extreme weather conditions, can cause households to slip into extreme hunger and poverty. World Vision's THRIVE program was designed to improve the livelihoods of smallholder farmers who suffer from financial precarity. The program model works to address the underlying causes of poverty, eliciting beneficiary-level changes to create more self-sufficient, resilient households.

This analysis estimates the overall efficacy of THRIVE in its implementation across five countries. World Vision engaged Tango International (Tango) to lead rigorous data collection and conduct impact evaluations for each country. **Table 2.1** contains a breakdown of these THRIVE implementations by country, project timeline, and the number of beneficiaries.

Table 2.1: THRIVE project locations, timelines, and beneficiaries

	Tanzania	Malawi	Zambia	Rwanda	Honduras
Timeline	2013-2021	2016-2022	2017-2023	2018-2023	2018-2023
Households Reached	9,201	17,098	15,917	15,287	17,020
Provinces/ Regions	Manyara	Lilongwe, Ntchisi, Nkhata Bay	Muchinga, Luwingu, Kasama, Katete	Southern, Northern, Western	Intibuca, Copa, Francisco Morazan
WV Area Programs	Magugu, Garowa, Kisongo	Chilenje, Nkhoma, Nthondo, Chikwina Mpamba	Mpika, Buyantanshi, Mwamba, Katete, Kawaza	Gisagara, Maraba, Simbi, Kivurugam Nyarutovu	Yamaranguila, Santa Rosa de Copan, Tegucigalpa

The THRIVE program model evolved substantially from its initial launch in Tanzania in 2013 through its launch in Rwanda and Honduras in 2018. In 2013, the program started as an initiative in Tanzania, consisting of four main components: (1) end-to-end farming, (2) natural resource management, (3) emergency and situational awareness, and (4) empowered worldview. **Figure 2.1** provides a descriptive depiction of THRIVE when it first began.

Figure 2.1: THRIVE Core Components (Source: THRIVE Malawi Endline Evaluation Report, 2023)

The end-to-end business of farming is the first pillar, recognizing the importance of agriculture as an engine for economic growth. Through the formation of savings groups, producer groups, and producer associations, THRIVE seeks to help smallholder farmers adopt good practices in value chains prioritized by the project. The second pillar, natural resource management, is designed to promote the sustainability and improved productivity of these good farming practices from the first pillar. Using on- and off-farm natural resource bases responsibly results in stronger and more self-sufficient families. Emergency and situational awareness is the third pillar, aiming to provide households with increased resilience capacities when faced with unforeseen agricultural shocks. The Biblical Empowered Worldview is the foundation of the THRIVE program. It is a faith-based approach that seeks to transform participants' worldviews from one of dependence to one of empowerment and personal responsibility. Over the course of a year, experiential workshops are facilitated to examine beliefs, mindsets, and behaviors according to Biblical principles. By fostering a perspective that brings hope and vision, it is expected that participants perceive their agency in using available resources to reduce poverty as a community.

While the goals of the THRIVE program were well-defined in its first launch, there was minimal structure surrounding the rollout of program components. With this in mind, World Vision incorporated insights from early launches and an evolving understanding of

stakeholder needs to update the design of THRIVE, changing the implementation of newer projects and updating the design of ongoing projects.

By 2019, World Vision had aligned the THRIVE model with its Building Secure Livelihoods (BSL) framework. THRIVE's BSL framework targets a progressive series of interventions and support components for smallholder farmers, their households, and communities. BSL is comprised of the following program models, which are implemented sequentially: Empowered Worldview (EWV), Savings for Transformation (S4T), Farming as a Business, Natural Resource Management (NRM), and either Disaster Risk Reduction (DRR) or Community-based Disaster Risk Management (CBDRM).

The targeting and recruitment of participants is done according to the local context. The THRIVE program is designed to benefit vulnerable families, and the definition of vulnerability may vary substantially across interventions. Graduation of the program entails the completion of all four components. By the end of each project, THRIVE aims to graduate 30 percent of targeted households, with the other 70 percent engaging in a subset of the components. **Figure 2.2** contains the standardized BSL model steps in accordance with WV's field handbook.

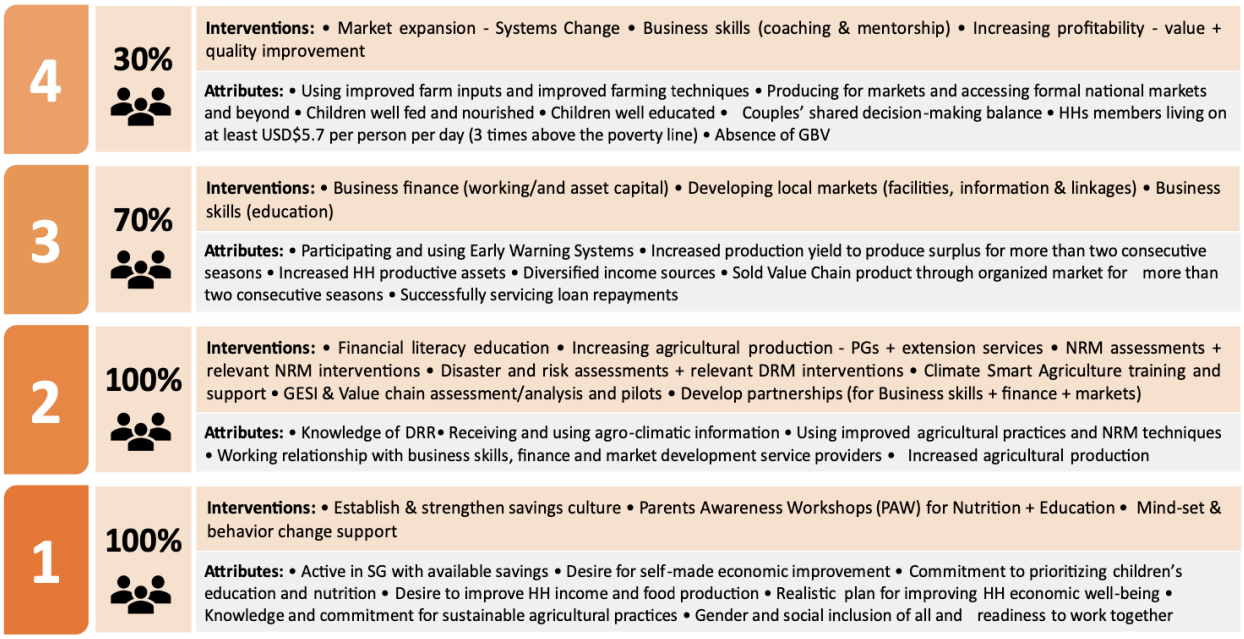

Figure 2.2: World Vision BSL Model components and participation targets (Source: THRIVE Malawi Endline Evaluation Report, 2023)

Figure 2.3 provides an updated representative depiction of THRIVE from the last launch in Honduras in 2018. Together, the figures illustrate a transition into a more structured, defined implementation and participation plan. Evidently, the five-step implementation in Honduras varies slightly from the standardized BSL framework. The first step in the THRIVE Honduras graduation pathway is EWV training, posed as a foundation for the

subsequent steps in the program. Each step outlines the outcomes it sets out to achieve as well as the targeted groups it intends to support.

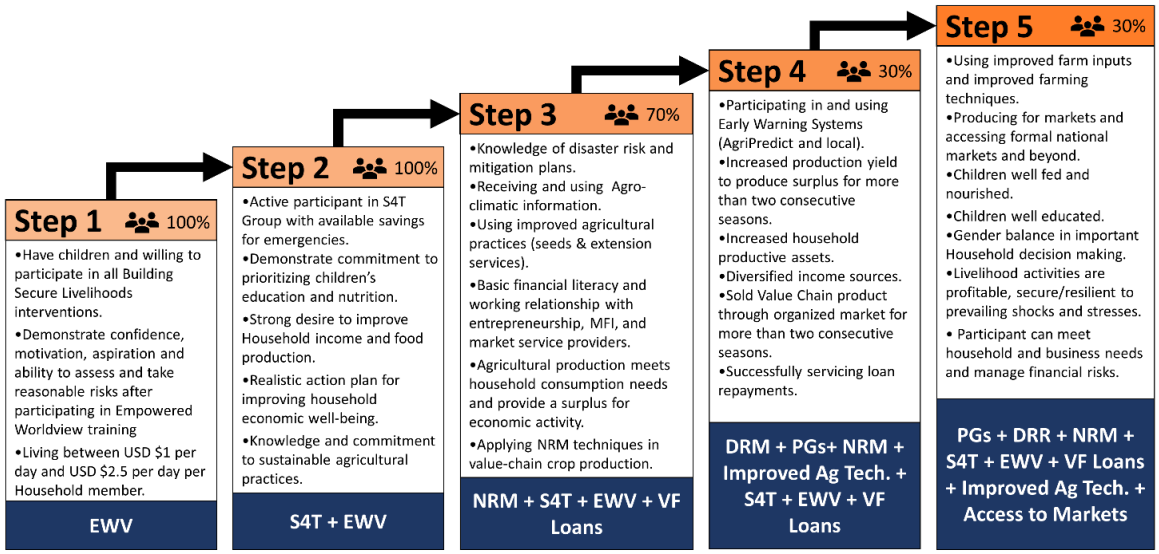

Figure 2.3: THRIVE Honduras Components and Attributes of Participant Progression (Source: THRIVE Rwanda Endline Evaluation Report, 2023)

2.2 THRIVE Impact Evaluation Data

Tango International conducted midline and endline data collection and evaluations for all five THRIVE implementations. They also were responsible for baseline data collection in Rwanda and Honduras. The data they collected is relatively high quality, with most periods including observations for both participants and a comparison group of non-participants. The analysis, however, is limited by a lack of baseline comparison group data in Malawi and Zambia and a lack of any baseline data in Tanzania.[1] The analysis methods used by Tango for the endline evaluations differed by country.[2]

The meta-analysis uses the data collected by Tango to estimate the country-level and overall impacts of THRIVE across 16 key performance indicators that are consistently reported across countries, which are summarized in **Table 2.3**.

[1] No baseline data was collected in Tanzania. Baseline data collected in Malawi and Zambia by other organizations lacked observations on comparison groups, and did not include all of the variables of interest. Data was also collected by Tango for midline evaluations, but did not include comparison groups in Zambia and Malawi.
[2] Tango's analysis for Tanzania used a difference-in-differences (DiD) analysis from midline to endline, Rwanda and Honduras used a combination of DiD, mean comparison, and regression analysis. Malawi and Zambia utilize descriptive and regression analyses to compare midline and endline for the treatment group.

Table 2.3: THRIVE Project Indicators

Impact Category	Indicator
Outcome 1: Livelihoods	*Financial measures:* 1) Household annual income 2) Number of income sources 3) Households income diversification score (>1 lower-risk income stream) 4) Household cash savings 5) Savings at formal financial institutions 6) Access to loans *Asset measures:* 7) Household assets 8) Productive assets 9) Transportation assets 10) Animal assets *General wellbeing measures:* 11) Reported ability to support children without assistance (child well-being) 12) Household Dietary Diversity Score (HDDS) 13) Household Food Insecurity Access Scale (HFIAS) 14) Proportion of households below the national poverty line
Outcome 2: Natural Resource Base	15) Practice of improved conservation agriculture practices (4 or more practices) 16) Households engaged in community management of on-farm natural resource bases (water) 17) Households with a positive NRM perceptions
Outcome 3: Resilience	18) Households report being fully prepared for a shock 19) Households report taking action to prepare for a shock 20) Households aware of community disaster preparedness plan 21) Households received early warning information in the past year 22) Households report avoiding negative coping strategies to deal with shocks [Outcome 1's Livelihood measures involving savings, assets, income diversification, and dietary diversity are also relevant for resilience.]
Outcome 4: Empowerment	23) Households report decision-making and empowerment over matters that affect the lives of their families and communities 24) Aspirations and confidence to adapt index

2.3 Contextual Factors

Understanding the contextual factors that influence the effectiveness of agricultural development programs is critical, particularly in countries where smallholder farming forms the backbone of rural livelihoods. We briefly review some of the contextual factors that may affect THRIVE outcomes or how local farmers perceive and interact with THRIVE.

Honduras[3] - Honduras' agricultural sector is characterized by structural challenges, including concentration of land ownership, limited access to productive land, and a reliance on cash crops like coffee that are susceptible to international price volatility. Additionally, frequent natural disasters such as hurricanes and floods contribute to the vulnerability of smallholder farmers. Indeed, two back-to-back hurricanes—Eta and Iota—hit the country at a critical period of the THRIVE project implementation. The

THRIVE Honduras midterm evaluation report by TANGO International indicates that the hurricanes disrupted the delivery of project activities and destroyed livelihoods. Political instability and high levels of corruption have been shown to hinder the effectiveness of development interventions, as they can disrupt supply chains and weaken institutional support. These factors can limit or affect the outcomes of an agricultural project like the THRIVE program. Honduras has continued to see significant investment from international donors, including USAID's Feed the Future initiative, which focuses on improving agricultural productivity and resilience. The presence of these large-scale programs may make it more difficult to isolate the impact of interventions like THRIVE, which were implemented at the same time.

Rwanda[3] - In Rwanda, the government has prioritized agricultural transformation as a cornerstone of its development strategy. The Crop Intensification Program (CIP), which promotes the use of improved seeds and fertilizers, has been central to efforts to increase productivity among smallholder farmers. Cooperatives also play a significant role in Rwanda's agricultural landscape, allowing farmers to pool resources, access markets, and adopt modern farming techniques. These cooperatives, alongside government support for infrastructure and market linkages, create an environment conducive to successful agricultural interventions. Rwanda's stability and strong policy framework have been identified as key factors in facilitating the success of development programs.

Malawi[4] - Agriculture in Malawi employs around 80% of the population, making it a key focus for development interventions. The government's Farm Input Subsidy Program (FISP), which provides farmers with access to fertilizers and improved seeds, has been credited with improving productivity in rural areas. However, smallholder farmers still face significant challenges, including climate variability, poor access to markets, and limited agricultural inputs. A World Bank report in 2022 shows that "for every three Malawians that moved out of poverty between 2010 and 2019, four fell back due to the impact of weather shocks" (Caruso and Cardona Sosa, 2022). Programs that focus on enhancing climate resilience and promoting sustainable farming practices, such as THRIVE, align well with Malawi's national development priorities and have the potential to build on existing gains.

Tanzania[5] - Tanzania's agricultural sector provides livelihoods for more than 65% of the population, with a focus on both subsistence and cash crops. The government has launched several initiatives to modernize agriculture and improve market access, such as the Southern Agricultural Growth Corridor of Tanzania (SAGCOT), which aims to boost agricultural productivity through public-private partnerships. The country's diverse climate allows for the cultivation of a wide range of crops, creating opportunities for smallholder farmers to diversify income sources. Programs that focus on improving rural

[3] See Republic of Rwanda (2018) and Bizoza & De Greve (2019), including www.minagri.gov.rw/index.php?id=469
[4] See Chinsinga & Chasukwa (2020) and IFAD (2019), www.ifad.org/en/web/operations/country/id/malawi
[5] See SAGCOT (2017) and FAO (2018), including http://www.fao.org/3/a-i8701e.pdf and http://www.sagcot.co.tz/uploads/media/SAGCOT_Investment_Blueprint.pdf

infrastructure, enhancing market linkages, and promoting climate resilience align with Tanzania's agricultural development strategy. These factors suggest a favorable environment for interventions aimed at improving livelihoods.

Zambia[6] - Zambia's economy is heavily dependent on smallholder agriculture, which supports over 60% of the population. The government has prioritized crop diversification and climate resilience, particularly in the face of frequent droughts and unpredictable rainfall. Public-private partnerships, as well as programs that focus on integrating smallholder farmers into agricultural value chains, have been central to improving market access and productivity. Zambia's fertile land and supportive agricultural policies create opportunities for programs like THRIVE to enhance farmer resilience and income.

The COVID-19 pandemic impacted all five projects. In all countries but Tanzania, COVID-19 disrupted the delivery of interventions as well as the livelihoods of communities. In Tanzania, the interventions had been completed by the time COVID-19 impacted daily life; however, the endline evaluation was underway at that time.

2.4 Challenges and opportunities of programs like THRIVE in low-income countries

Livelihoods

Smallholder farmers often rely on agriculture as their primary source of food, making them highly vulnerable to unforeseen shocks that can significantly increase food insecurity. Additionally, rural households in low- and middle-income countries (LMICs) frequently lack access to high-quality foods such as fruits, vegetables, dairy products, eggs, and meat, leading to micronutrient deficiencies that are crucial for health and development. Some agricultural interventions aimed at addressing these nutritional gaps have proven successful. For example, the introduction of biofortified crops, like sweet potatoes, has led to greater dietary diversity and higher levels of vitamin A among children (Low et al., 2007). Likewise, home gardening programs have consistently improved access to and consumption of micronutrient-rich foods. A gardening program in South Africa that incorporated a community-based growth-monitoring system resulted in a significant increase in infant retinol concentrations, consumption of yellow and dark-green leafy vegetables, and maternal knowledge of vitamin A (Faber et al., 2002). Similarly, a homestead food production program in Cambodia increased the production and consumption of diverse vegetables among participating households, contributing to a lower prevalence of fever in children under five years old.

[6] See Zambia Ministry of Agriculture (2019) and FAO (2020), fao.org/zambia/fao-in-zambia/zambia-at-a-glance and http://www.agriculture.gov.zm/index.php/component/content/article?id=248

For many rural households, smallholder farms are not only a key food source but also their primary income. In a study of three USAID-supported interventions in Kenya, Oehmke et al. (2010) found that net poverty in the treatment group decreased by 4.9 percentage points, and average household income rose by $322 USD. Notably, the gains were more pronounced among female-headed households. In Tanzania, agricultural value chain initiatives—including business contracts and market channels—reduced poverty by 5.6 percentage points and increased household income by 44% among smallholder farmers (de Castro, 2021). Conversely, the Millennium Villages Project (MVP), implemented across ten sites in Sub-Saharan Africa (SSA), did not significantly impact consumption-based poverty measures, though it did improve asset ownership (Mitchell et al., 2018).

Savings Groups

Key elements of the THRIVE program include savings groups, producer groups, and market access. In Ghana, a savings mobilization initiative improved both access to and the amount of credit borrowed (Twumasi et al., 2020). In Mozambique, access to savings increased the likelihood of fertilizer use by 30 percentage points (Batista et al., 2020). Among women micro-entrepreneurs in Tanzania, training on savings accounts raised the probability of receiving a loan by 14 percentage points and boosted the use of business practices—such as marketing, record keeping, and financial planning—by 6.7 percentage points (Gautam et al., 2020). In Haiti and the Dominican Republic, participants in savings groups were more likely to have COVID-19 response plans, larger savings reserves, greater income diversity, and more diverse farming practices (Sabin et al., 2022).

Production and Farming Practices

Many smallholder farmers' livelihoods depend on producing adequate seasonal yields. Small-scale, low-technology, rainfed farming leaves them vulnerable to various shocks, from droughts to economic downturns. While low- and middle-income countries have seen improvements in agricultural productivity, more is needed to ensure the self-sufficiency of these households. Previous agricultural interventions demonstrate that smallholder farming can be both productive and sustainable with appropriate support.

In Sub-Saharan Africa (SSA), for example, the yield gap—the difference between actual and potential yields—can be as high as 80%, meaning farmers could quadruple their harvests under optimal conditions (Silva et al., 2019). Adopting improved germplasm, particularly for crops like maize, could significantly reduce this gap. Over a 20-year period, the adoption of CGIAR-related maize varieties in SSA yielded estimated economic benefits of $0.37 to $0.53 billion USD (Krishna et al., 2023). Similar success stories exist for other crops in the region. In Nigeria, the Growth Enhancement Support Scheme, launched in 2010, improved the distribution of fertilizer and seeds. Participating maize and cassava farmers saw average

income increases of 50,381 NGN and 19,412 NGN, respectively, compared to non-participants (Ogunniyi et al., 2017).

Community-based natural resource management (NRM) also has the potential to enhance agricultural productivity while conserving biodiversity. By promoting democratic governance of resources, NRM improves access and management, fostering long-term resilience and community development. For instance, an NRM program in Namibia led to positive health outcomes, with conservancy households being twice as likely to own bed nets, which are crucial for preventing mosquito-borne infections (Riehl et al., 2015). In Malawi, an agroecology intervention had positive effects on both production and dietary diversity (Kansanga et al., 2021).

3. Meta-Analysis

3.1 Overview of methodology

To estimate the average impact of the THRIVE interventions, we regenerate country-level impact estimates using standardized methods across locations and then conduct a meta-analysis that aggregates the findings from the evaluations of all five THRIVE countries. This involved three main steps:

1) Use consistent data cleaning and analysis methods to measure standardized treatment effects for the THRIVE interventions in each of the five project contexts.
2) Estimate the combined effect of the THRIVE interventions using standard meta-analysis approaches.
3) Conduct sensitivity analysis to test the robustness of the meta-analysis findings.

Throughout the analysis, we focus on the 24 key indicators in **Table 3.1**.

Estimating individual project treatment effects

Before reestimating the country-level impacts, the data from all countries was combined and cleaned so that all key variables were consistently treated across projects, which was necessary to integrate the findings for the meta-analysis. The largest change from the original method was ensuring that each missing or non-applicable (NA) response was treated consistently across countries. The consistency of the treatment of NAs ensures that results are comparable across countries and not affected by any differences in the choice of imputation.

Once the data was reconciled, we estimated the treatment effects for each project. For Rwanda and Honduras, which have compatible baseline data for comparison and treatment groups, this involved a difference-in-differences (DiD) analysis. When baseline data was not available, we relied on post-intervention data. The endline differences in Malawi, Tanzania, and Zambia are credible "causal" estimates of THRIVE's impact to the extent that the individuals in the treatment and comparison groups were otherwise similar before the interventions were rolled out. While this cannot be verified in the data, since pre-treatment data is unavailable, the original evaluations selected the comparison areas because they were deemed similar to the treated areas.

To improve the match quality between treatment and comparison groups for all projects, this analysis used propensity score matching (PSM). PSM was used in all of the original country evaluations and again helped address potential differences between the treatment and comparison groups. This involved matching based on baseline demographic characteristics in the evaluations of Rwanda and Honduras and matching based on endline demographic characteristics in Malawi, Tanzania, and Zambia.

Meta-Analysis Approach

This meta-analysis follows the best practices in the latest Cochrane Handbook for Systematic Reviews of Interventions (Higgins et al., 2023). Similar meta-analyses have been conducted to review the portfolios of other NGOs; for example, a recent meta-analysis by Fuller (2017) reviewed Oxfam's livelihood projects implemented between 2011 and 2016. However, the combined THRIVE interventions are unique, and this specific combination has not yet been studied in the existing evidence.

There are several approaches that can be taken to assess the combined effects of the THRIVE programs. The primary approach used for the analysis is the inverse-variance weighting method, which weights each study based on standard errors when combining the results into an overall estimate. This gives more weight to the studies where there is the most certainty, making it less conservative than the random-effects model. Given the variation in experimental designs across projects, this will give more weight to the projects where the evidence base is more robust. We use an alternative approach, the random-effects approach, as a robustness check.

3.2 Interpreting the Meta-Analysis Results

The findings are presented using tables and plots, like the one presented in **Figure 3.1** below. The values presented in the tables represent the estimated causal impact of THRIVE on different outcomes. They represent the "best guesses" as to THRIVE's impact. However, the numbers themselves do not tell us how confident we are in the estimates, e.g., how much noise and uncertainty there is around the best guesses. To give insight into this uncertainty, we denote with stars whether the statistical significance or how confident we are that the program had a positive (or negative) impact on the outcome measure given the data. One star (*) means that we are 90 percent confident that the result, if we were to repeat the data collection and analysis over and over again, remain different from zero. Two stars (**) imply 95 percent confidence, and three stars (***) imply 99% confidence.

Another way to illustrate uncertainty in the results is to depict confidence intervals around the estimates. We illustrate the 90% confidence interval around each estimated value by country and for the overall meta-analysis result. Statistically, we are 90% certain that the true effect of the program falls within the illustrated range of values.

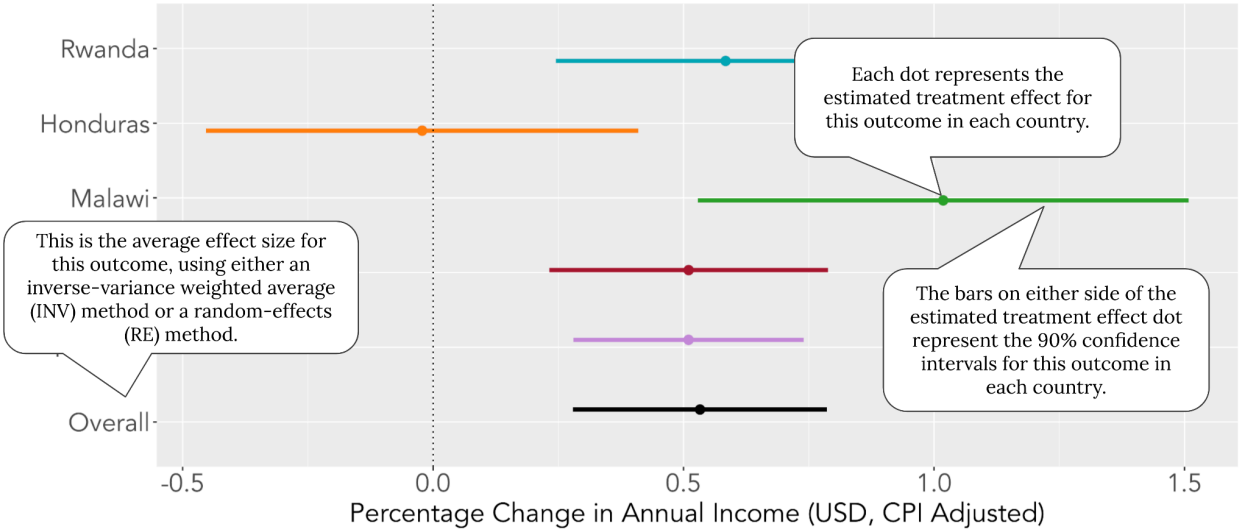

Figure 3.1: Interpreting Meta-Analysis Graphs

Each graph presents the impact of a specific outcome from **Table 3.1**. The dot in each colored line represents the size of the impact that THRIVE has had. And the full line shows how confident we are with these measures. When these lines are wide, there is less certainty about what the exact size of the impact is in that country. Bars that overlap with the vertical dotted line mean that the estimate for that coefficient is not significantly different from zero from a statistical perspective; we cannot be confident that there has been any impact.

In each graph, the black line shows the overall effect when we find the combined estimate of THRIVE's impact across these five projects using the inverse-variance average method, which is a standard approach for meta-analyses.

As a first step, the analysis compares the outcomes of participants in the treatment group and non-participants in the comparison group at the end of the program. An endline comparison between treatment and comparison groups from each of the five projects is presented in **Appendix Table A1.1,** which presents the Cohen's D values of endline differences for all outcomes. These comparisons provide a preliminary overview of the success of the program, but they are not comprehensive.

3.3 Impact of THRIVE: Meta-Analysis Results

Overall, the findings of the meta-analysis show that the THRIVE interventions had favorable and significant impacts on outcomes in all of THRIVE's impact categories. This is based on the findings of the meta-analysis, which combines the estimated impact from across multiple interventions. In addition to being intrinsically significant, these findings appear to be relatively large when compared to other programs that involved similar intervention components.

The meta-analysis estimates of THRIVE's overall impact are summarized in **Table 3.1**, which presents the estimates for all outcomes. This is followed by discussions of each of the outcome areas, including differences in key outcome variables across countries. In later sections, we show that the main findings are also robust to several different analytical approaches, including using different meta-analysis approaches and using alternative approaches to handle missing data.

Table 3.1: Overall Effect of THRIVE

Indicator	Overall Effect
Outcome 1: Livelihoods (Financial)	
Percentage change in annual average household income (CPI adjusted, USD)	0.534***
Difference in the number of income sources	0.171***
Difference in proportion with >1 lower-risk income streams	0.080***
Difference in proportion reporting cash savings	0.207***
Difference in proportion reporting savings at a formal financial institution	0.113
Difference in proportion reporting ability to access a loan	0.073*
Outcome 1: Livelihoods (Assets)	
Difference in the number of household assets	0.568**
Difference in the number of transportation assets	0.150*
Difference in the number of productive assets	2.656**
Difference in the number of animal assets	4.469***
Outcome 1: Livelihoods (General wellbeing)	
Difference in proportion of households able to fully provide for children	0.187***
Difference in Household Dietary Diversity Score (range: 0-12)	0.703***
Difference in Household Food Insecurity and Access Score (range: 0-27)	-2.775***
Difference in proportion of households living below national poverty line	-6.390**
Outcome 2: Natural Resource Management	
Difference in proportion of households using 4+ agricultural conservation practices	0.102**
Difference in proportion with positive Natural Resource Management perceptions	0.007***
Difference in proportion participating in community management of on-farm water resources	0.153**
Outcome 3: Disaster Risk Management	
Difference in proportion reporting being fully prepared for a shock	0.128***
Difference in proportion reporting preparing for a shock	0.092**
Difference in proportion with a disaster management plan	0.179***
Difference in proportion with access to a early warning info system	0.174***
Difference in proportion avoiding negative coping strategies during shocks	0.021
Outcome 4: Empowered World View	
Difference in Household Empowerment Score (in Standard Deviations)	0.419***
Difference in Aspirations and Confidence to Adapt Score (in Standard Deviations)	0.109***

* p < 0.1, ** p < 0.05, *** < 0.01

Impact on Livelihoods

Overall, the THRIVE interventions have a large impact on outcomes related to livelihoods. The THRIVE interventions are associated with a 53.4% increase in reported annual income at the end of the program. This impact is rather substantial when compared to other interventions. In a systematic review of agricultural interventions, Masset et al. (2011) found that five out of 23 studies reported positive income effects at the endline. Among the quantifiable income effects, there was a 40 percent increase for the introduction of intensive dairy farming in Kenya, 40 percent in an aquaculture program in Bangladesh, 15 percent in a poultry promotion program in Bangladesh, and 60 percent in a home garden intervention in Thailand. More recently, Sanchez et al. (2022) found that the mean impact of the implementation of diversified farming systems on gross farming income across 12 studies in SSA is 25 percent.

Figure 3.2 shows that in all of the Africa-based regions, the effect is positive and statistically significant. However, there has been no significant impact on Honduras. This differs from the original evaluation findings, which identified a positive impact on income in both the original evaluation's regression analysis and the simple comparison of means. There are two main reasons for this difference. The first is that the current findings used propensity score matching for all outcomes. However, it is not clear that the comparison and treatment group were matched before the was done in the original evaluation. Second, the original evaluation findings included controls for some of the individual intervention components. For the meta-analysis, this analysis uses propensity score matching for all outcomes. This allows the analysis to be consistent across all findings and to control for baseline differences. As shown in **Figure 3.3**, in Honduras, there is also no significant impact on the number of income sources, while in the two African countries where the treatment effects were more certain, the number of income sources increased. This contributed to the overall positive impact that we find THRIVE had on the number of income sources that households reported having.

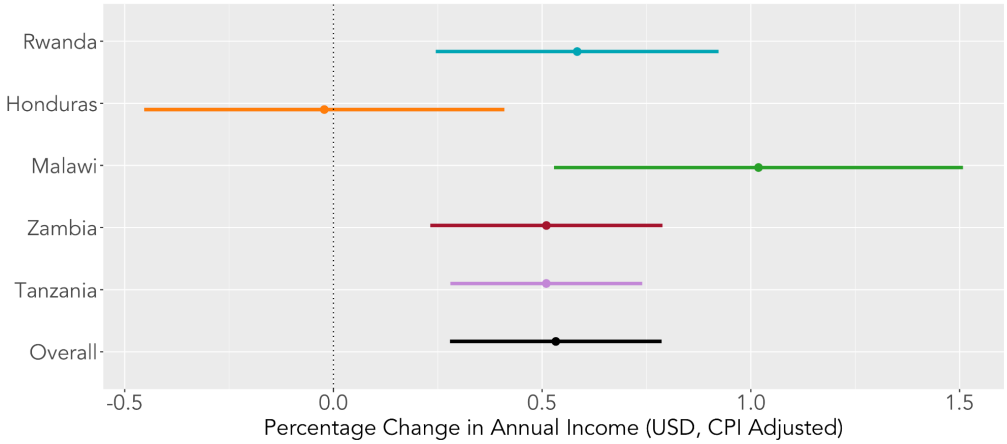

Figure 3.2: Impact on Annual Household Income

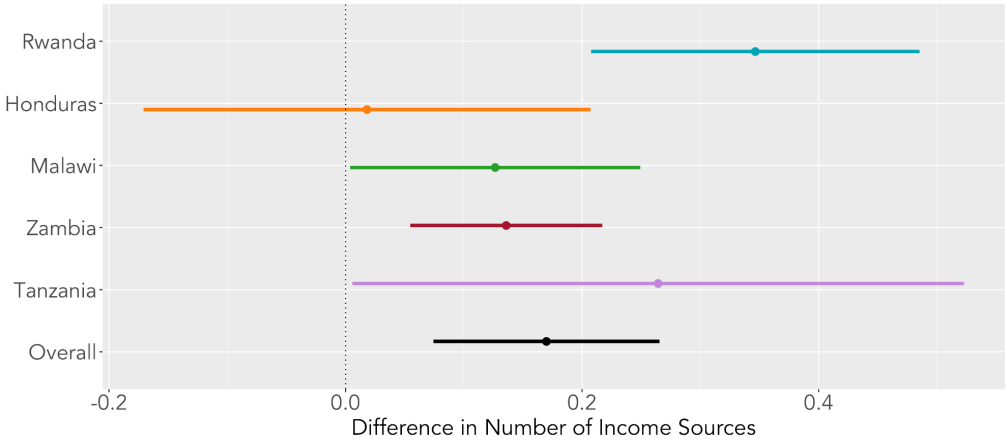

Figure 3.3: Impact on Number of Income Sources

These findings are consistent with the finding that after the THRIVE interventions, households also consistently report having more assets. The overall impact that THRIVE has had on these outcomes is shown in **Table 3.1**. Access to these kinds of assets is essential for productive agricultural practices and improved stability in agricultural output. The THRIVE interventions have also had a positive impact on the proportion of households using improved agricultural practices, which is another important outcome to support long-term stability in household livelihoods and food security. After THRIVE, the number of households using at least four of the key productive agricultural practices increased by ten percentage points. The country-specific breakdowns for these outcomes have been included in Appendix 1.

The THRIVE interventions were not targeted to specific genders. However, to understand the impact that the program has on different kinds of households, the following figure examines the impact that the interventions have had on households with male and female heads of household. This will also be relevant to the VfM analysis, which disaggregates the findings by gender. The overall impact is significant for both genders, though it is slightly larger for female-headed households. While the impact is only statistically significant in two countries for female-headed households at the 95% confidence interval, male-headed households experienced gains in all regions except Honduras.

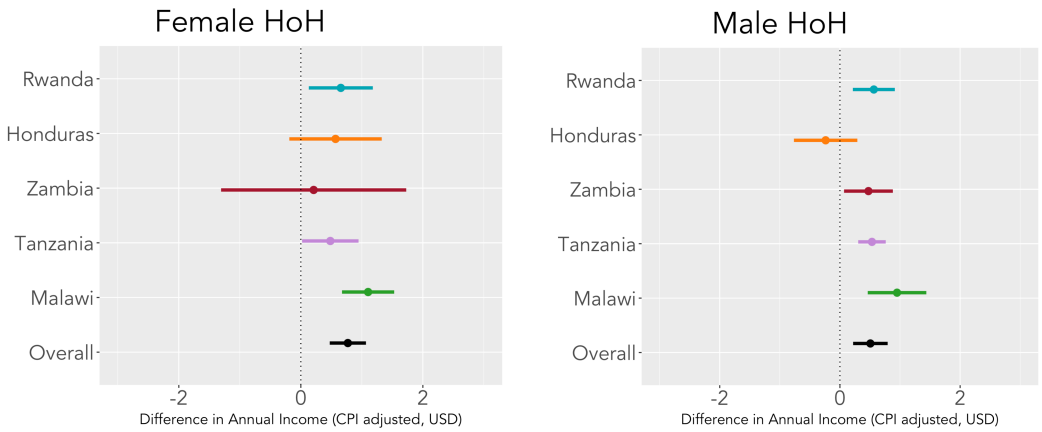

Figure 3.4: Impact on Income by Head of Household Gender

In addition to financial measures of household livelihoods, several key indicators are related to household social outcomes. This includes outcomes related to food security and child well-being. According to THRIVE's program model, we expect that if households have greater economic stability, this will contribute to improved food security and well-being within the household. Here, we test whether this has occurred by testing the overall effect that the THRIVE interventions have had on social outcomes across the THRIVE portfolio. **Table 3.1** shows that across all social outcomes, individuals in THRIVE communities were more likely to be able to provide for their children without external support and were less likely to experience food insecurity.

THRIVE exhibits impressive improvements in livelihood outcomes relative to similar interventions. In a multi-country analysis, Garbero and Jackering (2021) find that, overall, agricultural programs increase the Household Dietary Diversity Score (HDDS) by 0.042 and decrease food insecurity[7] by 1.5 percentage points. These impacts increase in magnitude when they restrict the sample to low-income countries: agricultural programs were found to increase the HDDS score by 0.056 and decrease food insecurity by 2.1 percentage points.

The overall impact typically shows that the THRIVE interventions have positive impacts on all of the social indicators considered; however, the following two figures show that these results vary across contexts. While all impact is positive in all countries, which contributes to an overall positive effect size, the impact on child well-being is statistically significant at the 95% confidence level in only Rwanda and Zambia. The impact on dietary diversity is statistically significant in all countries except Tanzania.

[7] Food insecurity is defined as an indicator for whether a household's probability of being food insecure is above the sample average.

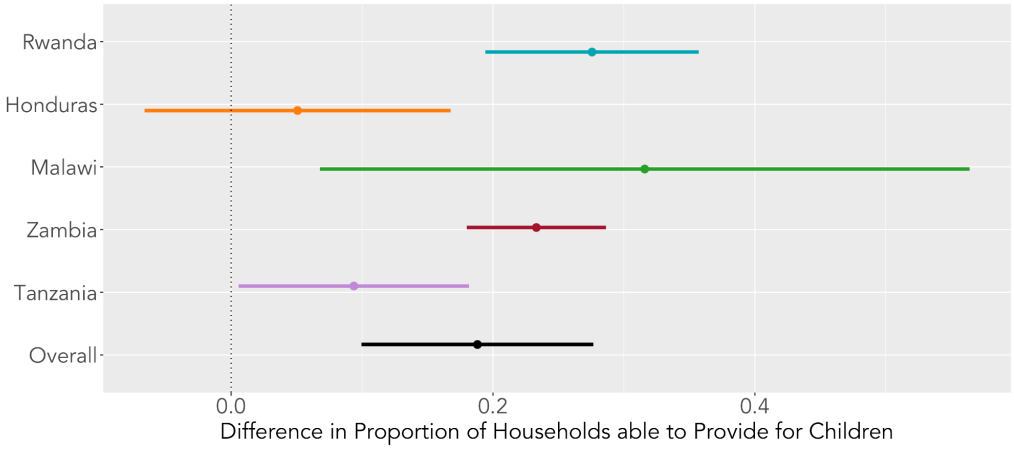

Figure 3.5: Impact on Ability to Provide for Children

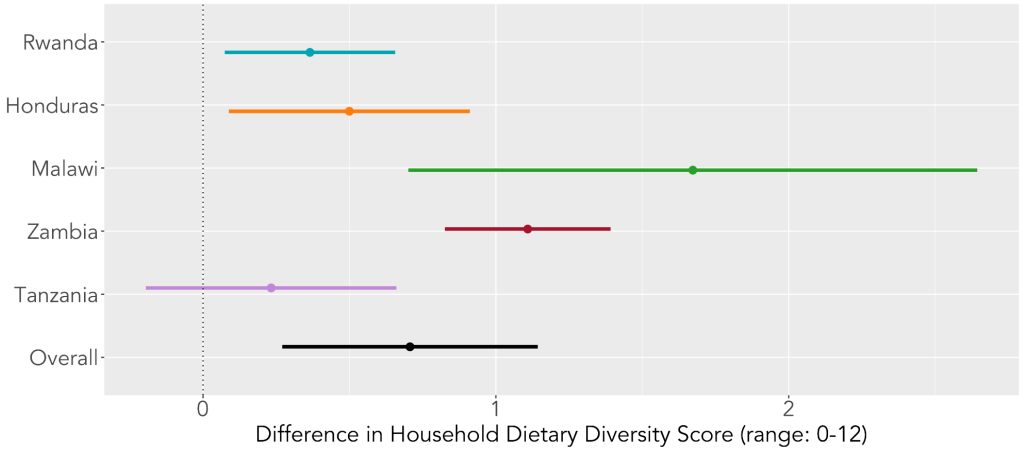

Figure 3.6: Impact on Household Dietary Diversity Scores

Impact on Natural Resource Management

In addition to outcomes related to household livelihoods, the THRIVE interventions are designed to improve the management of natural resources. **Table 3.1** shows the average impact that the THRIVE interventions have had on households' perceptions of natural resource management and their actions to manage on-farm water resources. After THRIVE, an additional 15 percent of participating communities were engaging in community management of on-farm water resources.

In terms of perceptions, an additional 0.7 percentage points of households report having positive perceptions of NRM. It should be noted that while this estimate is statistically significant overall, it is intrinsically quite small. The impact was also not significant in four

of the five THRIVE countries. Perceptions were only positive in Malawi, and the estimates were much less precise in all four other countries.

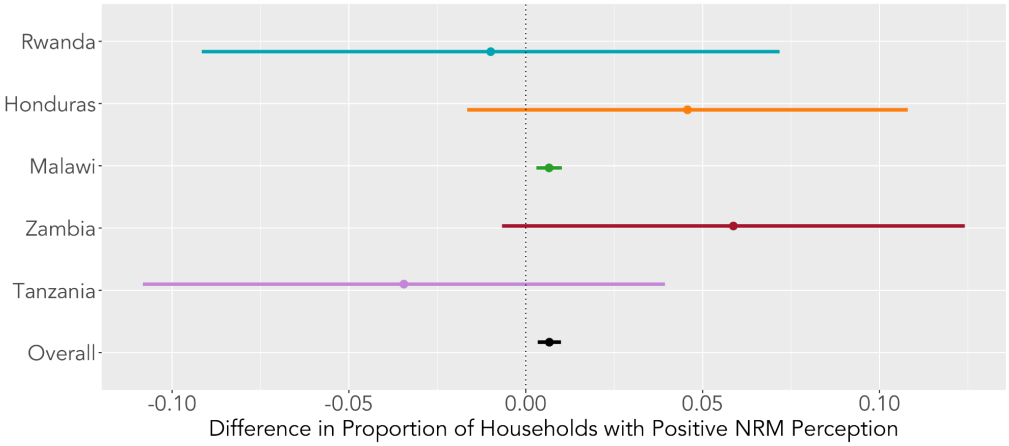

Figure 3.7: THRIVE's Impact on Natural Resource Management Perceptions

Impact on Disaster Risk Management

Like outcomes related to household assets, THRIVE's impact on outcomes related to disaster risk management is consistent with other findings related to household livelihoods and agricultural productivity. The THRIVE interventions are designed to improve the resilience of agrarian households, and **Table 3.1** shows that, by most definitions, households in THRIVE communities are better prepared for disasters, which should contribute to resilience.

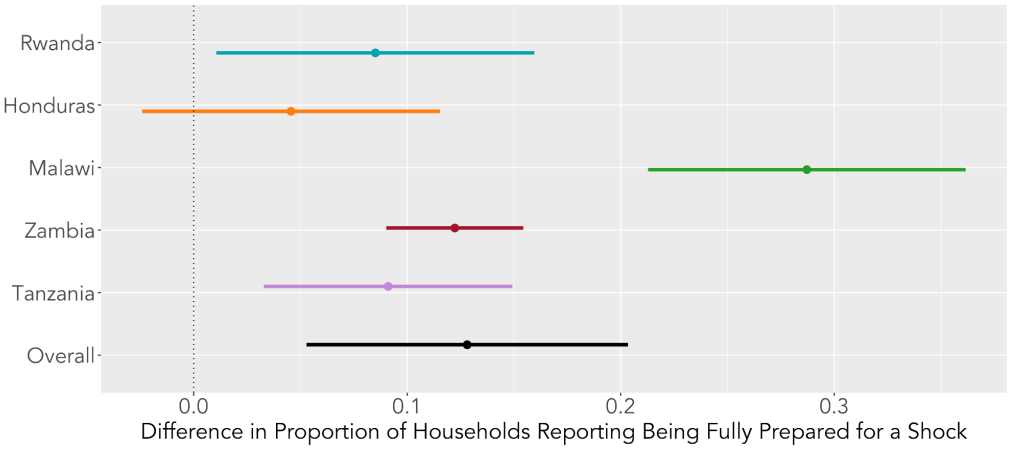

Figure 3.8: THRIVE's Impact on Household Shock Preparedness

THRIVE's impact on risk management is a critical assumption used to develop this project's VfM model, which assigns a monetary value to the increased stability associated with the

THRIVE interventions. As shown in the following figure, all countries observed a positive effect on the proportion of households who reported being prepared for a shock, though the impact is not statistically significant in all countries.

Impact on Empowered Worldview

Table 3.1 shows the overall effect of the THRIVE interventions on outcomes related to participants achieving a more empowered worldview. The interventions have substantially improved all indicators related to this outcome, with participants having a 0.11 standard deviation (SD) improvement in measures of aspirations and confidence and a 0.42 SD improvement in measures of empowerment.

3.4 Sensitivity Analysis

To test the sensitivity of the meta-analysis findings, we make changes to some of the key analytical steps to check whether the analysis methods affect the findings. In this section, we discuss the role of potential spillovers in program implementation that may have occurred in some locations. We also consider how alternative approaches to the meta-analysis may change the results. This includes making changes to the following parts of the analysis:

- *Alternative random-effects approach:* To test the sensitivity to how the individual program estimates are aggregated, we use a random-effects meta-analysis model.
- *Handling of missing data:* in the original data sets, there were many variables with missing responses or responses of "don't know." There appeared to be systematic patterns in what data was missing. To test whether this systematically affects the results, we use multiple imputation methods to replace the missing data with imputed values based on the other available data, then use the imputed datasets to re-estimate the individual program treatment effects and the combined effect. During the analysis, we also tested for the presence of differential attrition. When there is differential attrition, this suggests that individuals in the treatment and comparison groups could not be re-contacted with the same frequency at the endline. However, we find no evidence to suggest that this has been a concern.

The Potential Impact of Spillovers

Based on discussions with the project implementers, it is likely that there were substantial spillovers, particularly in Tanzania, meaning individuals in the comparison group also accessed some benefits from THRIVE interventions. Since the data on intervention participation in Tanzania is limited, it is not possible to test for this explicitly. However, if there were spillovers in Tanzania, we would expect this would lead to an underestimation of the treatment effects since the comparison group would have also experienced some of the treatment. This would minimize the measured difference between the treatment and

comparison groups after the interventions were completed, suggesting the main results are lower bounds regarding the impact of the program.

Sensitivity to Meta-Analysis Approach

Table A1.2 in Appendix 1 shows that the conclusions remain relatively consistent regardless of the meta-analysis model used to estimate the overall effect that THRIVE has had on each outcome. The only exception is the estimated impact that the project has on perceptions of natural resource management. As the following figure shows, because of the amount of uncertainty in the estimates for this particular outcome combined with the fact that the direction of the effect varied across countries, the estimated overall effect of THRIVE on perceptions of natural resource management is not significantly different from zero when a random-effects meta-analysis model is used.

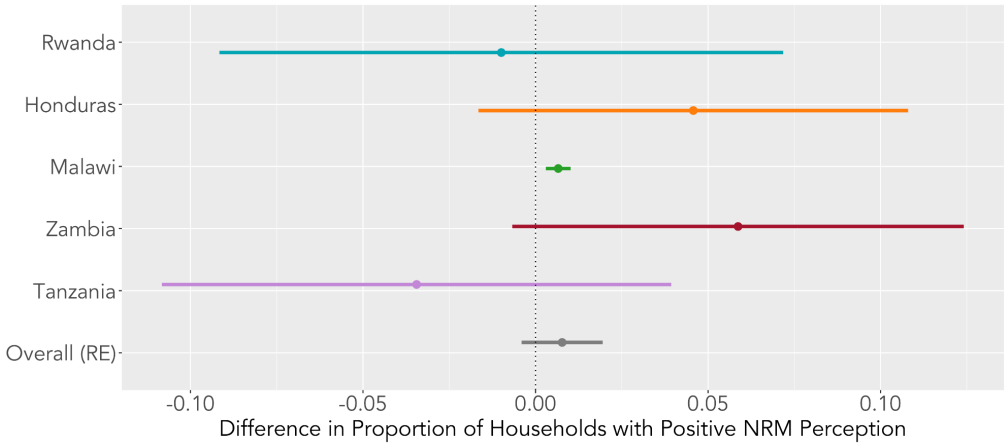

Figure 3.9 Estimated Impact on Natural Resource Management Perceptions using Random-Effects Meta-Analysis Model

All meta-analyses aggregate the findings from multiple projects. This requires making assumptions about how to aggregate the findings. We find that the findings remain constant regardless of what kind of aggregation method is used.

Exclusion of Honduras from Meta-Analysis Estimates

Table 3.2 shows that when the analysis only includes estimates from projects in Africa, where the delivery of the interventions was more similar, the overall effect becomes larger in magnitude. These findings exclude Honduras, where the individual country evaluation found that the THRIVE interventions did not consistently lead to intrinsically or statistically significant impacts. Table A1.2 in Appendix 1 includes this comparison for a longer list of outcome variables, where the conclusion is similar.

Table 3.2: Overall Effect of THRIVE on Livelihood Outcomes (Financial)

Indicator	Overall Effect (All)	Overall Effect (Africa Only)
Percentage change in annual income (CPI adjusted, USD)	0.534***	0.609***
Difference in the number of income sources	0.171***	0.192***
Difference in proportion using 4+ agricultural conservation practices	0.102**	0.124**
Difference in proportion able to fully provide for children	0.187***	0.216***
Difference in proportion reporting being fully prepared for a shock	0.128***	0.147***

* p < 0.1, ** p < 0.05, *** < 0.01

Sensitivity to Missing Data

In the original data sets, there were many variables with missing responses or responses of "don't know." There appeared to be systematic patterns in which data was missing. To test whether this systematically affects the results, we use multiple imputation methods to replace the missing data with imputed values based on the other available data, then use the imputed datasets to re-estimate the individual program treatment effects and the combined effect.

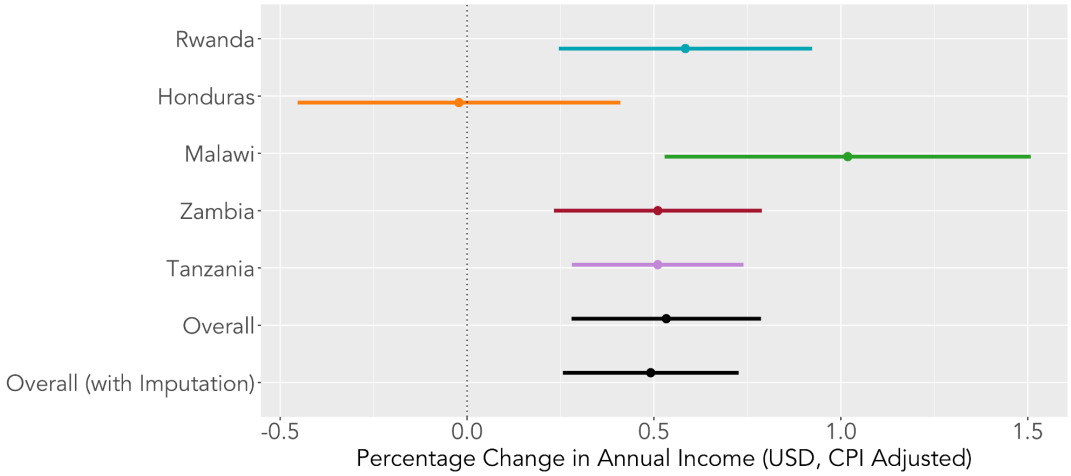

Figure 3.10: Estimated Impact on Annual Income, with and without imputation

Figures 3.10 and **3.11** show the average impact with and without the imputed data included for the findings related to annual income and child well-being. In both cases, including imputed data does not meaningfully change the direction or the significance of the findings. This is also the case for all other outcomes considered in the analysis.

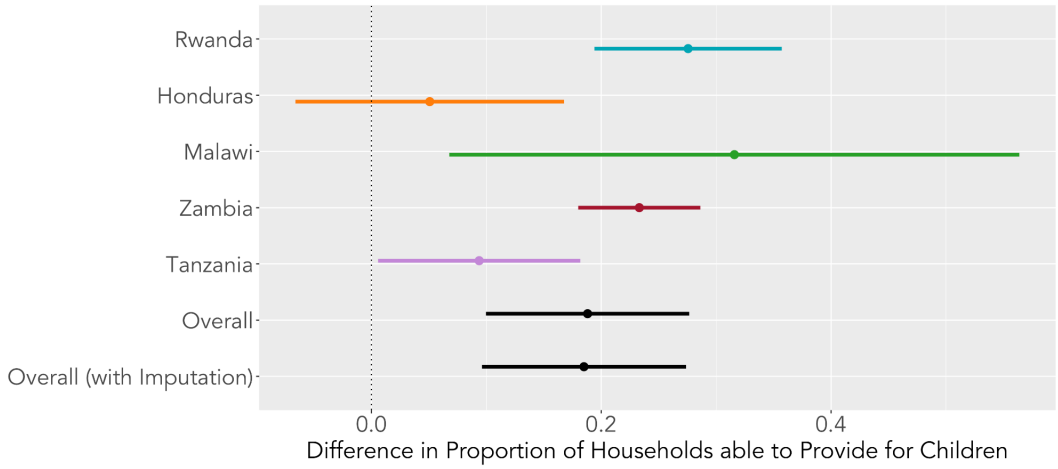

Figure 3.11: Estimated Impact on Child Well-Being, with and without imputation

3.5 Limitations of the Empirical Analysis

This section reviews the limitations of the analysis and how these limitations could affect the results and conclusions of this report. There are two main limitations of the empirical analysis.

First, without baseline data for Tanzania, Zambia, and Malawi, the evaluations for these countries assume that individuals in the treated and comparison households were similar before the interventions began. This means that if treated individuals were systematically different from individuals in the comparison group before the interventions began, any remaining differences after the program would be attributed to THRIVE even if they had already existed. This could lead to either underestimating or overestimating the average impact estimated in the meta-analysis. To minimize the effect of this, we have used propensity score matching to try to ensure individuals are similar in terms of demographic characteristics, which are expected to be more stable across time. However, this cannot correct for differences in other characteristics that aren't observed in the data.

Second, there is limited information about the counterfactual group selection for all five projects. The THRIVE interventions were not randomly assigned, and the comparison group was selected during the original evaluations based on local knowledge about the locations in the treated and comparison groups. These locations were selected several years ago, and the specific details available about how the comparison group locations were selected or what criteria were used to determine how similar they were are no longer available. Without these details, it is not possible to confirm the comparability of the comparison and treatment groups. In Rwanda and Honduras, we have been able to test for baseline differences across the two groups, which indicates that the groups have similar characteristics and baseline levels of outcomes. However, this cannot be confirmed in the other three countries.

4. Value-for-Money Analysis

Building on the meta-analysis results, Limestone conducted a VfM analysis using its Unified Cost-Benefit Analysis (UCBA) framework for impact accounting, which involves systematically defining the financial and non-financial costs and benefits of the program activities, modeling them, and aggregating them into standardized measures of value and performance. Where the meta-analysis informs about the program's impact, the VfM compares the costs and benefits to inform about whether the program was a cost-effective use of funds. The objective of the VfM analysis is to use the findings from the meta-analysis to estimate the value for money of the program.

4.1 VfM Methodology

The analysis was to be conducted to address the following questions:

- Accounting for the benefits and costs of the program, what was THRIVE's net value for individual beneficiaries and for society as a whole?
- Was THRIVE a cost-effective use of funding in each country and in aggregate?
- What were the costs per beneficiary and return on investment per country and on average?

Various analyses were considered for the VfM analysis. A rigorous **cost-benefit impact accounting** method was selected due to its ability to aggregate multiple benefit streams while accounting for potential double counting. This is crucial for programs like THRIVE, which have several impacts where economic benefits might overlap. The state of the available cost data also limits the applicability of other analyses. The cost data was provided in aggregate form, preventing the attribution of costs to specific components of the program and limiting the feasibility of analyses like cost-effectiveness analysis.

We estimated the Benefit-Cost ratio (BCR), which tells us the net present value of benefits generated for every dollar of costs required by the program. The BCR provides society-wide returns on investment rather than individual stakeholder returns on investment. This is a reasonable approach for the evaluation of social programs and philanthropic efforts, where those funding the project are not those benefiting from the spending. It is the ratio of the estimated value of aggregate benefits over the estimated society-wide costs. An alternative measure of social returns on investment calculates the net returns to society for every $1 in external funding. In the current analysis, the alternative measure leads to a nearly identical result as the BCR because the vast majority of THRIVE's costs are funded by external donors (WV) rather than from local sources.

Table 4.1 summarizes the benefits, costs, and perspectives (BC&P) that are incorporated into the VfM analysis. This table and model represent a general implementation of THRIVE.

All five countries are modeled separately; we also aggregate to get the total benefits for the entire THRIVE portfolio. The subsections that follow provide further description.

Table 4.1: Benefits, Costs, & Perspectives for THRIVE Implementations

Impacts	Direct Beneficiaries (Households)	Indirect Beneficiaries (Country)	World Vision
B1 Increased Income	✔		
B2 Decreased Livelihood Volatility	✔		
B3 Reduction in CO_2 emissions due to carbon sequestration		✔	
C1 Program Costs			✔
C2 Opportunity Cost of Improved Agricultural Techniques	✔		

Below, we provide a summary of how each of these values is estimated and discuss alternative approaches and sensitivity analyses. Prior to discussing the individual benefits and costs, we summarize some common assumptions that apply across the various estimations.

Table 4.2: Summary of the VfM high-level assumptions

Model Assumptions	
Dollar Values	All values are converted to **2020 USD** based on US BLS CPI estimates. Therefore, any dollar value reported, with the exception of the total program costs provided by World Vision are estimated 2020 dollar values.
Net Present Value estimates	The social return on investment is estimated using **Net Present Value (NPV) calculations**, applying an **annual discount rate of 9%** and calculating NPVs from the perspective of 2017, the initial year of THRIVE. The discount rate in a cost-benefit analysis captures more than just the time value of money. It also incorporates the risk concerns and other factors. 9% is a relatively standard assumption and was adopted by World Vision Canada for its cost-benefit analyses. To allow comparability across projects in the World Vision portfolio, we also adopt that standard here.
Social Return on Investment	The **benefit-cost ratio (BCR)** is the ratio of the NVP of total benefits over the NPV of total costs. A BCR greater than 1 means that the project has a positive social return. The BCR standard allows for a direct comparison between THRIVE and other social sector projects, which we provide in Section 5.
Inputs from the THRIVE program dashboard	The VfM uses the values reported through WV's THRIVE dashboard to estimate the number of beneficiaries by gender, as well as new participants and trees planted per year.
Inputs from the	The VfM uses the results from the meta-analysis to estimate the impact of

meta-analysis	THRIVE on (i) household income, (ii) improved farming practices, and (iii) financial inclusion status. It also provides baseline income data.
Inputs from external models of household finance	We calibrated a model of household income, savings, and consumption to estimate the benefits associated with a reduction in income and consumption volatility associated with both any increase in financial inclusion and the reduction in income volatility due to THRIVE's farming practices. This is discussed in more detail below.
Timeframe	The primary model considers benefits and costs incurred since 2017. Reported program costs are assumed to be uniformly spread from baseline to endline. Benefits to direct beneficiaries are assumed to last three years beyond the endline. The benefits to the environment from planting trees are assumed to last 20 years beyond the final program date.[8] We consider alternative assumptions around costs and benefit timelines in the sensitivity analysis.

Table 4.3: Summary Inputs By Country

	Honduras	Malawi	Rwanda	Tanzania	Zambia
Total Participants	17,020	17,098	15,287	9,201	15,917
Percentage Female	50.99%	71.65%	56.16%	63.01%	51.23%
Mean Income at Baseline (2020 USD)	$14,410	$522	$527	$1,024	$1,127
Percent Change in Income due to THRIVE	0.00%	108.84%	58.40%	51.00%	51.02%
Increase in Percent Financially Included due to THRIVE	6.33%	2.02%	4.76%	16.45%	34.17%
Annual value financial inclusion (2020 USD)	$820	$65	$47	$105	$136
Annual value increased income stability (2020 USD)	$343	$234	$14	$103	$181
Number of Trees Planted	1,369,705	400,620	6,124,571	6,671	16,018,203

B1 Increased income

The income effects of THRIVE participation represent a fundamental benefit that encompasses many gains, such as an increase ability to provide for children and improved nutrition through the cultivation and consumption of more diverse crops. Concerns about double counting benefits mean that because the income benefits are modeled, one should not also count the other benefits that accompany higher income. By capturing the

[8] This is consistent with Limestone, World Vision Canada, and Millenneum Challenge Corproation guidelines for the valuation of infrastructure investments.

increased income alone, we inherently account for these interconnected benefits.

The meta-analysis estimated the average increase in income that participants experienced because of THRIVE. We include separate estimates for each country, and where the analysis had sufficient power to identify income effects for males and females separately, we include independent estimates by gender within each country. The primary model specification assumes that these income benefits first occur the year after a household begins participating in the program and persists for three years after endline. We use the coefficient estimates from the meta-analysis even when they are insignificant, as they still provide the best available estimate of the program's income effect.

Table 4.4: Details for Income Effects Included in Primary VfM Analysis

	Honduras	Malawi	Rwanda	Tanzania	Zambia
Percent Change in Income	0.00%[9]	108.84%	58.40%	51.00%	51.02%
Percent Change for Females	NA[10]	110.24%	65.53%	53.31%	NA
Percent Change for Males	NA	95.02%	56.41%	48.33%	NA

We assume that beneficiaries first experience income effects in the year following their entry into THRIVE and their empowered worldview participation and that they persist for three years following the endline. We consider alternative timeline assumptions in the sensitivity analysis.

B2 - Decreased livelihood volatility

THRIVE's interventions aim to improve the resilience of its participants. Participating in savings groups, access to credit and savings mechanisms, and climate-sensitive agriculture practices, while all contributing to income growth, also aim to prevent significant losses of consumption during periods of shocks. This allows for more stable consumption over time. To calculate this benefit, we adapt an economic model of household income and consumption to incorporate THRIVE's resiliency benefits, calibrate the model with country and program data, and then use the model to estimate the equivalent cash transfer required to produce similar utility benefits as those generated by the decrease in lifetime volatility.

The model captures THRIVE's resiliency benefits through two different mechanisms. The

[9] The meta-analysis income effect estimate for Honduras is -2.18% and is highly statistically insignificant and indistinguishable form 0. Absent any significant results, we assume that THRIVE has non-negative income effects and drop the negative value to ensure a more-straightforward analysis. In sensitivity analysis, we consider a negative value for Honduras.

[10] We only assume different income effects for males and females when they are both statistically different from 0 within the country. When that is not the case, we rely on the combined analysis assuming that both males and females have similar income effects due to THRIVE.

first mechanism is improved crop production and income diversification during periods of shock. In the model, this is modeled as the household facing a smaller decrease in income during a period of shock. Income decreasing by less allows the household to maintain more consistent levels of consumption during periods of shock, raising their lifetime utility. The second mechanism is access to credit and savings mechanisms, also referred to as financial inclusion. This has two effects on the model: it allows THRIVE participants to borrow (i.e., savings can fall below zero) and reduces the cost of consumption tomorrow as they earn interest on all savings. Both of these mechanisms allow participants to smooth their consumption over periods of shock, raising their lifetime utility compared to the counterfactual no-savings group. However, not all in the comparison group were financially excluded and thus, this additional consumption smoothing benefit is only realized by the individuals who would have remained financially excluded if THRIVE were not to have happened.

These benefits are evaluated using a standard household finance model and data on the severity of income shocks. The model estimates the equivalent monetary transfer that would have resulted in the same utility benefits for households as does the estimated decline in volatility that results from THRIVE. **Table 4.3** above lists the annual value associated with THRIVE's impact on reduced volatility for the average participant household.

B3 - Reduction in CO2 emissions due to carbon sequestration

The third benefit captures the impact of THRIVE's NRM activities, which include practices such as planting and regenerating trees, water catchment, and soil conservation. While these practices yield significant environmental benefits, methods to monetize the benefits of decreased soil erosion and water conservation are not well-established in value-for-money (VfM) and cost-benefit analyses. As a result, we were unable to include these environmental benefits in the analysis.

This benefit focuses specifically on the sequestration of carbon resulting from planted and regenerated trees. By valuing the environmental benefits of carbon sequestration separately from direct economic gains in farm productivity, we avoid double counting and ensure a comprehensive understanding of THRIVE's contributions. This approach highlights THRIVE's role in promoting environmental sustainability and contributing to climate change mitigation through enhanced carbon capture. These benefits are realized at the country level, meaning the benefits accrued are not directly realized by the participants.[11] These benefits are calculated by estimating the hectares of regrowth associated with trees planted through THRIVE, accounting for survival over time,

[11] Theoretically, participants earn some benefit due to the reduction in CO2 however, the distribution of these benefits across regions within each country depends on each regions sensitivity to climate change. To avoid making indefensible assumptions, the team attributes this benefit to the country as a whole.

estimating the CO_2 sequestration associated with the increase, and then calculating the value associated with the CO_2 reduction using established methods.

C1 - Program financial costs

The primary cost of the program is the direct project costs financed by WVUS. The costs were provided in aggregate, meaning an overall project cost was provided, which included all costs associated with implementation between baseline and endline. We assume that the reported costs are spread evenly across each year.

C2 - Time cost of improved agricultural techniques

The second cost captures the additional time required for participants to implement the improved agricultural techniques promoted by THRIVE. All time has value, and through participating in THRIVE, participants had to give up time that could have been spent on leisure, other work, etc. It is important to account for the additional time that people spend on their farming and participation activities under THRIVE rather than the costs that would have been incurred even in the absence of THRIVE. However, little is known about the extra time that THRIVE participation involves. We assume that the typical THRIVE participant spends one extra hour per week on livelihood activities due to THRIVE, and those who THRIVE caused to use 4+ improved farming techniques spend an extra 2 hours per week on livelihood activities on average.

Omitted Benefits

The systematic comparison of a program's costs and benefits comes with several challenges. A frequent pitfall comes in double counting benefits or costs, which will bias the results. For example, the value of increased income already includes the value of goods and services purchased with that income, including shelter, food, and more general impacts such as "the ability to provide for children." On the cost side, double counting may involve considering both the financial costs and the value of the goods and services purchased with that funding. This means that some clear benefits and costs of the program are not included because they are already partially or completely captured by the included benefits..

Improvements to Nutrition: Improved nutrition is a likely benefit of the THRIVE program. Both improved cultivation of nutritious foods and the purchase of additional food are likely due to having higher incomes. Following the Millennium Challenge Corporation (MCC) guidelines on agricultural CBA (Szott & Motamed, 2024), we do not directly calculate the benefits of nutrition as it is generally assumed that the value of the nutrition a food contains is reflected in the price of the food. Therefore, the value of the nutrition would be accounted for by the change in income and the amount spent on food. The guidelines note that it is possible that the market prices do not reflect the nutritional benefits, and thus, the market price underestimates the social benefits (Szott & Motamed, 2024). However,

calculating this would require significant evidence that the prices do not account for the nutrition. Therefore, to avoid double counting, we do not directly calculate the benefits of improved nutrition and instead assume that it is captured by the increase in income due to THRIVE.[12]

Induced Benefits: Another benefit that may be considered is the spillover effects for agriculture-adjacent industries. The logic of this benefit is that higher income for agricultural productivity results in the increased utilization of agricultural support services, which may spur more investment for these industries. While the logic of these benefits is quite sound, the evidence of their realization is quite sparse. MCC reports that its independent evaluations have failed to find any significant impact of their agricultural interventions on induced benefit (Szott & Motamed, 2024). To remain conservative and to ensure the most accurate accounting of benefits based on the available evidence, we are omitting any potential spillover effect or induced benefits from the analysis.

More details of the description of the costs and benefits, including the analytical equations, are included in the Appendix.

4.2 Value-for-Money Results

The following results are presented in the author's preferred specifications of the model, which include a 9% social discount rate, the exclusion of null (or statistically insignificant results at the 90% significance level), and no impact after the endline survey.[13] These assumptions, while conservative, represent the most defensible specification of the model. All values in this section are reported in 2024 USD unless otherwise specified.

Results

Overall, THRIVE's operations can be considered cost-effective. **Table 4.5** contains an overview of the headline results for each country. The project created $254 million in NPV of benefits for a cost of $37.7 million (2024 USD), resulting in a net present value (NPV) of $216 million. The benefit-cost ratio (BCR) is 6.68, meaning that every dollar worth of costs incurred to implement and participate in THRIVE led to $6.68 in social benefits.[14] THRIVE is also estimated to result in the sequestration of nearly 16 million tons of carbon dioxide.

[12] It should also be noted that this represents a conservative estimate of the benefits of THRIVE.
[13] With the exception of infrastructure, in this case the lifespan of planted trees.
[14] We should note that BCR is technically not the same as the return on investment for THRIVE. This is because it includes costs incurred by participants in the bottom of the BCR equation. A more comparable measure to return on investment would be the net social returns for every dollar spent by WVUS. Due to the relatively small costs incurred by participants this measure is virtually identical across all countries. We therefore, use BCR as the main measure of the investments return.

Table 4.5: THRIVE's Headline Results by Country and Portfolio (2020 USD)

	Honduras	Malawi	Rwanda	Tanzania	Zambia	Overall
Program Costs per beneficiary	$576	$285	$472	$520	$691	$506
NPV of value gained per household (NPV)	$4,810	$3,016	$1,940	$2,869	$3,895	$3,375
Net Present Value	$72,094,099	$46,718,742	$22,727,564	$21,615,940	$52,798,094	$215,954,438
Benefit-Cost Ratio	8.20	10.54	4.15	5.47	5.79	6.68
Tons of Carbon Sequestered	215,246	275,169	4,206,705	963	11,002,217	15,700,299

Benefit-Cost Ratio: The following figure shows the BCR for each of the countries in which THRIVE was implemented, as well as the portfolio's overall BCR (highlighted in pink). Rwanda has the lowest BCR at 4.25. The most cost-effective implementation was Malawi, which returned $10.54 in benefits for every dollar in costs reflecting in part the highest percentage increases in income of all implementations. Honduras also performs better than average, reflecting the fact that the country has substantially higher average incomes than the other implementation locations, which contribute to the economic value associated with decreased volatility in livelihood outcomes. Therefore, Honduras performs relatively well despite recording no positive impacts on average earnings.

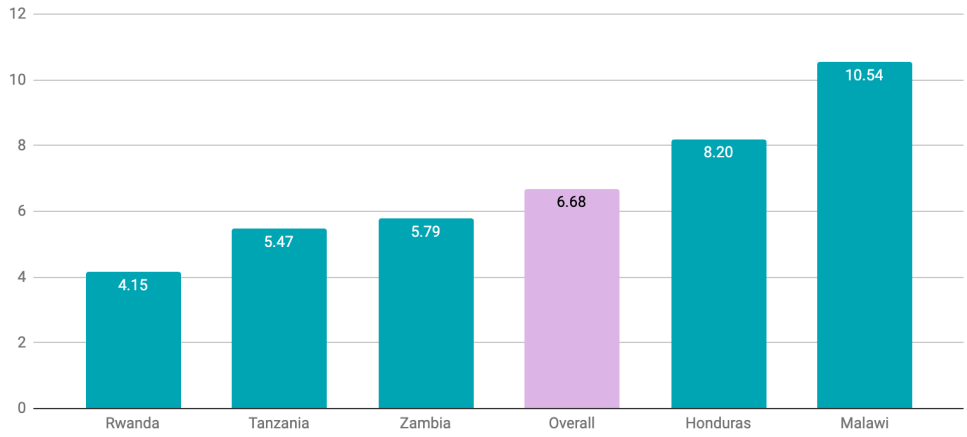

Figure 4.1: Benefit-Cost Ratio for THRIVE Implementations

Figure 4.2 contains a breakdown of the NPV by benefit and cost channel. THRIVE's most significant economic impact is its effect on participant's income, which accounts for 55% or $139 million in the NPV of benefits (2020 USD). The decrease in livelihood volatility is the second largest benefit, accounting $113 million or 44% of the program's net benefits.

Another way of interpreting this is that the value participants get from a more stable income and financial inclusion are nearly as important as the gains to income themselves. The external benefits to the environment make up only 1% of the present value of total gains..

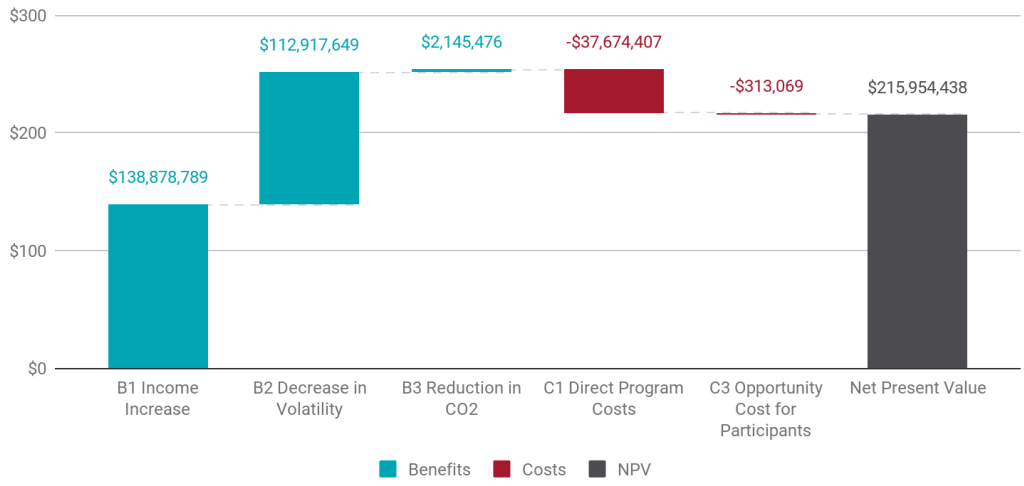

Figure 4.2: Breakdown of the THRIVE's Estimated Net Present Value (2020 USD)

Figure 4.3 contains the aggregate benefits and costs per participating household for each of the five THRIVE countries and the overall portfolio. Overall, THRIVE created $3,375 in NPV of benefits for each participating household at an NPV of cost of $506 per household. The returns were substantial across countries.

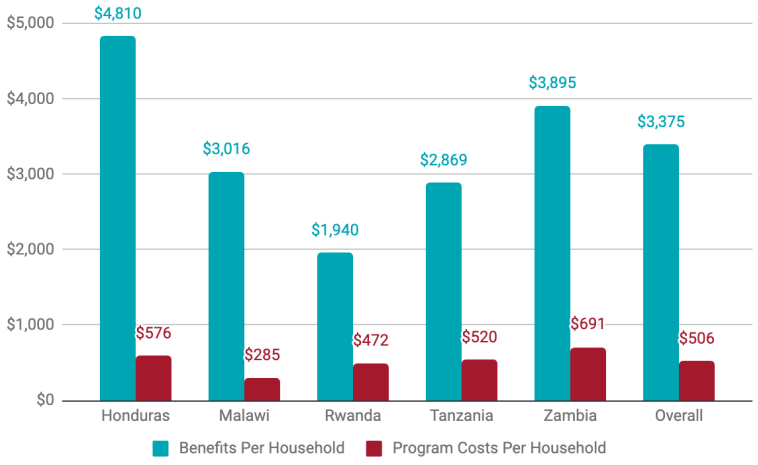

Figure 4.3: Benefits and Costs per Participating Household (2020 USD)

Zambia accounts for the largest share of carbon sequestration (more than 11 million tons), accounting for 70.1% of the portfolio's emissions reduction. This result follows from more

trees being planted in Zambia (more than 16 million trees) than in the rest of the portfolio combined (nearly 8 million trees).

Table 4.6: Tons and Value of CO2 Sequestration from THRIVE

	Honduras	Malawi	Rwanda	Tanzania	Zambia	Overall
Total Tons of CO2 Sequestered	215,246	275,169	4,206,705	963	11,002,217	15,700,299
Value of Sequestered Carbon	$82,112,450	$30,593	$282,381	$528	$1,800,187	$2,145,476

Perspective Analysis

Figure 4.4 compares the estimated benefits per household by the gender of the THRIVE participant. On average, female participants experience slightly larger income gains and are more likely to transition to financial inclusion due to THRIVE. The data is not sufficient to identify separate effects by gender in Honduras.

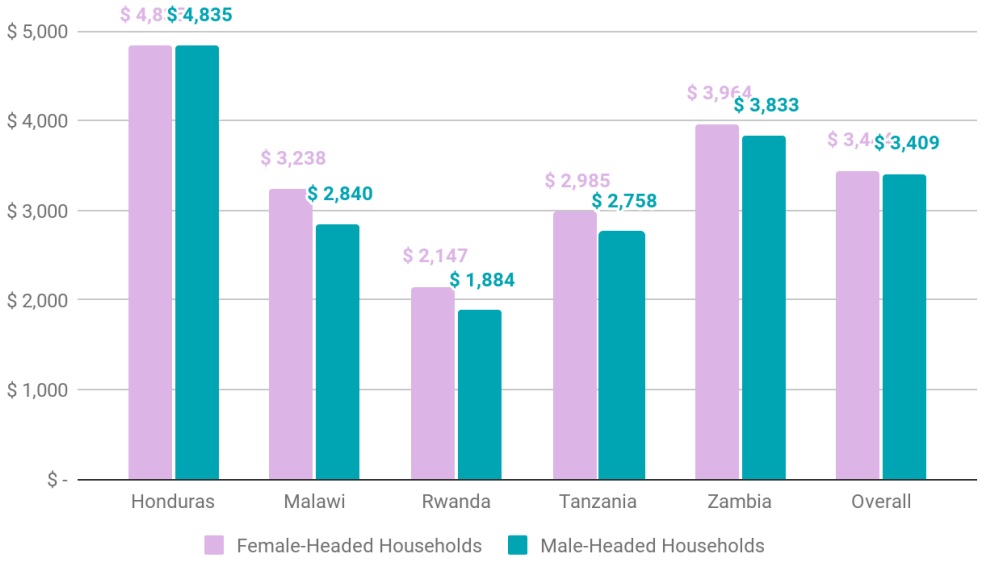

Figure 4.5: Breakdown of Net Present Value by Stakeholder (2020 USD)

4.3 VfM Sensitivity Analysis

The VfM analysis provides a conservative, best guess of the program's relative benefits and costs. It relies on a series of justifiable assumptions. This section considers how sensitive the results are to alternative assumptions.

Duration of Benefits

The VfM assumes that the impact of THRIVE on direct beneficiaries will last for three years after the endline. This is a reasonable assumption, given the existing evidence on the lasting effects of livelihood programs. It could be reasonable to assume an even longer time horizon for some of the benefits.

Table 4.7 presents BCR estimates for each country and overall under four alternative scenarios, ranging from no household benefits lasting beyond the endline to benefits lasting five years beyond the endline. While the alternative assumptions change the aggregate and NPV of benefits B1 and B2, the changes are not substantial enough to overturn the general results. Even under the most conservative of assumptions, THRIVE remains a cost-effective program across all countries.

Table 4.7: Benefit-Cost Ratios Under Alternative Benefit Duration Assumptions

	Honduras	Malawi	Rwanda	Tanzania	Zambia	Overall
Direct benefits end at endline	6.07	7.10	3.01	3.29	4.11	4.70
Direct benefits last 1 year beyond endline	6.84	8.35	3.45	4.08	4.72	5.42
Direct benefits last 3 years beyond endline	8.20	10.54	4.15	5.47	5.79	6.68
Direct benefits last 5 years beyond endline	9.33	12.36	4.76	6.64	6.69	7.75

Allowing Negative Impacts on Income

The VfM assumes that THRIVE does not decrease income. Because of this, we assume that THRIVE has no impact on average household income in Honduras. Alternatively, we could assume that THRIVE can have a negative impact on income and use the Honduras income estimate of -2.18%. Assuming that participation in THRIVE decreases income in Honduras in this way decreases the household benefits in Honduras and overall. The NPV of benefits in Honduras falls to $51 million after accounting for an aggregate decrease in income of nearly $31 million (2020 USD). However, because of the magnitude of the other benefits relative to costs, the program still maintains a BCR of 5.14 in Honduras (down from 8.20) and 5.88 overall (down from 6.68).

Accounting for Costs Incurred Prior to 2017

THRIVE-related programming started in Malawi and Tanzania prior to 2017. This creates some uncertainty in the timing of expenditures and benefits in these countries. The primary analysis assumes that the reported costs are spread evenly between baseline and endline and that only the share of costs attributed to 2017 and later are associated with programming for the people who are recorded as participating in THRIVE after 2017.

An alternative assumption includes all pre-2017 costs in the analysis. To test the sensitivity of the results to the inclusion of such costs, we assume that the entirety of the pre-2017 costs occur in 2017.

Table 4.8: Updated values when pre-2017 costs are included in estimates (2020 USD)

	Malawi	Tanzania	Overall
Original BCR	10.54	5.47	6.68
BCR with pre-2017 costs	8.67	2.78	5.81
Program costs per beneficiary with pre-2017 costs	$347	$1,030	$583
Net present value with pre-2017 costs	$45,662,846	$16,923,071	$210,205,673

This analysis includes one additional year of cost data for Malawi and four additional years of cost estimates for Tanzania. As such, the impact on Tanzania is substantial; although the program remains a cost-effective program with a BCR of 2.78 after the adjustment.

Reduced Volatility Benefits

THRIVE related programming started in Malawi and Tanzania prior to 2017. This creates some uncertainty in the timing of expenditures and benefits in these countries. The primary analysis assumes that the reported costs are spread evenly between baseline and endline and that only the share of costs attributed to 2017 and later are associated with programming for the people who are recorded as participating in THRIVE after 2017.

Table 4.9: Benefit-Cost Ratios Under Alternative Volatility Impacts

	Honduras	Malawi	Rwanda	Tanzania	Zambia	Overall
Original BCR	8.20	10.54	4.15	5.47	5.79	6.68
50% Volatility Reduction Benefit	4.10	9.93	3.87	4.96	5.07	5.20
25% Volatility Reduction Benefit	2.05	9.62	3.74	4.70	4.71	4.46
0% Volatility Reduction Benefit	0.00	9.31	3.60	4.44	4.35	3.71

Reducing the benefits associated with reduced volatility in the model has the most substantial impact on the results for Honduras, where there was no observable income increase associated with the program. Even if we assume that the volatility reduction benefits are only 25% of the estimated values, the BCRs are still greater than one across all projects and a strong 4.46 overall. However, it is important to emphasize that Honduras

may not be as good of an implementation if it is unlikely that THRIVE is substantially affecting income stability.

Increased Cost of Participation

The primary specification of the model assumes that THRIVE is a minimally time-consuming program for participants, with the majority of participants spending on average one additional hour per week on THRIVE-related activities and those who are seen to increase the use of improved agricultural techniques spending two hours. These are reasonable estimates, given that there is no data available on time associated with different THRIVE activities, and there is little reason to believe that THRIVE is substantially increasing the time requirements (as opposed to efficiency) of farming activities.

However, to be certain that our assumption is not driving the results, we consider alternative participation time requirements as a sensitivity analysis.

Table 4.10: Benefit-Cost Ratios Under Alternative Volatility Impacts

	Honduras	Malawi	Rwanda	Tanzania	Zambia	Overall
Original BCR	8.20	10.54	4.15	5.47	5.79	6.68
BCR with 5 x time costs	7.56	10.37	4.13	5.25	5.74	6.47
BCR with 10 x time costs	6.90	10.16	4.10	5.00	5.69	6.22

The table shows that even large increases in the assumed opportunity cost of the program, either by increasing the hours required or the marginal cost of time has little impact on the overall cost-effectiveness of the program.

5. Conclusions

5.1 Revisiting the Research Questions

In concluding the analysis, we discuss each of the initial research questions.

How effective was THRIVE in improving livelihood and resilience outcomes? What outcomes did THRIVE impact most?

The meta-analysis conducted a country-level and aggregated analysis of the THRIVE program's impact. We estimate THRIVE's impact across 24 key performance indicators related to livelihoods and resilience. The results strongly support the conclusion that THRIVE had a statistically significant and meaningful impact on outcome measures across categories.

Table 3.1 shows the effect of the program across the key indicators. To provide a another measure of impact across outcome for purposes of comparison, we calculate standardized Cohen's D values for the differences in treatment and comparison groups at endline for each output by country. **Table 5.1** ranks the top 10 outcomes by the average Cohen's D score across the five counties. These values represent the average standard deviation differences in outcomes between treatment and comparison groups. **Table 5.2** shows the outcomes with Cohen's D scores less than 0.1 SD in magnitude. Table A1.1 in the appendix provides a full list of Cohen's D values by country and on average across countries.

Cohen's D is a measure of the difference between two groups in terms of how many standard deviations apart they are. It helps show the size of an effect or difference, making it easier to understand whether a change or difference is meaningful beyond just statistical significance. In general, Cohen's D values of 0.2 are interpreted as "small", values of 0.5 are interpreted as "medium", and values of 0.8 are typically characterized as indicating "large" effect sizes.

Table 5.1: Top 10 Endline Treatment-Comparison Differences, Ranked by Aggregate Cohen's D

	Aggregate		Aggregate
HFIAS (food insecurity & access)	-0.686	Empowerment index	0.496
Having cash savings	0.649	Ability to provide for children without external support	0.481
Has disaster management plan	0.571	Being fully prepared for a shock	0.480
Household Dietary Diversity Score	0.531	Annual income (USD)	0.432
Receives early warning information	0.523	Use at least 4 agricultural practices	0.342

Table 5.2: Lowest Ranked Endline Treatment-Comparison Differences by Aggregate Cohen's D

	Aggregate
Positive NRM Perceptions	0.039
More than 1 lower-risk income source	0.101

These values suggest that THRIVE had the biggest relative impact on measures related to savings, income, risk planning, food security, and the ability to provide for children. It was associated with much smaller differences in outcomes related the number of lower-risk income sources and support for NRM.

While these standardized comparisons are insightful, they do not necessarily reflect the importance of THRIVE's impact on quality of life or well-being. They also do not control for other differences between the treated and comparison groups. When these differences are taken into account in the meta-analysis, certain outcomes stand out more than others.

Of particular note is the large and significant impact that THRIVE is estimated to have had on household annual income, increasing income by approximately 53%, on average. This substantial change in income contributed directly to several other positive outcomes, such as an increased ability to provide for children without external assistance, food security, and asset scores, and the reduction in the share of households living below the poverty line.

Based on our analysis, more than four thousand fewer families live below the poverty line because of THRIVE, 14 thousand additional families report being able to provide for children without external assistance, and nearly 10 thousand additional households report being fully prepared to deal with agricultural shocks. On the environmental side, THRIVE resulted in an estimated $2.7 million in aggregate social value from 24 million additional trees reducing carbon by 16 million tons. These are substantial impacts.

Are there differences in effect size by country? Are there contextual factors that explain these differences?

We observe variation impact across countries. This does not necessarily imply that THRIVE was better implemented in the places where it resulted in relatively large impacts, as the differences in performance may also reflect different challenges, opportunities, or needs across locations.

Given that THRIVE's implementation adapted to the expected needs of the beneficiary populations, it is not necessarily the case that THRIVE was better designed or better implemented in the countries in which it performed relatively better. Rather, the

differences in performance may reflect differences in the challenges and needs of the beneficiaries across contexts.

Section 2 includes a high-level overview of each country's agricultural environment, highlighting several contextual factors that may affect differences in performance across locations.

It is important to highlight the differences in THRIVE's impact on income in Honduras. THRIVE had a substantial, meaningful impact on household income in each of the four African implementations and in the aggregate meta-analysis results. In Honduras, however, the results around income are less favorable, showing no change in average income or number of income sources due to participation in THRIVE. The income results in the only Latin American implementation were statistically insignificant and very small in magnitude. While we cannot decisively conclude why the income effects are so different in Honduras, it is clear that there is something different about the Honduras context or implementation that is driving these differences. In Section 2, we discuss several factors that may lead to less effective programming in these environments, including differences in access to productive land. There may be differences in THRIVE implementation or exposure to other government or NGO programming in the comparison group that we are unable to observe in the data.

Furthermore, there is some anecdotal evidence in some of the locations that THRIVE programming frequently spilled over to the comparison group sample. Such spillovers work against the empirical analysis leading to an underestimation of the program's true impact. To the extent that spillovers differed across contexts, they may contribute to the differences in estimates across countries.

Accounting for the benefits and costs of the program, what was THRIVE's net value for individual beneficiaries and for society?

The Value-for-Money (VfM) analysis utilizes Limestone's UCBA framework for impact accounting to rigorously define and systematically compare the value of the program's costs and benefits to society. This includes accounting for the financial and non-financial costs and benefits to donors, beneficiaries, and society more broadly.

We estimate that THRIVE has impacted 74,523 households since 2017, providing a **NPV benefit worth $3,375 (2024 USD) to each household** after accounting for their gains in income and financial resilience, and their costs of participation. The estimated net benefit was slightly higher for female participants than male participants.

The THRIVE program cost approximately $55 million. A net present value analysis to assess aggregate costs and benefits of the program from the perspective of 2017 estimates that the present value of costs were $38 million compared to $254 million in benefits. In total, **THRIVE had a net present value of $216 million (2024 USD).** This accounts for the

improved income and financial resilience among households, as well as an aggregate environmental benefit equal to approximately $2.7 million due to improved agricultural practices that led to the sequestration of 16 million tons of carbon.

The VfM analysis breaks these estimates out by country.

What were the costs per beneficiary and return on investment per country and on average?

The primary measure of return on investment in the VfM compares total society-wide benefits to total society-wide costs. This Benefit-Cost Ratio (BCR) represents the total value of social good created with every $1 worth of financial and time investment into a project, regardless of who is undertaking the investment.

Overall, **every $1 in costs resulted in $6.68 in benefits** to society. The VfM analysis breaks this out by country, showing that BCR is substantially greater than 1 (the break-even value) for all five countries, ranging from 4.15 in Rwanda to 10.54 in Malawi.

One contributing factor to the differences in BCR across countries is the differences in costs per beneficiary. **Table 5.3** reports the program costs per beneficiary alongside the BCRs.

Table 5.3: THRIVE Program Costs and BCRs by Country

	Honduras	Malawi	Rwanda	Tanzania	Zambia	Overall
NPV program costs per beneficiary	$576	$285	$472	$520	$691	$506
Benefit-Cost Ratio	8.20	10.62	4.15	5.47	5.79	6.68

Was THRIVE a cost-effective use of funding, in each country and in aggregate?

If its BCR is greater than 1, a project's net social benefits outweigh its costs. This is the case across all five of the THRIVE implementations, suggesting that the projects were all worthwhile given their costs. Overall, we conclude that **THRIVE is a cost-effective program that has a meaningful impact on the lives of its beneficiaries**, suggesting that the project represents money well spent.

To provide additional insight into this question, we compare the BCR for TRIVE with those from other programs. **Table 5.4** provides a comparison with the estimated returns from other World Vision activities.

Table 5.4: Estimated BCRs for Select World Vision Programming[15]

	BCR		Avg
WASH programming	14.4	Savings for Transformation	5.6
Unlock Literacy	7.7	Positive Parenting	4.4
THRIVE	**6.7**	Farmer-Managed Natural Regeneration	2.1
Citizen Voice & Action	6.2	WV-World Food Programme projects	2.0

Source: World Vision Canada and this analysis

This comparison suggests that THRIVE offers good value for money compared to other programming, particularly involving agriculture and livelihood interventions. Furthermore, it suggests that THRIVE, by combining Savings for Transformation with elements from other programming, may provide greater cost-effectiveness than its individual components. This suggests that THRIVE's multi-component nature adds value.

The conclusion that THRIVE offers good value for money compared to other development programming, particularly in the agriculture and livelihoods space, is further supported by a comparison of BCR estimates for individual projects and social investment proposals within the countries in which THRIVE operates.

The Malawi Priorities Project, for example, calculated BCRs for 56 different social investment opportunities in Malawi. This included policy and institutional reforms, infrastructure investments, and social sector programs across many sectors. Of these 56 potential social-sector investments, only 11 had higher BCRs than THRIVE in Malawi, and the majority of these were in unrelated sectors to THRIVE. **Table 5.5** provides a comparison of BCRs between THRIVE in Malawi and related interventions assessed through the Malawi Priorities Project.

Table 5.5: BCRs for THRIVE and Malawi Priority Project interventions[16]

	BCR		Avg
Agricultural commodity exchange reform	16	PICS bags (for safe crop storage)	2.9
Improved early warning systems	16	Crop diversification efforts	2.0
THRIVE Malawi	**10.5**	Poultry outgrower model	1.3
Irrigation support	3.3	Training for quality control	1.2
Climate-smart agriculture	3.0	Agro credit guarantees	1.1

[15] The non-THRIVE values were reported during a joint World Vision Canada and Limestone Analytics presentation at the Society for Benefit Cost Analysis in Washington, DC in March 2024. They are based on the work conducted through the World Vision Citrus collaboration. See also World Vision (2023a, 2023b).
[16] Limestone collaborated on the Malawi Priorities Project for the Malawi National Planning Commission, producing several of the 56 BCR estimates using its UCBA framework for impact accounting. For details regarding the BCR estimates for the 56 social investment opportunities see Malawi Priorities (2021), including https://copenhagenconsensus.com/sites/default/files/documents/malawi_priorities_project_trifold_a4.pdf and https://copenhagenconsensus.com/malawi-priorities/background

Source: Malawi Priorities Project and this analysis

Again, we see that THRIVE offers a relatively high social return on investment compared to other development interventions, supporting the conclusion that THRIVE offers substantial value relative to its costs and relative to alternative uses for funding.

5.2 Recommendations for future data collection

In conducting the analysis, the team noted areas in which future efforts should be focused to improve subsequent analysis of THRIVE programming. Below, we present the recommendations and the reasoning behind them.

Documentation of Changes in Programming: The program collected component data in the surveys; however, in most cases, participation in the main components, Savings Groups, Farmer Associations, Producer Groups Horticulture Farming, and Empowered Worldview, was relatively low. The low participation rates suggest that programming deviated from the initial methods in the THRIVE or Building Secure Livelihoods documentation. To better understand what interventions drove impacts, details about the quality or intensity of the programming, along with information about variations in program implementation should be recorded in the surveys and evaluation reports.

Collecting more Granular Cost Data: The current cost data was provided in aggregate, meaning only a single estimate for the entire program cost was provided for each country. Cost data should be broken down by component (intervention) to allow for incremental analysis of the cost-effectiveness or VfM of each component. At a minimum, the program cost should be broken down by year to reflect the realities of program implementation.

Clear Documentation of Comparison Group Selection Criteria: The analysis in this report relies on the assumption that the comparison group represents a suitable counterfactual to the treatment group. Methods to account for this were conducted. However, we need detailed information on the selection criteria to directly confirm that they are suitable counterfactuals. Future analyses should clearly outline the selection criteria for comparison areas to ensure comparability.

Ensuring Gender Analysis is Sufficiently Powered: THRIVE saw large impacts for female-headed households. These impacts were not always statistically significant and often suffered due to a lack of power. Future analysis should ensure that the sample size for female beneficiaries is sufficiently large enough to reliably detect effect sizes and that this kind of demographic data is consistently collected to allow for this kind of analysis.[17] This will improve the reliability of these findings and enable more accurate assessments of the program's gender equity.

[17] Missing demographic information on many of the observations in the sample contributed to these concerns.

Appendix 1: Additional Meta-Analysis Results

Endline Comparisons of Outcomes

Table A1.1: Comparisons between treatment and comparison groups at endline (Cohen's D)

	Honduras	Malawi	Rwanda	Tanzania	Zambia	Aggregate
Outcome 1: Livelihoods (General Wellbeing)						
Ability to Provide for Children Without External Support	0.126	0.672	0.479	0.217	0.484	0.481
Household Dietary Diversity Score[18]	0.298	0.928	0.310	0.125	0.580	0.531
Household Food Inscurity & Access Scale[19]	-0.389	-0.989	-0.575	-0.423	-0.366	-0.686
Proportion Below the National Poverty Line	-0.331	-0.259	-0.239	-	-0.546	-0.274
Outcome 1: Livelihoods (Financial)						
Annual Income (USD)	0.131	0.619	0.565	0.426	0.382	0.432
Number of income sources	0.066	0.208	0.389	0.225	0.216	0.203
>1 Lower Risk Income Streams	-0.058	0.123	0.096	0.181	-	0.101
Having Cash Savings	0.651	0.753	0.723	0.466	0.764	0.649
Savings at Formal Finance Institution	-	0.069	-0.015	0.125	0.735	0.270
Can Access a Loan	0.050	0.063	0.529	0.482	-	0.273
Outcome 1: Livelihoods (Assets)						
Animal Assets	0.092	0.721	0.228	0.266	0.521	0.270
Household Assets	0.223	0.340	0.099	0.218	0.416	0.284
Productive Assets	0.128	0.834	0.427	0.136	0.340	0.270
Transportation Assets	0.265	0.371	0.032	0.062	0.403	0.269
Outcome 2: Natural Resource Management						
Use At Least 4 Agricultural Practices	0.361	0.566	0.349	-0.043	0.352	0.342
Participates in Management of On-Farm Water Resources	0.409	0.537	0.100	-0.166	0.602	0.278
Positive NRM Perceptions	0.013	0.115	0.064	-0.098	0.133	0.039

[18] HDDS is a standardized measure to assess the dietary diversity of households. For more information see https://inddex.nutrition.tufts.edu/data4diets/indicator/household-dietary-diversity-score-hdds
[19] HFIAS is an experience-based food insecurity scale developed by the United States Agency for International Development (USAID). For more information see https://inddex.nutrition.tufts.edu/data4diets/indicator/household-food-insecurity-access-scale-hfias

Reports Disaster Management Plan	0.318	0.810	0.384	0.201	0.765	0.571
Receives Early Warning Information of Shock	0.217	0.767	0.419	0.262	0.615	0.523
Avoided Negative Coping Mechanism	-0.014	0.089	0.205	0.040	0.155	0.114
Being Fully Prepared for a Shock	0.324	0.687	0.329	0.278	0.423	0.480
Reports Preparing for a Shock	0.146	0.115	0.510	-0.027	0.629	0.247
Empowerment Index	0.204	0.543	0.546	-	0.506	0.496
Aspirations & Confidence Index	0.087	0.111	0.122	-0.004	0.135	0.105

Additional Livelihood Outcomes

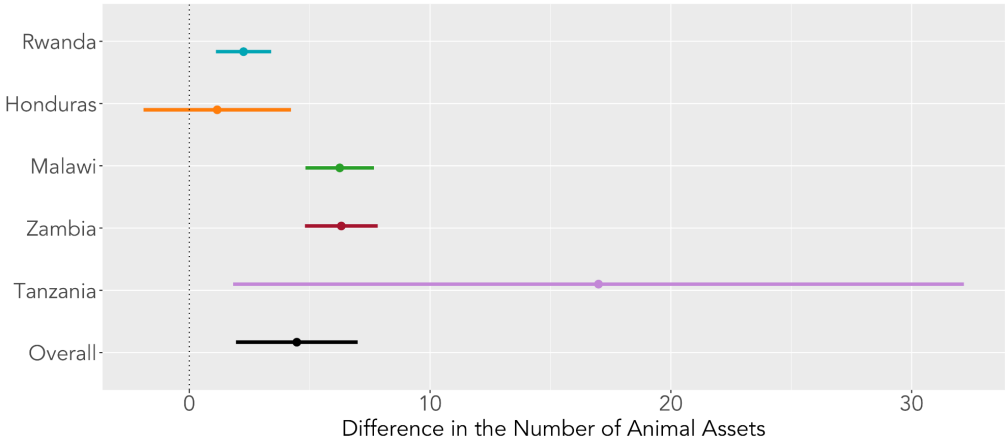

Figure A1.1: THRIVE's Impact on the Number of Animal Assets Households Report

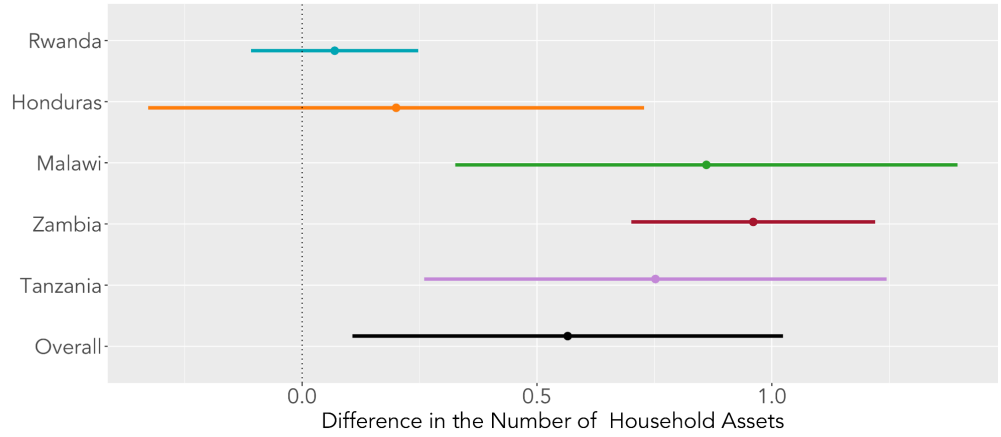

Figure A1.2: Impact on the Number of Household Assets Households Report

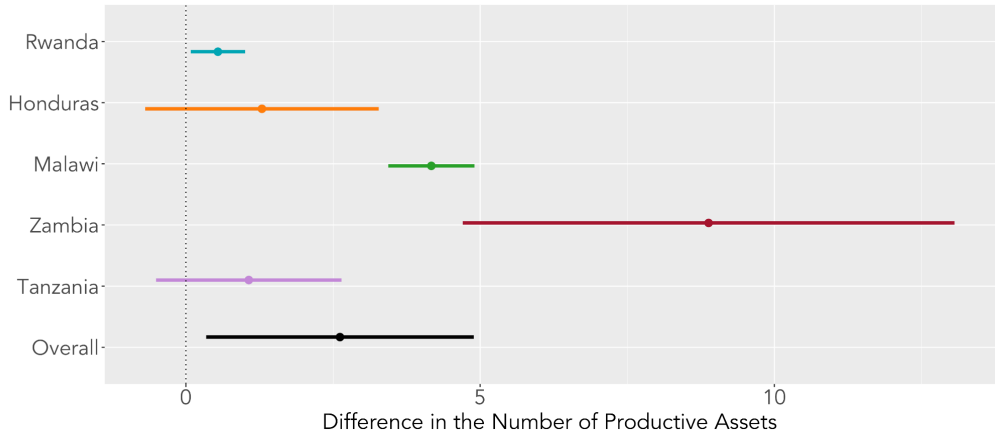

Figure A1.3: Impact on the Number of Productive Assets Households Report

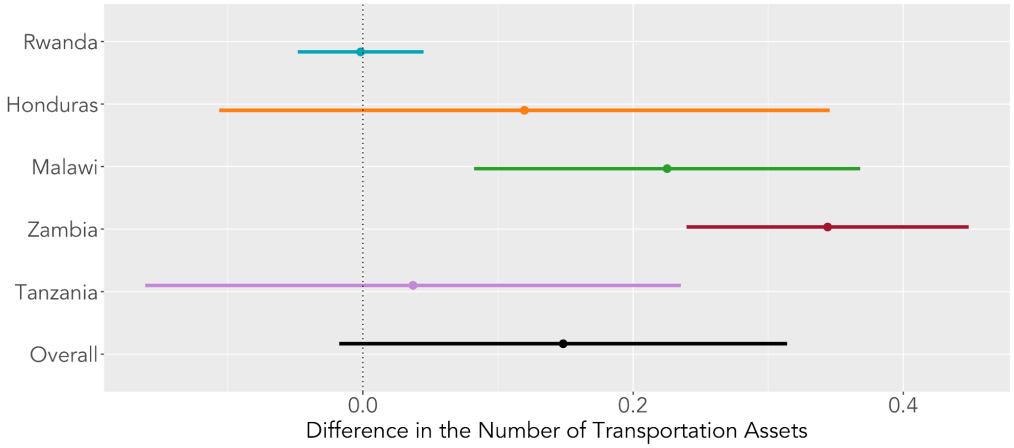

Figure A1.4: Impact on the Number of Transportation Assets Households Report

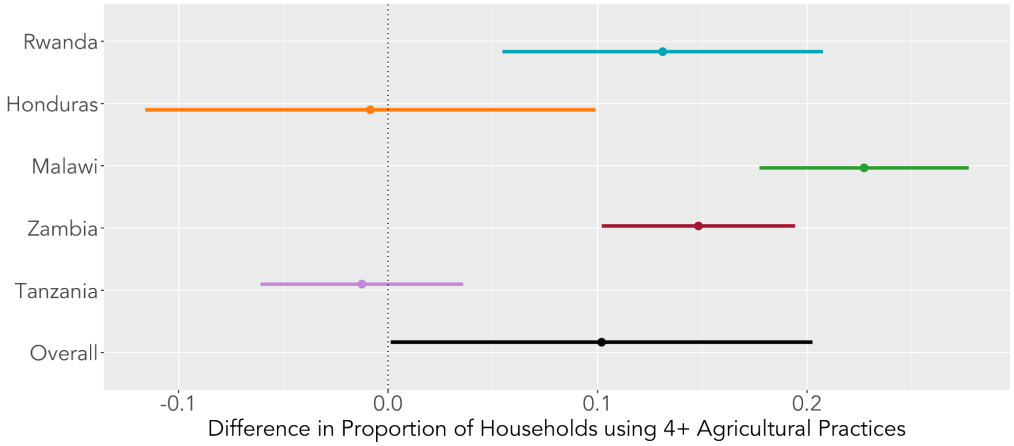

Figure A1.5: Impact on the Proportion of Households Using Productive Agricultural Practices

Natural Resource Management

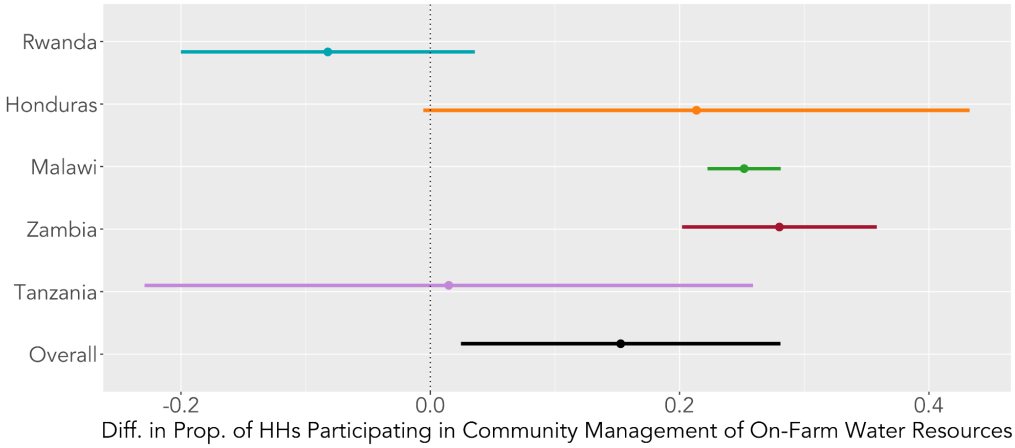

Figure A1.6: Impact on Participation in Water Resource Management

Empowered World View

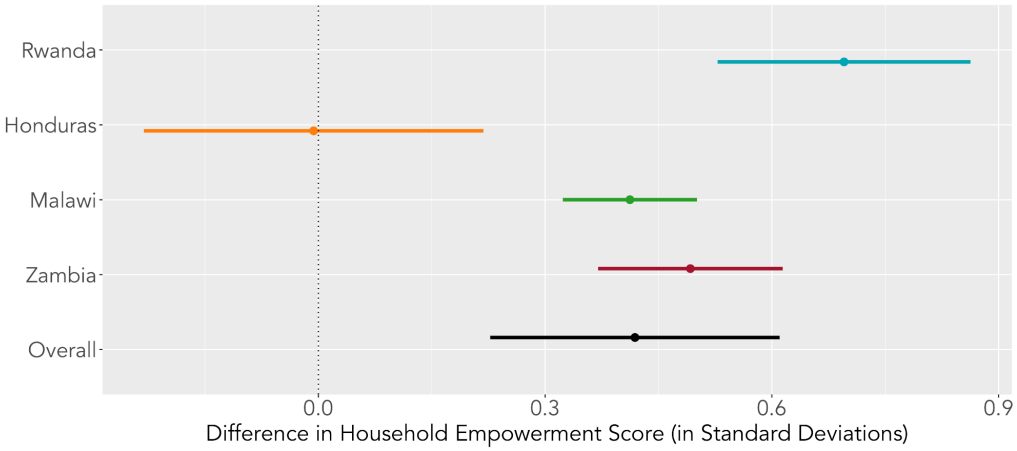

Figure A1.7: Impact on Household Empowerment

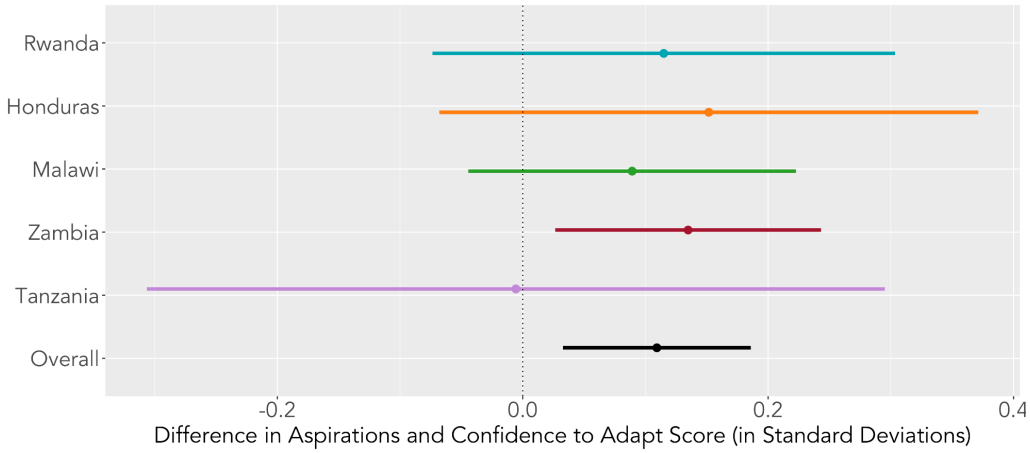

Figure A1.8: Impact on Household Aspirations and Confidence to Adapt

Alternative Meta-Analysis Models

Table A1.2: Sensitivity of Findings to Meta-Analysis Approach

Indicator	Overall Effect (Inverse-Weight)	Overall Effect (Random Effects)
Difference in Proportion of Households able to Provide for Children	0.188***	0.188***
Difference in Proportion of Households with >1 Lower Risk Income Streams	0.080***	0.080***
Difference in Household Dietary Diversity Score (range: 0-12)	0.707***	0.721***
Difference in Household Food Insecurity and Access Score (range: 0-27)	-2.784***	-2.968***
Difference in Probability of Being Below the National Food Poverty Line	-0.828***	-0.828***
Difference in Probability of Being Below the National Poverty Line	-6.390**	-6.365***
Difference in Probability of Being Below $1.25/day Poverty Line	-5.259***	-4.394***
Difference in Number of Income Sources	0.170***	0.171***
Difference in Annual Income (USD, CPI Adjusted)	0.533***	0.530***
Difference in the Number of Household Assets	0.565**	0.559***
Difference in the Number of Transportation Assets	0.148*	0.148**
Difference in the Number of Productive Assets	2.617**	2.792*
Difference in the Number of Animal Assets	4.465***	4.770**
Difference in Proportion of Households Reporting Cash Savings	0.209***	0.209***
Difference in Proportion of Households with Positive NRM Perception	0.007***	0.008
Difference in Proportion of Households with a Disaster Management Plan	0.180***	0.180***
Difference in Proportion of Households with Early Warning Info System	0.174***	0.175***
Difference in Proportion of Households Reporting Being Fully Prepared for a Shock	0.128***	0.128***
Difference in Proportion of Households Reporting Preparing for a Shock	0.092**	0.094*
Difference in Household Empowerment Score (in Standard Deviations)	0.419***	0.409***
Difference in Aspirations and Confidence to Adapt Score (in Standard Deviations)	0.109***	0.109***
Difference in Proportion of Households Participating in Community Management of On-Farm Water Resources	0.153**	0.151**
Difference in Proportion of Households Reporting Savings at Formal Financial Inst.	0.114	0.114
Difference in Proportion of Households Reporting Ability to Access a Loan	0.073*	0.073***
Difference in Proportion of Households Avoiding Negative Coping Strategies	0.022	0.022
Difference in Proportion of Households using 4+ Agricultural Practices	0.102*	0.103**

* p < 0.1, ** p < 0.05, *** < 0.01

Sensitivity of Findings to Inclusion of Honduras

The following table summarizes some of the main findings of the meta analysis with and without Honduras. When the meta-analysis only includes the findings from the four THRIVE projects that took place in Africa, the overall effect tends to be larger in magnitude for most outcomes. This is consistent with earlier findings, which shows that the impact on many outcomes is not statistically significant in Honduras.

Table A1.3: Sensitivity of Select Findings to Inclusion of Honduras

Indicator	All Countries	Africa Only
Outcome 1: Livelihoods (Financial)		
Percentage Change in Annual Income (CPI adjusted, USD)	0.534***	0.609***
Difference in the Number of Income Sources	0.171***	0.192***
Difference in Proportion of Households Reporting Savings at Formal Financial Institution	0.113	0.114
Difference in the Number of Productive Assets	2.656**	5.195***
Difference in Proportion of Households using 4+ Agricultural Practices	0.102**	0.124**
Outcome 2: Natural Resource Management		
Difference in Proportion of Households Participating in Community Management of On-Farm Water Resources	0.153**	0.141*
Outcome 3: Resilience		
Difference in Proportion of Households Reporting Being Fully Prepared for a Shock	0.128***	0.147***
Difference in Proportion of Households with a Disaster Management Plan	0.179***	0.217***
Outcome 4: Empowered Worldview		
Difference in Household Empowerment Score (in Standard Deviations)	0.419***	0.511***
Difference in Aspirations and Confidence to Adapt Score (in Standard Deviations)	0.109***	0.105**

* p < 0.1, ** p < 0.05, *** < 0.01

Appendix 2: VfM Benefits & Costs

B1 Increase in Income

Narrative

Through the practice of improved agriculture techniques, access to improved seeds, the gain of access to credit services, and training on value chain activities, THRIVE aims to improve the income of smallholder farmers. This benefit captures those activities' impact on the farmer's overall income. Using the CPI-adjusted change in income (in USD), from the meta-analysis and impact evaluations, we can calculate the aggregate household income due to the THRIVE intervention. The calculation of this benefit requires the following steps:

1. Use impact evaluation data to estimate pre-intervention average income by country, adjust to 2020 USD standard currency using US BLS annual CPI estimates.
2. Determine the number of households participating in THRIVE per project year by country using the THRIVE program dashboard's accounts of EW participation,
3. Determine the number of households potentially accruing financial benefits per year by aggregating all reported EW participants from previous years. Use the share of participants by gender to disaggregate the participant per year estimates for males and females.
4. Determine the average income increase. Where the gender results from the meta analysis are significant within a country, we disaggregate the impact by gender. Where they are not both signficantly different from zero, we use aggregated results. We assume no negative income impacts in the primary specification.
5. Estimate the total gains in income per year by country and gender in 2020 USD.
6. Calculate the aggregate gains in 2020 USD for different durations of benefits (end with endline, lasting 1 or 3 or 5 years after endline). Calculate the net present value gains to 2017 for the same benefit-duration periods.

Timeframe(s)

2017 - YE, where YE = endline, endline+1, endline+3, endline+5

Inputs		Dimensions	Unit	Source
$\Delta_{c,\,HoH}$	*Increase in Annual Income due to THRIVE*	*Country, HoH Gender*	%	*Meta-Analysis*
$I_{c,\,HoH}$	*Baseline Income for THRIVE Comparison Group*	*Country, HoH Gender*	USD	
$HH_{c,t}$	*Total Household Participating in THRIVE per Year*	*Country, Time*	#	WVUS (ND)
P_c	*Percentage of Female-Headed Households*	*Country*	%	WVUS (ND)
GDP_t	GDP Deflator for the United States	*Time*	#	IMF (2024)

Intermediate Calculation(s)

ΔI_c^{Female}	***Increase in Annual Income for Female-Headed Households*** $\Delta I_c^{Female} = \Delta_c^{Female} \times I_c^{Female}$
ΔI_c^{Male}	***Increase in Annual Income for Male-Headed Households*** $\Delta I_c^{Male} = \Delta_c^{Male} \times I_c^{Male}$
$FHH_{c,t}$	***Female-Headed Households Participating in THRIVE***

	$FHH_{c,t} = HH_{c,t} \times F_c$
$MHH_{c,t}$	***Male-Headed Households Participating in* THRIVE** $MHH_{c,t} = HH_{c,t} \times \left(1 - F_c\right)$
$TFHH_{c,t}$	**Total Female-Headed Households Participating in THRIVE** $TFHH_{c,t} = FHH_{c,t} + FHH_{c,t-1}$
$TMHH_{c,t}$	**Total Female-Headed Households Participating in THRIVE** $TMHH_{c,t} = MHH_{c,t} + MHH_{c,t-1}$
$AI_{c,t}^{Female}$	**Increase in Annual Income for Female HoH** $I_{c,t}^{Female} = TFHH_{c,t} \times \Delta I_{c,}^{Female} \times \frac{GDP^{2024}}{GDP_{t=Baseline}}$
$AI_{c,t}^{Male}$	**Increase in Annual Income for Male HoH** $I_{c,t}^{Male} = TMHH_{c,t} \times \Delta I_{c,}^{Male} \times \frac{GDP^{2024}}{GDP_{t=Baseline}}$

Calculation

Benefit: $B1_t^{Households} = AI_{c,t}^{Female} + AI_{c,t}^{Male}$

B2 Decrease in Livelihood Volatility

Narrative

THRIVE's interventions aim to improve the resilience of its participants. Participating in savings groups, access to credit and savings mechanisms, and climate-sensitive agriculture practices, while all contributing to income growth, also aim to prevent significant losses of consumption during periods of shocks. This allows for the smoothing of consumption over time. By consuming less during good times, and consuming (relatively) more during bad times, participants are better able to sustain a standard of living across periods. This benefit aims to capture the additional value households place on ensuring their livelihood remains relatively stable. To calculate this benefit, we adapt an economic model of household income and consumption to incorporate THRIVE's resiliency benefits, calibrate the model with country and program data, and then use the model to estimate the equivalent cash transfer required to produce similar utility benefits as those generated by the decrease in lifetime volatility.

The first step in calculating this benefit is to lay out the model and conditions required for equilibrium for the analysis. We use a standard constant relative risk aversion (CRRA) utility function. The budget constraint consists of income, the savings from the last period plus the interest earned from those savings, the consumption in this period, and the savings for the next period (i.e., the savings that will be accumulated in this period). The income shocks are idiosyncratic and are assumed to follow an AR(1) process, with the persistence of the shock and the magnitude of the shock both coming from the meta-analysis.

The second step is to modify the model to capture THRIVE's resiliency benefits. This is modeled explicitly in two different mechanisms. The first mechanism is improved crop production and income diversification during periods of shock. In the model, this is modeled as the household facing a smaller decrease in income during a period of shock. Income decreasing by less allows the household to maintain more consistent levels of consumption during periods of shock, raising their lifetime utility.

The second mechanism is access to credit and savings mechanisms, also referred to as financial inclusion. This has two effects on the model: it allows THRIVE participants to borrow (i.e., savings can fall below zero) and reduces the cost of consumption tomorrow as they earn interest on all savings. Both of these mechanisms allow participants to smooth their consumption over periods of shock, raising their lifetime utility compared to the counterfactual no-savings group. However, not all in the comparison group were financially excluded and thus, this additional consumption smoothing benefit is only realized by the individuals who would have remained financially excluded if THRIVE were not to have happened. To calculate this, we will take the change in the proportion of individuals with savings in formal institutions from the meta-analysis and multiply it by the number of participants.

The next step in calculating the benefit is monetizing the model. To do this, we follow a similar method to Tremblay (2021), who calculates the state contingent equivalent cash transfer of savings group participation. This is modeled as a cash transfer that equates the utility of the comparison groups and of the THRIVE participation group in equilibrium. This state-contingent cash transfer is added to the budget constraint of the comparison groups. The average cash transfer across states is then taken as the value of the decreased volatility per year.

We will then calculate the average value of the cash transfer across states and countries for both financially excluded individuals and financially included ones.[20] We can then calculate the total value of the decreased lifetime volatility benefit by multiplying the number of participants and the consumption smoothing value for each group. To remain comparable across years we convert this value to 2024 USD using the GDP deflator for the USA.

Timeframe(s)

2017 - YE, where YE = endline, endline+1, endline+3, endline+5

Inputs	Dimensions	Unit	Source

[20] This will be done outside of the excel model in a programming language that allows for dynamic programming.

w_c	*Median Household Income*	*Country*	USD	*Meta-Analysis*
r_c	*Interest Rate*	*Country*	%	*Trading Economics (2024)*
α_c	*Coefficient of Relative Risk Aversion*	*Country*	#	*Gandelman, N., & Hernández-Murillo, R. (2015), Holden (2015)*
ρ_c	*Wage Process Persistence*	*Country*	#	*Tremblay (2021)*
β_c	*Time Discount Factor*	*Country*	#	*Trading Economics (2024)*
$\sigma_{c,s}$	*Standard Deviation of Wage Shocks*	*Country*	#	*Tremblay (2021)*
$Fe_{c,HoH}$	*Change in Percent of Households Who are Financially Included*	*Country, Head of Household Gender*	%	*Meta-Analysis*
$HH_{c,t}$	*Total Household Participating in THRIVE per Year*	*Country, Time*	#	*WVUS (Nd)*
GDP_t	*GDP Deflator for USA*	*Time*	#	*IMF (2024)*

Intermediate Calculation(s)

Utility Function

$$u(c_t) = \frac{c_t^{1-\alpha_c}-1}{1-\alpha_c}$$

THRIVE Participant's Lifetime Consumption Function

$$U^{Thrive}(z,s) = \max_{C_t, S_{t+1}} u(c_t) + \beta E\left[U_{t+1}^{Thrive,FI}(z,s)\right]$$

$$s.t.\ w_t e^{z_t} + S_t \times (1+r) = C_t + S_{t+1}$$

Where:

$$z_t = \rho_c z_{t-1} + \varepsilon$$
$$\varepsilon \sim N(0, \sigma^2_{Low})$$

Financially Excluded Comparison Groups' Lifetime Consumption Function

$$U^{Non-Thrive,FE}(z,s) = \max_{C_t, S_{t+1}} u(c_t) + \beta E\left[U_{t+1}^{Non-Thrive,FE}(z,s)\right]$$

$$s.t.\ w_t e^{z_t} + S_t = C_t + S_{t-1} + ct(z,s)$$

Where:

$$z_t = \rho_c z_{t-1} + \varepsilon$$
$$\varepsilon \sim N(0, \sigma^2_{High})$$
$$S \geq 0$$

Financially Included Comparison Groups' Lifetime Consumption Function

$$U^{Non-Thrive,FI}(z,s) = \max_{C_t, S_{t+1}} u(c_t) + \beta E\left[U_{t+1}^{Non-Thrive,FI}(z,s)\right]$$

$$s.t.\ w_t e^{z_t} + S_t \times (1+r) = C_t + S_{t-1} + ct(z,s)$$

Where:

$$z_t = \rho_c z_{t-1} + \varepsilon$$
$$\varepsilon \sim N(0, \sigma^2_{High})$$

Financial Value of Consumption Smoothing Benefit:

$$CS_i = \int_{Z \times S} ct(z,s) d\lambda^{CT}$$

$ct(z,s)$ solves:

$$\min_{\{ct(z,s)\}_{z \in Z, s \in S}} \int_{Z \times S} ct(z,s) d\lambda^{CT}$$

$$s.t.\ U^{Thrive}(z,s) \leq U_s^{Thrive}(z,s)\ \forall z \in Z, s \in S$$

$DL_t^{FE\ Households,\ Female}$

Decrease in Livelihood Volatility for the Formerly Financially Excluded Female-Headed Households

$$DL_t^{FE\ Households,\ Female} = \left(CS^{FE} \times HH_{c,t,\ HoH} \times Fe_c^{Female} \times P_c\right) \times \frac{GDP^{2024}}{GDP_{t=\ Baseline}}$$

$DL_t^{FE\ Households,\ Female}$

Decrease in Livelihood Volatility for the Financially Included Female-Headed Households

$$DL_t^{FI\ Households,\ Female} = \left(CS^{FI} \times HH_{c,t,\ HoH} \times \left(1 - Fe_c^{Female}\right) \times P_c\right) \times \frac{GDP^{2024}}{GDP_{t=\ Baseline}}$$

$DL_t^{FE\ Households,\ Female}$

Decrease in Livelihood Volatility for the Formerly Financially Excluded Male-Headed Households

$$DL_t^{FE\ Households,\ Female} = \left(CS^{FE} \times HH_{c,t,\ HoH} \times Fe_c^{Male} \times \left(1 - P_c\right)\right) \times \frac{GDP^{2024}}{GDP_{t=\ Baseline}}$$

$DL_t^{FE\ Households,\ Female}$

Decrease in Livelihood Volatility for the Financially Included Male-Headed Households

$$DL_t^{FI\ Households,\ Female} = \left(CS^{FI} \times HH_{c,t,\ HoH} \times \left(1 - Fe_c^{Male}\right) \times \left(1 - P_c\right)\right) \times \frac{GDP^{2024}}{GDP_{t=\ Baseline}}$$

Calculation

Benefit:

Benefit 2 - Decrease in Livelihood Volatility Female-Headed Households

$$B2_t^{Female} = DL_t^{FI\ Households,\ Female} + DL_t^{FE\ Households,\ Female}$$

Benefit 2 - Decrease in Livelihood Volatility Male-Headed Households

$$B2_t^{Male} = DL_t^{FI\ Households,\ Male} + DL_t^{FE\ Households,\ Male}$$

B3 Reduction in CO_2 Emissions due to Carbon Sequestration

Narrative

A major component of THRIVE is the natural resource management activities. Practices such as planting and regenerating trees, clearing bushes and shrubs, water catchment, and soil and water conservation techniques all lead to more sustainable and resilient crops. These activities have two benefits, the first is larger farm profits, and the second is the various environmental benefits attributable to these interventions. This benefit focuses on the latter.[21] This benefit focuses specifically on the carbon sequestered from additional tree coverage resulting from THRIVE's tree planting and regeneration activities. Carbon sequestration by trees refers to the removal of atmospheric carbon dioxide, CO_2, and its storage within its biomass. THRIVE improved sequestration through its planting and regeneration of trees.[22] The calculation of this benefit requires the following steps:

1. determine the hectares of trees planted or regenerated,
2. estimate the amount of trees that will survive each year,
3. calculate the annual tons of CO_2 (tCO_2) sequestered and
4. value the sequestered carbon using the social cost of carbon (SCC).

The number of trees planted can be obtained through the THRIVE dashboards. Unfortunately, we do not have a way to determine THRIVE's impact on tree cover. The total hectare planted or regenerated can be estimated by taking the number of trees and dividing it by the average number of trees per hectare.

Using the annual hectares of trees planted each year, we can calculate the number of trees that will survive each year. A study by Banin et al. (2023) estimates that 18% of saplings die within the first year, and 44% are dead within the 5th year. Using this study, we will then estimate that 18% of the planted trees never sequester any carbon, and the amount of trees that sequester decreases at 6.5 percentage points per year.

We can then use estimates of the carbon sequestration potential per hectare of trees from Bernal et al. (2018) to estimate the total amount of CO_2 sequestered. Bernal et al. (2018) estimate the CO_2 removal rates of natural regeneration planting, agroforestry, planted forests, and mangrove restoration. To remain conservative, we will use the agroforestry estimate for Africa and Latin America.

The final step is to value this sequestered carbon using the SCC for each THRIVE country from Ricke et al. (2018). To do this, we multiply the tCO_2 sequestered by the SCC. Following Tol (2023) we adjust the annual SCC by 2% per year to reflect the rising cost of climate change. To remain comparable across years we convert this value to 2024 USD using the GDP deflator for the USA.

Timeframe(s)

2017-2044

Inputs		Dimensions	Unit	Source
$Tp_{t,c}$	*Trees planted/regenerated per year*	*Time, Country*	#	WVUS (ND)
Sr_t	*Survival Rate in Year t*	*Time*	%	*Banin et al.* (2023)
H	*Number of Trees per Hectare*		#	*Ndayambaje et al.* (2021), *Garrity et al.* (2010) *Lupala et al.* (2015) *Ngo Bieng et al.*

[21] The income or profit aspect of this benefit is captured in B1 - Increases in Income.
[22] Other interventions like soil conservation agricultural techniques likely had environmental benefits like reduced soil erosion, however, currently we do not have a way to measure the environmental cost of soil erosion. The income aspect of that intervention is also captured in B1.

				(2022)
S	*Sequestration Potential of 1 Hectare of Trees (Agroforestry)*	*Time.*	tCO_2	*Bernal et al.* (2018)
SCC_c	*Country-level Social Cost of Carbon per ton of* CO_2	*Country*	USD	*Ricke et al.* (2018)
δ	*Social Cost of Carbon Growth Rate*		%	*Tol* (2023)
GDP_t	*GDP Deflator for the United States*	*Time*	#	IMF (2024)

Intermediate Calculation(s)

$SCC_{c,t}^{2024}$	**Social Cost of Carbon per ton of CO2 (2024 USD)** $SCC_{c,t}^{2024} = SCC_c \times \frac{GDP^{2024}}{GDP_t}$
$HTP_{t,c}$	**Number of Hectares of Trees Planted:** $HTP_{t,c} = \frac{Tp_{t,c}}{H}$
$SH_{t,c}$	**Surviving Hectares** $SH_{t,c} = HTP_{t,c} \times SY + SH_{t-1,c} \times \left(1 - Sr_t\right)$
$ASCC_c$	**Adjusted Social Cost of Carbon** $ASCC_{c,t} = SCC_{c,t}^{2024} \times (1 + \delta)^t$
$C_{t,c}$	**Total CO_2 Carbon Sequestered:** $C_{t,c} = SH_{t,c} \times S_c$

Calculation

Benefit:	$B3_{t,c}^{Country} = C_{t,c} \times ASCC_{c,t}$

C1 Program Costs

Narrative

Program costs are provided by World Vision as estimated expenditures from baseline to endline. As the primary specification, we assume that the unadjusted costs estimates are evenly spread across years, which implicity assumes slightly higher expenditures earlier on after adjusting for inflation. We adjust the annual expenditure estimates to 2020 USD using US BLS annual CPI values.

We then calculate both the aggregate 2020 USD expenditures, and the NPV of the values from the perspective of 2017 forward. In sensitivity analysis, we include pre-2017 expenditures (which are relevant only for Malawi and Tanzania, as their baseline was prior to 2017) in 2017.

Timeframe(s)

2017-endline

Inputs		Dimensions	Unit	Source
C_c	*Aggregate Program Cost*	*Country*	*Nominal USD*	WVUS 2024
GDP_t	*GDP Deflator for the United States*	*Time*	#	IMF (2024)

Intermediate Calculation(s)

T_c

Year duration of implementation:

$$T_c = Year(endline_c) - Year(baseline_c)$$

Calculation

Unadjusted Annual Program Costs from Baseline to Endline

$$C1_{t,c}^{WVUS} = \left(C_c / T_c\right)$$

Cost:

Annual Program Costs from Baseline to Endline (2020 USD)

$$C1_{t,c}^{WVUS} = \left(C_c / T_c\right) \times \frac{GDP^{2020}}{GDP_t}$$

C2 Opportunity Cost of THRIVE participation

Narrative

We estimate the opportunity cost of farmers participating in THRIVE activities by assuming that the standard participant spends a certain amount of time per week, with the possibility that those who increase their use of improved agricultural practices in an observable way may spend additional time. We then estimate the value of this time using hourly wage estimates.

The total value of this cost can then be calculated by using the value of leisure time and multiplying it by the amount of time spent on these incremental practices. To remain comparable across years we convert this value to 2024 USD using the GDP deflator for the USA.

Timeframe(s)

2017 - YE, where YE = endline, endline+1, endline+3, endline+5

Inputs		Dimensions	Unit	Source
ΔF_c	*Change in Farmers Practicing at least four Improved Agricultural Techniques*	*Country*	%	*Meta-analysis*
$HH_{c,t}$	*Total Household Participating in THRIVE per Year*	*Country, Time*	#	WVUS (ND)
$T_{c,\,At}$	*Hours Required for THRIVE participation*	*Country, Agricultural Technique, Time*	*Hours*	*Assumption*
W_c	*Hourly Wage Rate of Agricultural Workers*	*Country*	USD	ILO 2024
GDP_t	*GDP Deflator for the United States*	*Time*	#	IMF (2024)

Intermediate Calculation(s)

W_c^{2024}

Hourly Wage Rate of Agricultural Workers (2020 USD)

$$W_c^{2024} = W_c \times \frac{GDP_{2020}}{GDP_t}$$

$TS_{c,t}$

Time Spent on Improved Agricultural Practices per year for Households

$$TS_{c,t} = HH_{c,t} \times (\Delta F_c \times T_{c,\,high} + (1 - \Delta F_c) \times T_{c,low})$$

Calculation

Benefit:

Cost 2 - Opportunity Cost of THRIVE participation

$$C2_{t,c} = TS_{c,t} \times W_c^{2024}$$

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