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Final Report

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List of Acronyms

BCC	Behavior Change Communication
BDL	Bio-reclamation of degraded lands
BMI	Body Mass Index
CBSP	Community-based Service Provider
CLTS	Community Led Total Sanitation
CNV	Community Nutrition Volunteer
CLUSA	National Cooperative Business Association
CR	Communautés Rurale
CSO	Civil Society Organization
CWG	Citizen Work Groups
DD	Difference-in-Difference
DFS	Decentralized Finance Systems
DHS	USAID Demographic and Health Survey
DQA	Data Quality Assurance
ENA	Essential Nutrition Actions
ESPS	2005/6 Enquête de Suivi de la Pauvreté au *Sénégal*
FGD	Focus Group Discussion
FtF	Feed the Future
ISRA	Institut du Sénégal pour la Recherche
KII	Key Informant Interview
LPM	Linear Probability Models
LRP	Local Resource Person
LSC	Local Steering Committee
M&E	Monitoring and Evaluation
MAD	Minimum Acceptable Diet
MDES	Minimum Detectable Effect Size
MIE	Mid-term Impact Evaluation
MtM	Mother-to-Mother
NGO	Non-governmental Organization
NLA	Nutrition Led Agriculture
OLS	Ordinary Least Squares
PBS	Population-based Survey
PMP	Performance Monitoring Plan
POA	Producer Organization Agent
POG	Passing on the Gift
PPP	Purchasing Power Parity
PSM	Propensity Score Matching
RRDA	Regional Rural Development Agency
USAID	U.S. Agency for International Development
WASH	Water, Sanitation and Hygiene
WHO	World Health Organization

EXECUTIVE SUMMARY

I. Project Background

Senegal suffers from persistently high food insecurity and undernutrition. Despite improving nutrition status of its population, rural areas are especially vulnerable to hunger and micronutrient deficiencies. Especially in both 2014 and 2015, Senegal experienced recurrent droughts, especially in northern Senegal, resulting in harvest deficits of rain-fed agriculture and prolonged 'lean seasons.'

Taking a structural approach to the question of food security, the USAID Yaajeende Agriculture and Nutrition Development Program is a five-year Feed the Future (FtF) initiative that received a two-year extension (November 2010 to September 2017), implemented by the National Cooperative Business Association (NCBA)/CLUSA International, Counterpart International, Heifer International, and Sheladia Associates in four regions of Senegal. It has operated in Matam, Bakel and Kédougou, the least food secure geographic zones in Senegal, since 2011, and was introduced in Kolda in 2014. Yaajeende's goal is to accelerate the participation of the very poor in rural economic growth and to improve the population's nutritional status. Yaajeende adopts a Nutrition-Led Agriculture (NLA) approach, which promotes improved production, trade, and local consumption of high quality, nutritious foods, including foods that resolve priority nutritional deficiencies. The approach is guided by the belief that mutually supporting programs of nutrition and agriculture will be more efficacious in improving nutritional status than either of the components on their own.

Yaajeende program activities cover the four FtF pillars of food security: availability, access, utilization, and sustainable governance. Availability interventions relate to farm production to introduce and increase production of key crops. Access interventions focus on farm productivity to increase farmers' access to inputs and agriculture services that permit enhanced production of nutritious food crops via a network of private sector, community-based service providers (CBSPs). Utilization interventions aim to create demand for nutritious foods and potable water by educating the public about the need for a diverse diet and increasing their ability to prepare foods in ways that maximize nutritional content. Sustainable governance interventions work towards strengthening local government and civil society by improving local actors' ability to engage in dynamic partnerships to guide food production and administer resources. Yaajeende program offices are currently in Dakar, Matam, Kédougou, and Bakel.

II. Evaluation Purpose and Questions

With the Yaajeende program running in its fifth year, the purpose of the Midterm Impact Evaluation (MIE) is to measure whether Yaajeende is on track to produce positive discernible impact on its beneficiary populations by the end of the program with respect to its globally mandated FtF high level goals and 16 key indicators. The MIE will also provide guidance on how to adapt the Yaajeende program to enhance impact or, if needed, change course. The MIE analyzes the marginal effect of partial exposure to project activities, as well as the global effect of the full project with intended synergies between its components. Baseline data collection was conducted from May to June 2011. The evaluation is organized around four Study Questions, addressing nutrition, healthy household practices, agricultural practices and production, and the synergistic impact of NLA (detailed in Findings below).

III. Methods

The MIE utilizes a mixed-method approach involving a non-experimental quantitative strategy and qualitative techniques. On the quantitative side, a population-based survey (PBS) was administered to 2,720 households in treatment and control villages across 19 communautés rurales (CRs, or sampling areas) in Bakel, Matam, and Kédougou. A multi-stage cluster sampling approach was used to select households that participated in the 2011 baseline survey along with households from 27 "new intervention villages," enabling both panel and cross-sectional analyses. Data were collected electronically on tablets by 68 enumerators using Computer Assisted Personal Interviewing (CAPI) from May to June 2015, to correspond with the baseline. CAPI increases the speed of data collection and entry, allows for real-time compilation of collected data to facilitate monitoring and correction of shortcomings as the work unfolds, and dramatically reduces the extent of data errors. Data analysis used a difference-in-difference (DD) approach combined with propensity score matching (PSM) to compare changes in key indicators over time between treatment and control villages, focusing on the impacts of interactions between the following pre-defined activity packages on key indicators:

- **Package A: Core Nutrition Package.** Key behavior change activities, fortified foods, and clean potable water;
- **Package B: Agriculture Production Package.** Energy dense cereals, micronutrient rich vegetables and fruits, and animal protein and lipids; and
- **Package C: Governance Package.** Increased access to quality products and services and improved coordination and resource use through good governance.

While some activities are aimed at the individual level, Yaajeende seeks to influence local populations and markets beyond the individual beneficiaries that participate in its activities. Yaajeende is intended to create positive spillovers throughout the villages and rural communities where it operates. In this evaluation, assignment to treatment or comparison group is observed at the village level. Every household in the treatment village is considered as a treatment household, regardless of whether the individuals in that household personally participated in project activities. The project's activities are broadly organized into *packages* for nutrition, agriculture, and governance; and high-intensity villages that received all three packages. Where the nutrition package was delivered, all the residents of that village are in the nutrition treatment package; and the same for all households in villages that received any of the treatment packages.

The comparison group is comprised of villages where Yaajeende did not operate. However, these comparison villages may have benefited from other technical services, donors, or NGOs with a similar agenda. To achieve maximum coverage of development interventions across its territory, the Government of Senegal often disperses projects with similar goals. Therefore, it is important to note that the treatment effects discussed in this study reflect the difference between treatment and comparison villages as events actually transpired, and not a randomized control trial where the comparison villages receive no interventions of any kind.

The comparison group also differs from the treatment group in its geography. The regions of Matam and Bakel differ from Kédougou in their climate, economy, language, infrastructure, and international borders. The comparison group is concentrated in Kédougou, and the treatment group is concentrated in Matam and Bakel. The consequence of this change is that, where geography alone produced differences in the trends of key indicators between baseline and midterm, the study may attribute those differences to project exposure. Extensive statistical tests were used to assess whether more favorable statistical results could have been obtained using regional subsamples. However, the tests did not produce a pattern of more favorable results, so the original statistical tests are presented in the report instead.

Qualitative research methods included 54 key informant interviews (KIIs) and 14 focus group discussions (FGDs) conducted by a qualitative research field team consisting of 6 persons with differing language skills. This team met with Yaajeende regional staff upon arrival in each region to get an overview of project activities particular to that region and to plan the breakdown of KIIs and FGDs. All phases of data collection were subjected to rigorous quality control procedures, including an eight-day training for enumerators on surveying and obtaining anthropometric measurements, regular storage of encrypted, raw data files on a secure cloud-based server, and ongoing validation of data files using SurveyBe software. All qualitative audio deliverables were translated into French, transcribed onto paper and into Microsoft Word, verified, and corrected as needed.

IV. Findings

Study Question 1: Nutrition

Did households and individuals living in villages located in project intervention areas see greater improvement in nutritional status indicators than those residing in non-project areas?

Summary. Yaajeende beneficiaries experienced statistically significant decrease in stunting rate, by 7 percentage points, but the treatment effect of about 4.3 percentage points is statistically insignificant. While not statistically significant, the size of the treatment effect is large, corresponding to a decline of about one-third in the odds ratio of stunting. Effectively, this shows that Yaajeende beneficiaries are unambiguously better off at midterm than at baseline, but the pattern of variation is not consistent with uniform treatment effect.

Changes in child wasting and child underweight were indeterminate. Wasting among children under age 5 worsened during the period of study, but the results were fragile and depended on the sample and model specification. Yaajeende beneficiaries were not significantly better off at midterm than at baseline, and the treatment effect of Yaajeende on wasting was not positive. Underweight among both beneficiaries and the comparison group may have improved somewhat, but the treatment effect of Yaajeende was very close to zero.

When calculated using the z-scores, wasting, stunting, and underweight showed significant, positive treatment effects in a difference in differences model. The nutrition treatment had a favorable impact significant at the 95 percent level on the z-score of length-for-age, and a favorable impact at the 99 percent level on the z-score for weight-for-age.

The beneficial trends in stunting and z-scores suggest but do not conclusively prove Yaajeende's effect on nutrition. This merits further study.

Both beneficiary and comparison experienced decline in minimum acceptable diet (MAD) and the treatment effect on minimum acceptable diet (MAD) is inconclusive. Yet, the project contributed to an improvement in the dietary diversity criterion of the MAD indicator. While not statistically significant, Yaajeende also had a beneficial treatment effect of about 3.1 percentage points on underweight women rate. Treatment effect on consumption of fewer than two meals per day is inconclusive. Participants in high-intensity villages did, however, experience a shortened duration of reduced food intake (*soudure*) of one-third of a month greater than the comparison group._High-intensity villages displayed synergistic benefits for wasting and underweight indicators.

Table 1. Results by Indicator, Nutrition

Indicator	Results[1]
1.1 Wasting, Ages 6-59 mo	Synergy effect[2] in high intensity villages of 9 percentage points but not statistically significant (*p*=0.11). Nutrition and agriculture treatment effect are beneficial at 0.8 percentage points (*p*=0.76) and 1.5 percentage points (*p*=0.59) respectively but not statistically significant. [3]

[1] All results are estimated for the entire population unless otherwise stated.

[2] Synergy effect denotes the treatment effect of high intensity intervention beyond the independent contribution of the nutrition and agriculture programs. When positive, it shows that the high-intensity beneficiaries experienced a treatment effect greater than the sum of the treatment effects for nutrition and agriculture programs.

[3] This summary discussion refers to ordinary least squares (OLS) models. For binary key indicators (such as wasting), treatment effects are equivalent to percentage point increases in the key indicator attributable to the project. The statistical annex also presents logistic regression results with treatment effects shown as marginal odds ratios.

Indicator	Results[1]
1.2 Stunting, Ages 6-59 mo	7 percentage points decrease (*p*=0.008) in stunting among beneficiaries but no statistically significant treatment effect. Strongest treatment effect from the nutrition treatment rather than agriculture or high-intensity (treatment effect size of 4.3 percentage points).[4]
1.3 Underweight, Ages 6-59 mo	High-intensity villages display synergy effects, with high intensity treatment 11 percentage points below predicted value from agriculture and nutrition (*p*=.02). No statistically significant treatment effect and effect size less than 1 percentage point.
1.4 Underweight Female, Ages 15-49 yrs	No statistically significant results. Strongest treatment effect in high-intensity villages (effect size of approximately 3 percentage points).
1.5 Minimum Acceptable Diet, Ages 6-23 mo	No statistically significant treatment effect. Pernicious treatment effect size of about 1 percentage point. Both secular[5] and beneficiary group decline in MAD greater than 6 percentage points. Negative synergy of about 15 percentage points in the high-intensity group (*p*=0.04).[6]
1.6 Duration of Reduced Food Intake *(Soudure)*	Agriculture treatment effect was a decline of 0.3 months (about 9 days) in the duration of food scarcity (*p*=0.087). Better p-values found with the Poisson model[7] (*p*=0.021).
1.7 Fewer than Two Meals per Day	No statistically significant treatment effect. Very low prevalence at baseline. Secular increase in rates.

Yaajeende's treatment effects on the nutritional status of children under age 5 were found to be beneficial, but generally failed to attain statistical significance. Stunting among the beneficiaries decreased and was statistically significant. While the treatment effects for stunting were also in the desired direction, the variance of the estimates was too high to show conclusive treatment effects. The treatment effects on wasting and underweight among children aged 6-59 months could not be distinguished from zero. Using the z-score distributions of child nutritional status, Yaajeende's treatment effects are beneficial and statistically significant for z-scores for weight-for-age and length-for-age.

Women of reproductive age have improved food diversity, food preparation, and hygiene, especially during pregnancy, yet resource constraints often remain a barrier to enhanced nutrition. Quantitative evidence suggests both individual and

[4] Treatment effect size denotes the average additional change experienced by beneficiaries as compared to the change in the comparison group.

[5] The term secular denotes the change between baseline and midterm only, regardless of dispersion or volatility of the indicators during the period of the study.

[6] By pernicious effect, we mean a treatment effect opposite to the desired intent of the project. That is, the change experienced by beneficiaries was worse than that experienced by the comparison group. By "negative synergy," we mean that the change experienced by the high-intensity group was smaller or less beneficial than the marginal effects estimated by nutrition and agriculture interventions.

[7] A Poisson model is a regression analysis that fits a Poisson distribution rather than a normal distribution, and which is appropriate for measuring infrequent events or survival time. This makes the model appropriate for measuring the duration of food insecurity (Indicator 1.6).

combined effects of the three treatment groups on the prevalence of underweight women, but lack of statistical significance is supported by qualitative findings on economic constraints to applying lessons learned during trainings, including consuming fruits and orange foods.

Prevalence of a MAD for infants underwent a steep overall decline between 2011 and 2015, but not due to a Yaajeende treatment effect. While focus groups show that women in project areas do have increased awareness of the importance of a diverse diet and that meat and dairy consumption in project areas has improved, there is limited evidence that mothers continue to breastfeed their children in survey areas after the first 6 months. The overall decline in MAD in treatment and control villages is independent of Yaajeende participation.

Yaajeende programming related to agricultural production increased resilience as measured by the duration of annual food stress. The period of *soudure* increased markedly between the baseline and midterm in all villages, but the increase was smaller in the beneficiary population by approximately one-third of a month. Multivariate analysis suggests, but does not conclusively demonstrate, greater impact among high-intensity households as compared to low-intensity.

Yaajeende exhibited synergistic benefits with regard to wasting and underweight, even when the project treatment effect was not statistically significant. This shows tentative support for the development hypothesis, which predicts greater benefits from simultaneous nutrition and agriculture interventions than the sum of either alone.

Study Question 2: Healthy Household Practices

Did households living in villages located in project areas see greater adoption of healthy nutritional and WASH practices than those residing in non-project areas?

Summary. Households living in villages located in project areas generally did not see greater adoption of healthy nutritional and WASH practices than those residing in non-project areas, due to high prevalence at baseline and factors exogenous to the project. A crucial circumstance for hygiene indicators was the Ebola outbreak in Guinée, which influenced norms related to handwashing during the period of the midterm study. Because local government, NGOs, and residents of villages acted in solidarity to protect public health, it is extremely likely that favorable trends in handwashing were caused by factors beyond the scope of the study. Similarly, while significant improvements were found in the adoption of hygienic kitchen practices and water treatment, high prevalence of these behaviors at baseline and similar increases in comparison areas resulted in a lack of detectable statistical significance in treatment areas. No statistically significant treatment effects were observed for the use of cold and covered food storage, food conservation practices, or salt iodation. An enormous shift in exclusive breastfeeding took place during the period of the study, but the comparison group's increase of 20 percentage points constituted a very challenging benchmark for evidence of impact. Households in project areas did, however, experience greater food diversity than in comparison areas by about half of a point on the food diversity score as a result of the nutrition treatment effect, in the context of successive droughts in northern Senegal.

Table 2. Results by Indicator, Health Household Practices

Indicator	Results
2.1 Kitchen Hygiene	No discernible effects.
2.2 Food Storage	No discernible effects.
2.3 Water Treatment	Pernicious treatment effect of 7.7 percentage points masks absolute improvement due to comparison group trend. Beneficial trend among beneficiaries of 20 percentage point increase (p=0.07).[8]
2.4 Food Conservation	No discernible effects. Many variables are distilled into a single binary variable. Recommendation: investigate specific techniques.
2.5 Salt Iodation	No discernible effects. Iodized salt is widely bought but rarely stored in closed containers.
2.6 Exclusive breastfeeding	Treatment effect not robust to different model specifications. Trend among beneficiaries is a 23 percentage point increase ($p<0.001$). Logistic model shows a treatment effect equal to 3.5 times increase in the odds ratio of exclusive breastfeeding ($p=0.071$). Among high intensity villages, the treatment effect was a 6.2 times rise in the odds ratio ($p=0.039$) but no significant treatment effects were found with linear models.
2.7 Food diversity	Food diversity declined by about 0.5 food groups less in nutrition treatment areas than in comparison areas in a context of overall declining food diversity.
2.8 Handwashing	Pernicious treatment effect of about 11 percentage points. In the context of a 26 percentage point secular increase, this masks an absolute rise of about 15 percentage points in handwashing.
2.9 Drinking water	No discernible effect. This variable discusses improved water sources, a community resource, and not water treatment.
2.10 Cooking water	No discernible effect. This variable discusses improved water sources, a community resource, and not water treatment.

Yaajeende has not had a statistically significant impact on the prevalence of hygienic kitchen practices or safe food storage in intervention areas. Program impacts may be muted by the fact that Yaajeende has been implemented in villages where these were already in use following the Ebola outbreak in Guinée, along with limited access to water and resources to purchase soap. However, FGDs do suggest increased understanding around hygiene as a result of relevant program activities.

Between 2011 and 2015, the proportion of beneficiaries treating their drinking water rose from 7% to 26%. The improvement cannot necessarily be attributed to Yaajeende, since the comparison group saw an increase of 27 percentage points over the same period. Participants from FGDs indicated increased understanding around water filtering

8 This summary discussion refers to ordinary least squares (OLS) models. For binary key indicators (such as improved drinking water), treatment effects are equivalent to percentage point increases in the key indicator attributable to the project. The statistical annex also gives logistic regression results with treatment effects shown as marginal odds ratios.

and treatment due to Yaajeende training. Increases in the use of improved water sources for cooking and drinking, however, were much more modest, as Yaajeende does not directly invest in these supply-side infrastructure projects. Prevalence of improved water sources at baseline was over 70%, and intertemporal changes were promising but not statistically significant.

Yaajeende had mixed results on essential nutrition actions (ENAs), such as exclusive maternal breastfeeding and salt iodation. Exclusive maternal breastfeeding of children below the age of 6 months among beneficiaries rose from 1% to 24% among beneficiaries. However, large rises occurred (in exclusive maternal breastfeeding) among both the comparison and project groups over the period of study. The counterfactual test asks whether the project group's increase was systematically larger than the comparison group over the same period. Statistical tests showed conflicting results on whether the change can be attributed to Yaajeende. Tests using a linear model failed to show results under this framework. Tests using nonlinear models, which are potentially more appropriate because of the very low prevalence at baseline, showed a treatment effect of a 3.5-fold increase in the odds ratio (p=0.07).[9] Therefore, it is difficult to determine that the treatment effect observed should be attributed to Yaajeende's work alone. Qualitative analysis indicates that mothers often find it difficult to practice exclusive breastfeeding despite high levels of awareness around its benefits, due to undernourishment among mothers and difficulties overcoming the traditional belief in the importance of cool water for infants. No significant improvement in salt iodation occurred. However, respondents from FGDs confirmed an increase in these behaviors as a result of visits by community nutrition volunteers (CNVs) to ensure that salt is properly stored, and confirmed near-universal knowledge of the importance of iodized salt.

Nutrition programming had a statistically significant and favorable impact on increased food diversity in program areas. The treatment effect of Yaajeende on food diversity is equivalent to about one-half of a food group, on average, among beneficiary households, using an index of 12 food groups. Focus groups reinforce that Yaajeende emphasizes education related to nutritious foods, particularly through community meals.

Though the prevalence of handwashing stations in Matam, Bakel, and Kédougou has increased substantially since 2011, it appears that Yaajeende has not directly contributed to this trend. A univariate regression analysis revealed unfavorable impacts of the nutrition and agriculture treatments on this indicator in the context of large positive trends. Qualitative evidence suggests that not all handwashing stations are being used because they are often viewed as expensive to maintain and easily damaged by the sun.

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[9] The odds ratio is the ratio of the probabilities of a positive (exclusive breastfed) to a negative (not exclusively breastfed) outcome. To calculate the odds ratio for a given population, we begin with the odds ratio of the positive outcome, and multiply by all the coefficients that apply. The treatment effect is one of these coefficients. When we multiply the treatment effect by the odds ratio for the comparison group at midterm, we obtain the final odds ratio for the treatment group at midterm. For details, see Section 3.8 Statistical Approach below.

Study Question 3: Agricultural Practices and Production

Did households living in villages located in project intervention areas see greater use of improved agriculture and livestock than households living in non-project areas? Did those practices lead to greater agriculture production and greater productivity?

Summary. Overall, qualitative evidence confirms that households living in villages located in project intervention areas saw improvements in animal husbandry, use of livestock, and animal health promotion, as compared to households in non-project areas and as a result of the Pass on the Gift (POG) program, but saw mixed results regarding improved agriculture use. Though livestock is a crucial project area that was difficult to measure in the survey data, site visits demonstrated saturation of targeted populations in just a few years as families claimed repayment rates well in excess of 90 percent. Similarly, during a period of overall decline in seed purchases, Yaajeende had a statistically significant and positive impact on beneficiaries' purchase of improved seeds through the development of sustainable markets, in comparison to comparison areas. However, no statistically significant results related to fertilizer purchases were found, as treatment and comparison areas experienced similar increases during this time. Adoption of improved agricultural technologies was modest, despite increased awareness of their benefits in project areas, due to the high risks associated with investing in technologies in the context of adverse weather conditions. Regarding the prevalence and use of CBSPs, treatment effects could not be estimated without baseline data. Qualitative findings, however, indicate that they have contributed to improved nutrition and agriculture practices in the areas they serve.

Yaajeende did not result in a statistically significant improvement in agriculture production, but did result in a statistically significant and beneficial impact on poverty reduction in project areas. Specifically, households in project villages did not increase surface area planted as a result of the project to a greater extent than households in comparison villages. Similarly, though individuals that invested in Yaajeende tillage services saw a dramatic rise in production on a per-acre basis, low adoption rates limited the rise in productivity across the entire beneficiary population. Total production of field crops underwent a strong secular decline across treatment and comparison areas, though surface area devoted to horticulture did experience a highly statistically significant increase in project intervention villages. Yet households located in project zones saw a decline in poverty, from 35% to 33%, whereas the comparison group's poverty rate was approximately the same. There were clear statistical links between poverty reduction and any level of project exposure: nutrition, agriculture, either, or both. Logistic difference in difference regression showed declines of 11% to 12% in the odds ratio of poverty. There was no evidence that the nutrition and agriculture components of the project were synergistic. Despite limited improvements in agriculture production, one of the most striking impacts of the project was on poverty as defined by the World Bank $1.25 per day criterion. Yaajeende interventions were statistically associated with reductions of the poverty rate by about 2.5 to 2.9 percentage points, and a lowered odds ratio of any single household's likelihood of poverty by about 10 percent. Similarly, project areas experienced a strong treatment effect of CFA 27,000

(USD 45) in agricultural revenue as a result of Yaajeende, nearly balancing the overall secular decline of CFA 30,000 in comparison areas during the same period.

Table 3. Results by Indicator, Agricultural Practices and Production

Indicator	Results
3.1 Poverty (Estimated)	Treatment effect of about 2.9 percentage points in high-intensity areas. No evidence of synergy in high-intensity group (p=0.01).[10]
3.2 Surface Area Planted	No discernible effect. Large secular rise (1.8 ha) in comparison group masked absolute rise within the Yaajeende group.
3.3 Surface Area for Horticulture	Highly significant treatment effect of 0.12 ha rise in horticulture surface area. Robust for all packages, no synergy (p=0.002).
3.4 Surface Area for Irrigation	Project households exhibited clearly more irrigation than the comparison group. Lacking baseline data, however, no counterfactual impact attribution.
3.5 Surface Area for Flood Plains	No discernible difference between project and comparison group in the aggregate. Lacking baseline data, no counterfactual impact attribution.
3.6 Agriculture Production	No statistically significant treatment effect on the average production of Yaajeende households.
3.7 Agriculture Revenue	Beneficial treatment effect of CFA 27,000 (USD 45) in agriculture revenue. Context is a secular decline in revenue of CFA 30,000 (p=0.03).
3.8 Seed Purchases	Treatment effect of 12 percentage points for high-intensity cohort. During the period of the study, a large secular decline in seed purchases occurred (p=0.003).
3.9 Fertilizer Purchases	No statistically significant results. Secular increases of 17 percentage points indicate an absolute increase among the project cohort.
3.10 Agriculture Investment	No statistically significant differences between project and comparison groups at the midterm. Due to the absence of baseline data, no counterfactual treatment effects are estimated.
3.11 Improved Seed Source	No significant differences between project and comparison groups at the midterm. Due to the absence of baseline data, no counterfactual treatment effects are estimated.
3.12 Use of CBSP	Nutrition package has a 12 percentage points higher likelihood ex-post of using a CBSP. Due to the absence of baseline data, no counterfactual treatment effects are estimated. CBSPs are not systematically available to the comparison group.
3.13 Improved Fertilizer Source	No statistically significant differences between project and comparison groups.
3.14 Trainee Head Count	High intensity intervention associated with an 18 percentage points synergy relative to agriculture and nutrition packages; but this synergy is offset by pernicious marginal effects in low-intensity areas (p=0.001).

Each of the Yaajeende program packages is statistically associated with a reduction of the poverty rate in intervention areas by about 2.5 to 2.9 percentage

[10] This summary discussion refers to ordinary least squares (OLS) models. For binary key indicators (such as poverty), treatment effects are equivalent to percentage point increases in the key indicator attributable to the project. The statistical annex also gives logistic regression results with treatment effects shown as marginal odds ratios.

points. This refers to poverty as defined by the World Bank $1.25 criterion and is one of the most striking positive impacts of the project. A household's likelihood of poverty was estimated as a percentage based on responses to ten simple, multiple-choice questions using the scorecard approach in Marc Schreiner's "A simple poverty scorecard for Senegal".[11] Effects were seen as a result of project participation, nutrition, and agriculture treatments taken individually.

Total household production and revenue declined during the period of study in both treatment and comparison groups. Yaajeende had a protective effect against declining revenues, with a treatment effect (CFA 27,000) nearly sufficient to offset the downward trend in farm income (CFA 30,000). Agriculture production among the comparison group fell by more than 400 kg on average, and the related treatment effect was not statistically significant among beneficiaries.

The poverty finding raises the question of what caused the rise in income and the decline in poverty. While we have several pieces of evidence, we do not know conclusively what caused the decline in poverty. We know that higher production of maize, millet, and rice was *not* the cause of the rise in income. Average production of these crops fell during the period of study, without any statistically significant treatment effect of Yaajeende. We also know that livestock income should have risen in many villages due to the POG project. Beneficiaries confirmed the dual benefits of dairy production and increase in the number of livestock, as well as the cost effectiveness of veterinary care, pasture services, and insurance. A third possibility is that farmers shifted their acreage into more valuable crops, including horticulture and arboriculture. A final possibility is that nonfarm income caused the drop in poverty, and that its rise was systematically concentrated in Yaajeende villages. The counterfactual methodology used to test treatment effects of Yaajeende cannot distinguish between the second, third, and fourth hypotheses.

In our interviews, we could have measured whether the total gain of livestock assets was greater in Yaajeende villages (with direct livestock subsidies) versus without it (no subsidies). But it would be extremely unlikely that comparison villages reported large, exogenous, positive shocks in livestock assets at the same time that project villages received thousands of head of livestock through the *passage du don*. We know that the livestock subsidy is valuable. Yaajeende's monitoring database is a far more accurate source of data on the total subsidy of livestock distributed, the rates of repayment, and the annual growth in livestock per household. The counterfactual impact evaluation design used here cannot easily distinguish between gross increases in livestock (with subsidy) and net increases in livestock (gross increase less subsidy from POG).

Land planted for horticulture increased under Yaajeende, with a treatment effect of about one-eighth of a hectare in the average household, while increases in total surface area planted could not be attributed to Yaajeende. Yaajeende focuses on horticulture, conservation agriculture, arboriculture, irrigation and flood recession

[11] Available at http://www.microfinance.com/#Senegal

agriculture, rather than extensive agriculture. The agriculture treatment had a significant correlation with surface area irrigated, yet this is an ex-post effect: the counterfactual approach and standard DD model do not apply without baseline data.

Beneficiaries invested more in agriculture inputs, such as improved seed, than the comparison group. Yaajeende had a significant and beneficial treatment effect on the purchase of seeds, and a marginally beneficial effect on the purchase of fertilizer, though not to a statistically significant degree. Beneficiaries were more likely than the comparison group to use improved seed sources and fertilizer sources as well, although treatment effects could not be estimated due to the limitations of the baseline dataset.

Nutrition programming has had a strong, positive effect on the prevalence and use of CBSPs in program areas. Univariate specifications identified high nutrition program effects on this indicator, though no significant program synergy effects were found. Field observations indicate that CBSPs and CNVs are significantly contributing to improved nutrition in the communities they serve.

Study Question 4: Nutrition-led Agriculture (Synergies)

Did individuals and households who benefited from both nutrition and agricultural project components experience greater improvement than those who benefitted from neither or from only one?

Summary. Statistical evidence for the synergistic effects of the agriculture and nutrition components of Yaajeende is limited, but suggestive. It was found that individuals and households who benefitted from both project components experienced a greater reduction in prevalence of underweight children (by about 11 percentage points based on the baseline village sample) than would have been expected based on the marginal effects of nutrition and agriculture interventions taken alone. Similarly, while there was found to be a favorable impact of the nutrition and agriculture treatment synergy on child wasting by 9 percentage points using the baseline village sample, this impact fell just short of statistical significance and the overall estimated treatment effect on wasting was less than a one percent reduction. Moreover, the synergy effect of the high-intensity intervention on hygienic kitchen practices was large, indicating that low-intensity villages deteriorated while high-intensity villages remained similar to the comparison group. No evidence of synergy was found on the poverty estimate.

These results show tentative support for the hypothesis that households benefiting from both project components experience greater improvement, or suffer less in the context of food security deterioration, than those who benefit from neither or from only one. However, they do not necessarily indicate that all high-intensity villages were significantly different from the comparison group. Due to the clustering design of the research, one possible interpretation of the data is that Yaajeende's combined effects were strong in some high-intensity areas, but not all, due to high variance in treatment effect estimates.

V. Recommendations

Overall, the MIE found that the Yaajeende program is relevant to beneficiary needs, coherent with USAID priority objectives, and is achieving results. Therefore, it is recommended that Yaajeende be continued. The impact evaluation has identified a number of recommended project strategy adjustments, including:

Focus Yaajeende resources where the complete, mutually reinforcing set of Yaajeende interventions can be implemented. While synergies are not evident everywhere, there is important evidence that high-intensity villages do better than low- and mid-intensity villages on key measures of child nutritional status. The most productive allocation of resources would be to focus on areas where the complete NLA approach can be implemented and on Yaajeende's most effective and complete interventions.

Recognize the success of Yaajeende in promoting food diversity and reducing the annual period of food scarcity. The project should analyze the ways in which beneficiaries managed to protect themselves from unfavorable trends in these areas, and amplify these successes. The most likely contributing components of Yaajeende were trainings, mothers' groups, CNVs, CBSPs, livestock programs, and horticulture.

Reinvest in livestock programs, with mutually supporting subsidy programs, financial services, training, and veterinary care. Results showed that pools of eligible beneficiaries had been saturated with the livestock subsidy program, POG, and that beneficiaries recognized the nutritional and financial benefits of livestock. The next challenge is to ensure the sustainability of livestock lending programs and livelihoods.

Scale up CBSPs. Nascent markets for agriculture inputs, livestock inputs, and nutritional products are dependent on the sustainability of the CBSPs' business models. The project should continue with capacity building, business training, and management of these important resources, to ensure that their markets outlast the Yaajeende project's support.

Expand the Citizen Work Group (CWG) program to cover more Yaajeende zones and focus the CWGs on community asset building, such as water and electricity, which are beyond the means of individual households. These community organizations are crucial to the consolidation of technical gains in productivity and nutrition. The CWGs can address political priorities, such as infrastructure, partnerships, and land tenure, on behalf of individual households.

Continue to raise awareness about the importance of ENAs, such as exclusive maternal breastfeeding. Senegal has a culture of respect for seniority, which makes movement away from traditional practices regarding food and childrearing, such as giving water to infants, difficult. Though breastfeeding is a common practice, consistent behavior change and shifts in household beliefs will take time.

Consider whether to allocate effort away from sectors where the comparison group shows positive trends. Where there is good evidence that project and non-project villages are experiencing a similar rise in access to clean water and hygiene, for example, the project should ascertain the drivers of change and focus on opportunities to leverage the efforts of local government, technical services, or charities already at work in these areas.

Study non-farm income among beneficiaries, including remittances. Since total agriculture declined and yet the treatment effect of Yaajeende on poverty was positive, it would be useful to know trends in other sources of income, such as trades and remittances. It is worth exploring why income benefits were concentrated among beneficiaries and whether or not this additional income was related to Yaajeende programming.

Realistically address household resource constraints. Yaajeende has demonstrated success in raising awareness of ENAs and WASH, and reducing poverty. Nonetheless, poverty remains a barrier to adoption of techniques for some beneficiaries. It is worth engaging local partners, such as the Citizen Working Groups, to explore strategies for additional asset building, income generation, or social safety net.

Further explore synergies between the nutrition and agriculture packages and the health sector. Maternal health and child nutrition outcomes were identified in qualitative research as being closely related to the availability of community health workers and centers.

Deepen attention to risk management. Because interviews suggest that adoption of improved seeds and fertilizer was limited by fear of adverse weather conditions, the theme of risk could be better incorporated into the project using a participatory approach to identify concerns and possible management strategies.

1. PROJECT BACKGROUND

1.1 Overview of the Yaajeende Program

Senegal suffers from persistently high food insecurity and undernutrition. Despite improving nutrition status of its population, rural areas are especially vulnerable to hunger and micronutrient deficiencies. Especially in both 2014 and 2015, Senegal experienced recurrent droughts, especially in northern Senegal, resulting in harvest deficits of rain-fed agriculture and prolonged ‘lean seasons.’

Taking a structural approach to the question of food security, the USAID Yaajeende Agriculture and Nutrition Development Program seeks to accelerate the participation of the very poor in rural economic growth and to improve the population’s nutritional status. Yaajeende is a five-year Feed the Future (FtF) initiative that received a two-year extension (November 2010 to September 2017), implemented by the National Cooperative Business Association (NCBA)/CLUSA International, Counterpart International, Heifer International, and Sheladia Associates in four regions of Senegal. It has operated in Matam, Bakel and Kédougou, the least food secure geographic zones in Senegal, since 2011, and was introduced in Kolda in 2014. Yaajeende adopts a Nutrition-Led Agriculture (NLA) approach, which promotes improved production, trade, and local consumption of high quality, nutritious foods, including foods that resolve priority nutritional deficiencies. The approach is guided by the belief that mutually supporting programs of nutrition and agriculture will be more efficacious in improving nutritional status than either of the components on their own.

The USAID Yaajeende Agriculture and Nutrition Development Program is a five-year Feed the Future (FtF) initiative that received a two-year extension (November 2010 to September 2017), implemented by NCBA/CLUSA, Counterpart International, Heifer International, and Sheladia Associates in four regions of Senegal. It has operated in Matam, Bakel and Kédougou since 2011, and was introduced in Kolda in 2014. Yaajeende invests in studies to identify needs related to FtF’s four pillars (detailed below) in order to make informed decisions about its activities.

At the core of Yaajeende is the Nutrition Led Agriculture (NLA) approach, which promotes improved production, trade, and local consumption of high quality, nutritious foods, including foods that resolve priority nutritional deficiencies. The NLA theory of change is that mutually supporting programs of nutrition and agriculture will be more efficacious in improving nutritional status than either of the mutually reinforcing components on their own. The NLA approach supports the development of a set of skills and techniques that are thought to have direct influence on local food security, defined as availability, access, utilization, and governance of food resources, in the communities where the project operates. Components of the approach include improving access to, and understanding of, relevant technologies and techniques, promoting structural changes, and developing the capacity of local institutions to create local markets for high quality nutritious foods.

Yaajeende program activities span the four FtF pillars of food security:

1. **Availability.** Interventions related to farm production – this bundle of activities is aimed at introducing and increasing production of key crops such as Vitamin A-rich orange flesh sweet potato, millet bio-fortified in iron and zinc, and micro- nutrient rich fruits and vegetables;

2. **Access.** Interventions related to farm productivity – these activities are aimed at increasing farmers' access to inputs and agriculture services that permit enhanced production of nutritious food crops via a network of private sector, community-based service providers (CBSPs or APS in French);

3. **Utilization.** Interventions aimed at creating demand for nutritious foods and potable water – these activities educate the public about the need for a diverse diet that includes fruits and vegetables and increases their ability to prepare these foods in ways that preserve and maximize the food's nutritional content; and

4. **Sustainable governance.** Interventions aimed at strengthening local government and civil society – These activities strengthen local actors' ability to engage in creative and dynamic partnerships to guide food production and water- related activities, and administer related resources, in an equitable and inclusive fashion that prioritizes the needs of the most nutritionally vulnerable populations.

Distinct from traditional development programs, Yaajeende trains and relies on local agents of change to effect behavior change. Agents include CBSPs, Community Nutrition Volunteers (CNVs or VNC in French), relays, and auxiliaries who work closely with Yaajeende staff. CBSPs are trained on components of Yaajeende programs that they can then sell as services in their local communities. They are organized into regional networks with regional steering committees, which help them to easily purchase products and resell them locally, thereby addressing the challenge of limited access to goods. CNVs are trained by Yaajeende program staff on nutrition topics and given starter kits, allowing them to hold Mother to Mother (MtM) groups, provide local trainings, and conduct Q/A sessions (*causeries* in French) to ensure participants have absorbed the material. CNVs are also trained on animal health and support Yaajeende's livestock program.[12] Relays benefit from, and assist with, Yaajeende agriculture or livestock trainings, serving as a local resource for communities. Auxiliaries are government extension agents that similarly serve as local resources and ensure animal health based on Yaajeende husbandry training.

Yaajeende's organizational structure has changed since the launching of the initiative. In 2011, Yaajeende began with offices in Dakar, Tambacounda, Matam and Kédougou, with technical specialists and decision-making centralized in Tambacounda. However, in

[12] CNVs can sell services to their local communities and thus become CBSP-CNVs.

2012, the Tambacounda office was closed, technical specialists were dispersed across the regions, and an office was opened in Bakel. This change reflects a Yaajeende management decision to adopt a more community demand-driven approach, as technical decisions have since been made in collaboration with regional staff. The Kolda office opened in 2014. In the regional offices, the personnel structure consists of a Regional Coordinator, Lead Program Managers, Assistant Program Managers, Coaches, Coach Local Resource Persons (LRP or PRL in French) and Interns. Directors are centralized in the Dakar office.

1.2 Yaajeende Program Activities

Within the NLA framework, Yaajeende nutrition program activities cover a wide range of behaviors concerning food choice, food preparation, food conservation, water, and sanitation, while agriculture program activities promote techniques for commercial and subsistence agriculture, horticulture, arboriculture, and livestock. Agriculture and livestock activities focus on local food production over international supply chains. Nutrition programs complement locally available foods, rather than advocating for the adoption of exotic foods and techniques. Yaajeende provides minimal subsidies to key activities and slowly transfers project ownership to local populations in activity areas.

The following sections provide further details on activities implemented in each of the four FtF pillar categories:

Pillar 1: Availability

Conservation Agriculture and Soil Health Program. In this intervention, a cadre of CBSPs offer a package of farming practices to local producers. This package, called the Zero Risk Package, consists of skills including composting and intercropping along with tractors and rippers, improved short-cycle seeds, organic fertilizer, microdose chemical fertilizers, and crop insurance. Women's groups are eligible to participate in a bio-reclamation of degraded lands (BDL) program that teaches women techniques to transform unused, biodegraded land into productive land. Men are also trained on these techniques in order to assist their wives with intense labor. Yaajeende assists some of these women's groups to procure deeds to lands for at least 25 years. It is otherwise difficult for women's groups and individual women to own land, as fields are typically passed down from father to son.

Agroforestry and Arboriculture. Private sector nurseries maintained by Arboriculture CBSPs are the primary method of extending agroforestry to participating communities. Such nurseries sell trees like Acacia Melifera, Mango, Moringa, Bauhinia, Cashew, Madd and Henna. They install live fencing on community projects including schools, land reclamation sites, commercial gardens, and community gardens. They also plant fruit trees on land adjacent to houses, schools, and health huts. Yaajeende also provides trainings on grafting the Sahel apple, rich in Vitamin C, onto jujube trees.

Rain-fed Agriculture. Rain-fed agriculture is the most common form of agriculture in

Yaajeende intervention zones and its successful use during the rainy season is crucial to farmers. Yaajeende recognizes this by identifying appropriate seasonal strategies. The program focuses its efforts on a group of leading producers (*grands producteurs* in French) that adopt a package of techniques, including intercropping, use of improved seed varieties, and use of fertilizer. CBSPs offer a number of key agricultural services: tillage, organic fertilizer, improved seeds, enhanced crop varieties, cereal processing, and cereal storage. Yaajeende promotes deep urea placement for rice cultivation to avoid nutrient losses caused by surface broadcasting.

Irrigated and Flood Recession Agriculture. In partnership with the Government of Senegal and other projects, Yaajeende promotes irrigation and flood recession agriculture in appropriate regions so that farmers can be productive outside of the rainy season. CBSPs provide seed, fertilizer, seedlings, and trainings to local populations. They also lease and sell irrigation pumps to communities with optional service agreements for repair. Large producers that purchase irrigation pumps are trained in accounting and financial planning. CBSPs also offer crop insurance with improved seed and tillage.

Commercial Horticulture. Rainy and counter-season commercial horticulture aim to increase the sale and consumption of fruits and vegetables in the project zones. Large-scale commercial gardens are supported by CBSPs through a broad range of services: financing, accounting, marketing, irrigation, seed, fertilizer, and various technical trainings to increase farmers' skills in different seasons. Women's groups farm community gardens with Yaajeende support. Crops include tomato, okra, bissap, hot pepper, eggplant, bitter eggplant, cabbage, lettuce, and onion.

Bio-fortified Crops Program. Both CBSPs and producer organizations promote the adoption of nutritionally enhanced hybrid varieties of maize, rice, millet, sweet potato, and beans. MtM groups and large producers participated in trials of bio-fortified orange flesh sweet potatoes that they have since adopted.

Seed Production Program. In partnership with public and private sector organizations, Yaajeende promotes seed multiplication activities. Specific partners include ISRA, Tropicasem, Hortis, Agroseed, Regional Rural Development Agency (DRDR), and the Association of Producers of Corn and Sorghum in the Senegal River Valley.

Livestock Enterprise Program. MtM and Citizen Work Groups (CWG) are involved in many phases of the animal husbandry program, including targeting of direct animal subsidies of chicken, goat, and sheep. CBSPs conduct trainings on animal care, breeding, marketing, and dairy products. Animal insurance was introduced using microfinance institutions in 2014 in certain locations. Recipients of direct animal subsidies have begun growing forage cowpeas and dolich for animal feed across the project zones. Emerging livestock breeders are supported with trainings from Yaajeende.

Livestock Health Program. CBSPs, relays, and auxiliaries trained in animal husbandry provide veterinary care and track the health of animals issued from the Passing on the Gift (POG) program, having identified animal health as an area in need of significant support in their areas of intervention. Yaajeende supports these businesses with marketing in cooperation with the Government of Senegal. The program has assisted the first private veterinarian to open a practice in Kédougou and involves veterinarians in the other regions in the livestock program. CBSPs also fabricate and sell mineral licks to breeders to increase consumption of important nutrients.

Passing on the Gift, or *passage du don*, is a livestock program with roots in traditional West African lending practices. POG is a direct livestock subsidiary to beneficiaries. Beneficiaries receive lots of livestock, either ten fowl or three small ruminants. Each head of livestock is intended to be repaid to the community's pool of animals for subsequent subsidy. Beneficiaries are educated on animal care and dairy practices. Beneficiaries can sell or consume the dairy products from livestock, and learn the nutritional and financial benefits of livestock. Livestock recipients are also obliged to purchase insurance and veterinary services. In POG villages, the project also encourages local markets for pasture services, meaning herders are available for hire to care for animals in the pasture on behalf of beneficiaries. Targeting of the POG program is a participatory community process. Where POG has long been active, some villages describe that the pool of beneficiaries has been completely saturated.

Pillar 2: Access

Financial and Insurance Program. Yaajeende has trained CBSPs and Coach LRPs on issues related to credit, including Decentralized Finance Systems (DFS), financial education, and how to submit credit applications. Coach LRPs help CBSPs in managing credit records. Credit has been obtained for agriculture, livestock, horticulture, CBSP activities, staple crops, and processing foods. Agricultural insurance, for livestock mortality and crops, is another component of this program.

CBSP Mechanization, Postharvest and Marketing Program. This program focuses on reinforcing CBSPs to address challenges in the agriculture program. CBSPs receive training to professionalize and reinforce the capacity of their network. This increases linkages between private sector firms and CBSPs in order to distribute more inputs. This program includes investigating postharvest options such as cold storage for seeds and postharvest equipment facilitation. Marketing of surplus agricultural production by CBSPs is also part of this program.

Nutrition-based Enterprises. This Year 4 program aims to promote the emergence of enterprises that transform and process nutritious foods that can be marketed through the CBSP networks, by supporting CNVs to begin providing services as CBSP-CNVs.

Pillar 3: Utilization

Educational and Nutritional Gardening. Yaajeende supports community gardens and trains CNVs on micro-gardening itineraries and the nutritional importance of vegetables. CNVs, in turn, train MtM groups on these topics and work with MtM groups in their community gardens. MtM participants keep micro-gardens in their homes and consume the vegetables they grow within the home. MtM groups are taught to use compost in their gardening activities and are given inputs at the beginning of the program to support these activities. CNVs track the amount of produce grown, sold, and consumed from community gardens. School gardens are set up to educate students on the growth and consumption of vegetables and to improve the students' diets through the school cafeteria. A recipe book incorporating wild and nutritious foods is currently being assembled for distribution amongst program beneficiaries.

Potable Water, Sanitation and Hygiene Program. CNVs train MtM groups on Water, Sanitation, and Hygiene (WASH) issues and about Community Led Total Sanitation (CLTS). These trainings aim to develop participants' skills in areas such as latrine management, trash collection, and hand-washing to reduce diarrheal diseases, especially in children. They have taught people to create holes filled with rocks and charcoal to receive used water from latrines to prevent this water from being absorbed into the water table. CNVs also teach MtM groups to make simple handwashing stations called TippyTaps and drying racks covered with mosquito nets to protect utensils, plates, etc. from animals and insects when drying after being washed. CBSPs sell soap, bleach, and filtered water as part of this program.

Food Fortification and Transformation Program. Wild foods activities include promotion and distribution of recipes with micronutrients (iron, zinc, vitamin A, iodine). Household fortification of flour includes incorporating cowpeas, peanuts, and/or corn for later use in locally produced enriched flours that mothers are taught to incorporate into their families' diets for improved nutrition. Participants are trained to process milk into cheese and yogurt. In cooperation with the NGO ACCRA, Yaajeende participants have been trained to use a solar dryer to dry grains, okra, and beans in the Matam region.

Behavior Change Communication (BCC) Program. BCC activities include community meals, MtM meetings, WASH activities, and awareness caravans. This program includes implementing activities around the Essential Nutrition Actions (ENA or AEN in French) and teaching members of the MtM groups the principles of the ENA. CNVs also teach MtMs the importance of consuming iodized salt and proper storage techniques so the salt retains its nutrients. This also includes behavior change activities targeting grandmothers and men.

Social Marketing Program. Vitamin A is a major concern in all Yaajeende intervention areas. To build demand to support commercial production of Vitamin A-rich produce, facilitate understanding around the contribution of Vitamin A to good health, and encourage orange foods consumption, the project developed a major social marketing campaign called "Eat Orange." This campaign focuses on getting people to consume orange flesh sweet potato, mangoes, carrots, papaya, and squash. Campaigns have also been run on conservation agriculture, biofortified crops, seed breeding, and livestock vaccination.

Pillar 4: Sustainable Governance

Local Governance and Civil Society Organization (CSO) Capacity Building Program. CWGs for Food Security engage in the leadership of food security issues within localities in collaboration with LRPs, which include CBSPs, CNVs, and Producer Organization Agents (POAs). CWGs apply for land grants for women to help them gain formal access to bio-degraded lands. Yaajeende develops the capacity of CWGs by having Governance Coaches teach them elements necessary to run an organization.

Local Partner Capacity Building Program. Yaajeende signs contracts with federations and other partners on targeted techniques for the implementation and follow-up of food security activities. This program strengthens local partner producer organizations on identified weaknesses according to capacity building plans.

Cross-cutting Activities

In addition to activities falling under the four FtF Pillars, Yaajeende implements activities in a number of cross-cutting areas. These include:

Gender. The majority of participants in the counter-season commercial horticulture program are women. The gender dimension is widely present in project interventions designed to improve maternal, infant and child health; in the rehabilitation of biodegraded lands; in the promotion of hygienic cooking practices, etc. Women's unique contribution to health and nutrition is recognized in, e.g., the putting in place of MtM networks.

Partnerships. Yaajeende has benefited from many partnerships since 2011, such as with USAID/PSSCII (Community Health Program): Child Fund's Community Health Program, USAID/PCE (Economic Growth Project), ARD (Regional Development Agency), PRN (Nutritional Reinforcement Program), and Teranga Gold Operations. Yaajeende collaborates with Africare and World Vision and does research with University of Cheikh Anta Diop and ICRISAT (International Crop Research Institute for the Semi-Arid Tropics). The biggest collaboration has been with the Institut du Sénégal pour la Recherche Agricole (ISRA) for the introduction and trial of improved and bio-fortified seeds, fertilizer, and orange fleshed sweet potato cuttings.

Climate Change Adaptation. The "Zero Risk" package promotes conservation agriculture which is best suited to climate change adaptation.

Training

Nutrition trainings for CBSPs and CNVs cover the following topics: ENAs, enriched flour, transformation of fruits and vegetables, sweet potato marmalade, handwashing, purification of water, preparation of enriched flour, diet of children aged 6-24 months, importance of the three food groups, transformation of sweet potato, hibiscus syrup, transformation of onion, transformation and conservation of milk, transformation of jujube into jujube galette, WASH, training on the 1000 days from pregnancy to 24 months, fabrication of mango jam and transformation of fruits and vegetables, use and maintenance of latrines, nutrition education, importance of Vitamin A, micronutrients, and domestic water treatment. Agriculture trainings cover: agricultural techniques, bio-restoration of degraded lands, market gardening, rice growing, and husbandry. Trainings for school children cover WASH and nutrition education.

Summary

The overarching goal of the Yaajeende program is to improve nutritional status in beneficiary households, and especially the nutritional status of women and children. These beneficiary households reside in geographically defined areas consisting of villages and municipalities (CRs). In pursuit of its goal, the program provides a comprehensive range of nutrition, agricultural, and rural development services to farmers and local communities, all with an emphasis on sustainable solutions to local challenges. To accomplish its objectives while mitigating risks, community-based and participatory approaches are favored. According to Yaajeende's theory of change, complementary nutrition and agriculture interventions will improve nutritional status more than the sum of their independent effects. That is, the synergy from complementary programs should be as large as the independent effects themselves.

1.3 Village Selection Criteria

In Year 1 of the Yaajeende program, 38 CRs were targeted in the region of Matam, the department of Bakel, and the region of Kédougou. These are the least food secure geographic zones in Senegal. In Year 4, the project extended its activities to 13 CRs and 172 villages in the Kolda region.

Selection criteria, in addition to food insecurity, were population, water, potential, dynamism, and agriculture. Villages had to meet a minimum population standard in order to maximize the impact of Yaajeende activities. They also had to have access to water necessary for Yaajeende's agriculture, horticulture, and livestock techniques, as well as WASH programs. Villages needed to be actively engaged in agriculture suited to Yaajeende techniques and technology, such as maize, millet, sorghum, and rice, along with gardening and commerce. Yaajeende did not detail their study of village potential or specify the specific criteria used to evaluate village dynamism. No formal database of village dynamism was available at the time of the MIE.

The selection procedure was rigorous. The selection team visited the 38 candidate municipalities to evaluate them for selection into the project. In each candidate municipality, project staff enumerated the villages and sent staff to each village to evaluate them on the five criteria listed above: population, water, potential, dynamism, and agriculture. Using a scoring grid, the staff selected the villages with the highest scores and consulted with local partners to validate the results of the scoring grid. In this way, the project applied local knowledge and experience to the selection criteria, incorporating information available on the potential of identified villages.

Yaajeende's Monitoring and Evaluation (M&E) Department keeps detailed records of project activities and output at the village level, including: rainy season crop production and consumption; counter season crop production and consumption; number of animals placed through POG; sales and services provided by CBSPs; number of credit applications submitted; and names of participants in each Yaajeende training.

2. Evaluation Purpose and Questions

2.1 Purpose

With the Yaajeende program running in its fifth year, the purpose of the Yaajeende Midterm Impact Evaluation is to measure whether Yaajeende Is on track to produce positive discernable impact on its beneficiary populations by the end of program with respect to its globally mandated FtF high level goals and 16 key indicators. The MIE will also provide guidance on how to adapt the Yaajeende program to enhance impact or, if needed, change course. The impact evaluation will analyze the marginal effect of partial exposure to project activities, as well as the global effect of the full Yaajeende project, which is intended to have synergies between availability, access, utilization, and governance components.

2.2 Questions

The MIE is organized around four Study Questions, each with a set of sub-questions and corresponding Indicators:

Study Question 1 – *Nutrition*
Did households and individuals living in villages located in project intervention areas see greater improvement in nutritional status indicators than those residing in non-project areas? Individual-level monitoring and evaluation data include anthropometry (height and weight) of children aged 0-59 months and women aged 15-49 years. Dietary diversity is measured for children under 23 months of age. Also measured at household level is the duration of the period during the year when food intake is reduced (called the soudure).

Study Question 2 – *Healthy household practices*
Did households living in villages located in project areas see greater adoption of healthy nutritional and WASH practices than those residing in non-project areas? The second set of questions looks at project impact on household practices related to food, WASH, and nutrition that should promote better nutritional status. These behaviors touch on a wide variety of practices in the home, but particularly those associated with methods of preparing, handling, storing, and enriching foods, rather than the choice of specific foods or their allocation to vulnerable members within the household. Choice of foods is included in Study Question 1.

Study Question 3 – *Agricultural practices and production*
Did households living in villages located in project intervention areas see greater use of improved agriculture and livestock than households living in non-project areas? Did those practices lead to greater agriculture production and greater productivity? The agriculture, horticulture, and livestock components of the Yaajeende project should produce improvements in household revenue, productivity, and thus enhanced availability of, and access to, food. A variety of improvements to agriculture inputs are promoted, including seed, fertilizer, tillage, financial services, and post-harvest processing. Similar

improvements in horticulture often focus on community gardens, women's groups, and members of women's groups. Even when horticulture products are consumed and not sold, these techniques can increase both availability of and access to vegetables. Livestock programs include both direct subsidies as well as training and improved inputs, such as financial services and veterinary medicine.

Study Question 4 *– Nutrition-led agriculture*
Did individuals and households who benefitted from both nutrition and agricultural project components experience greater improvement than those who benefitted from neither or from only one? The Yaajeende theory of change holds that nutrition-led agriculture will be more effective in improving nutritional status than the sum of the individual effects of nutrition and agriculture interventions alone.

2.3 Indicators

Each of the study questions above is informed by a series of specific, measurable, and concrete key indicators. Detailed definitions are presented in Annex I. These lend themselves to quantitative analysis from the household surveys conducted at baseline (2011) and midterm (2015) and were also designed with supporting qualitative research and monitoring data in mind. As shown in Annex II, the MIE key indicators correspond closely with the Performance Monitoring Plan (PMP) key indicators and in many cases are taken directly from the PMP definitions. Where indicators differ from PMP definitions, they have been developed in dialogue with project and USAID personnel.

Most of the key indicators are binary variables that take the values zero or one – e.g., a child either meets the criteria for wasting or he does not; a household either consumed fewer than two meals yesterday, or it did not. However, for convenience and clarity indicators are generally described in terms of prevalence among all the individuals or all the households in the survey (i.e., proportion of individuals or proportion of households, a number between zero and one). In the regression approach described below, coefficients may be interpreted as the marginal impact on prevalence. The Key Indicators associated with the Study Questions above are as follows:

Study Question 1 *– Nutrition*

1.1 Wasting among children aged 6-59 months.[13] Defined according to the child’s z-score on a weight-for-length curve using World Health Organization (WHO) reference data.
1.2 Stunting among children aged 6-59 months. Defined according to the child’s z-score on a length-for-age curve using WHO reference data.
1.3 Underweight among children aged 6-59 months. Defined according to the child’s z-score on a weight-for-age curve using WHO reference

[13] Indicators 1.1, 1.2, 1.3, 1.4, and 1.5 are binary variables observed at the individual level. Trends, treatment effects, and related PMP targets are estimated as a change in prevalence of the key indicator among beneficiary populations.

data.

1.4 Underweight among women aged 15-49 years. Defined as a body mass index (BMI) below 18.5.

1.5 Minimum acceptable diet (MAD) among children aged 6-23 months.[14]

1.6 Average duration of reduced food intake in the household (months).

1.7 Fewer than two meals in the previous 24 hours prepared in the household.[15]

***Study Question 2** – Healthy household practices*

2.1 Household reports at least one hygienic kitchen behavior, including handwashing and hair covering.[16]

2.2 Households reports in improved food storage practices, including cold storage and covered storage.

2.3 Household treats drinking water using at least one of the following: bleach, filters, and silver filters (binary).

2.4 Household practices at least one food conservation technique, including fermentation, germination, torrefaction, drying, or fortification (mélange).

2.5 Household uses and properly stores iodized salt.

2.6 Exclusive maternal breastfeeding of infants under 6 months of age.

2.7 Household food diversity score (1.12).

2.8 Household has a handwashing station in common use.

2.9 Household drinks water from an improved source, meaning from a covered well, faucet, or deep well.

2.10 Household cooks with water from an improved source, meaning from a covered well, faucet, or deep well.

***Study Question 3** – Agricultural practices and production*

3.1 Poverty, estimated as a propensity to fall below the World Bank's USD $1.25 Purchasing Power Parity (PPP) daily income line.[17]

3.2 Surface area devoted to agriculture (ha).

3.3 Surface area devoted to horticulture (ha).

3.4 Surface area devoted to irrigated agriculture (ha).

3.5 Surface area devoted to flood-plain agriculture (ha).

3.6 Total agricultural production (kg).

3.7 Total revenue from agriculture (FCFA).

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[14] See Annex II for a detailed discussion of food groups and feeding frequencies, specified for both breastfed and non-breastfed children.

[15] Indicator 1.7 is a binary indicator observed at the household level. Trends, treatment effects, and related PMP targets are estimated as changes in prevalence among households.

[16] Indicators 2.1, 2.2, 2.3, 2.4, 2.5, 2.8, 2.9, and 2.10 are binary variables observed at the household level. Trends, treatment effects, and PMP targets are estimated as changes in prevalence among households.

[17] Poverty is estimated using the scorecard approach in Marc Schreiner (2009) "A simple poverty scorecard for Senegal," available at http://www.microfinance.com/#Senegal. The household's likelihood of poverty is estimated as a two-digit percentage, based on responses to ten simple, multiple-choice questions. The scorecard can be calibrated to any of a menu of poverty lines, including USAID extreme poverty, the national poverty lines, and multiples of the preceding. By multiples, we mean double or triple the income of that poverty line; for example, the scorecard can be calibrated not only to the World Bank's $1.25 PPP daily income line, but also to $2.50 PPP and to $3.75 PPP daily income.

3.8 Household purchases seed.[18]
3.9 Household purchases fertilizer.
3.10 Index of agriculture technology adoption.[19]
3.11 Household uses an improved seed source: government technical service, specialized vendor, non-governmental organization (NGO) or CBSP.
3.12 Household purchases goods or services from a Yaajeende CBSP.
3.13 Household uses an improved fertilizer source: government technical service, specialized vendor, NGO or CBSP.
3.14 Head count of individuals in household that have attended agricultural trainings in last 12 months.

The indicators related to Study Question 3 are designed to highlight changes to the practice of agriculture and livestock rather than the value of direct subsidies received. Given the isolation of project communities from supply chains on both the buy and sell sides (i.e., purchase of inputs, marketing of production, and sale of outputs), the value of agriculture sales and the gross margins of agriculture may be of limited value in measuring agricultural performance, especially as it relates to availability of and access to food. Rather, indicators selected to approach Study Question 3 include the allocation of land to specific agriculture techniques, the adoption of improved inputs, and the production of certain staples that are predominantly consumed rather than sold. Study Question 3 implicitly also asks whether project participation affects overall poverty rates, so we include a poverty assessment scorecard based on simple observable questions such as house construction materials, educational attainment, and ownership of consumer durables.

Table 4 below lists the PMP indicators that are also studied in the MIE. The correspondence between indicators and those used in the PMP are discussed in Annex II, as are technical issues related to the poverty scorecard. Targets for change, as listed in the PMP as of December 2013, are intended to be achieved by the end of the Yaajeende project. “Track only” in the table refers to case where no quantitative target was set.

[18] Indicators 3.8, 3.9, 3.11, 3.12, and 3.13 are binary variables observed at the household level. Trends, treatment effects, and PMP targets are estimated as a change in prevalence among households.

[19] Indicator 3.10 is a count of specific Yaajeende agriculture techniques adopted by the household. See Annex II for a complete list of the techniques scored in the index. It takes natural number values of 0 or greater, and the maximum value in the sample is 17.

Table 4. Performance Monitoring Plan (PMP) Targets Related to the Impact Evaluation

Type	Ind. No.	Project Performance Indicator	Cumulative Target Change
Outcome	1	% of Households that have increased dietary diversity score by at least 8%.	80%
Outcome	6	Number of HHs adopting improved practices or behavior after training by USAID|Yaajeende (new)	Track only
Outcome	8	Number of Households with improved livestock production	Track only
Outcome	9	Number of Households with Increased livestock related income	Track only
Outcome	27	Total number of months of the previous 12 months a household was unable to meet its food needs (annual reduction compared to the baseline)	-30%
Impact	28	Prevalence of stunted children under five years of age* (Reduction)	-20%
Impact	29	Prevalence of underweight children under five years of age* (Reduction)	-25%
Impact	30	Prevalence of wasted children under five years of age* (new)	Track only
Impact	31	Prevalence of underweight women* (new)	Track only
Outcome	32	Reduction in % of households that consume fewer than 2 meals per day	-50%
Outcome	33	Prevalence of children 6-23 months receiving a Minimum Acceptable Diet MAD)*	Track only
Outcome	35	Percentage increase over baseline of households using iodized salt and storing it properly	30%
Outcome	36	Number of HH adopting food processing, food safety or nutrition practices due to USAID|Yaajeende (new)	25000
Outcome	40	Number of HH adopting improved water, sanitation and hygiene practices due to USAID|Yaajeende	9,500
Outcome	41	Percent of households with soap and water at a handwashing station commonly used by family members	30%
Outcome	42	Percent of households using a drinking water source	50%

3. METHOD

3.1 Introduction

In order to investigate the impact of the Yaajeende program on the communities where it operates, the MIE estimates changes in key indicators during the period of performance and analyzes correlations between those changes and participation in relevant program components to make causal inferences about the program's impact (see Appendix I, the MIE Statement of Work). The MIE uses a mixed-method approach involving a non- experimental quantitative strategy and qualitative techniques including KIIs and FGDs. It looks at the impacts of Yaajeende's nutrition and agriculture programs and asks whether there have been synergies between the two areas of project intervention. Baseline data collection was conducted from May to June 2011 and midterm data collection was conducted from May to June 2015.

The principal regression methodology used in this evaluation is difference-in-difference (DD) analysis. The DD method compares changes in key indicators over time between randomly selected households from villages that participated in the Yaajeende program and from villages that did not participate in the program.[20] This counterfactual approach looks at how program beneficiaries compare to non-program beneficiaries, while also accounting for initial time-invariant differences between the two groups (i.e., baseline conditions). The MIE compares changes in nutritional status, household practices, and agriculture practices experienced by households in treatment and comparison communities over the same period of time, between 2011 and 2015.

Using a DD framework, the evaluation measured whether the project households experienced greater (or lesser) improvements in key indicators, than did comparison households, indicating positive (or negative) program impact. While several of the indicators, such as underweight and exclusive maternal breastfeeding, are observed at the individual level rather than the household level, every household in the village has the same status of participation in this evaluation, regardless of whether the individuals in that household personally participated in project activities. Therefore, the same DD framework applies.

The DD framework relies on a parallel trends assumption. It assumes that villages from the project and comparison groups would have experienced identical changes in key indicators during the period of study, from baseline to midterm, without the impact of the project. Where the change in a key indicator among project villages is systematically greater (or lesser) than the change among comparison villages during the same period of time, we attribute that difference to the impact of the project, often

[20] For the purposes of the MIE, a household is defined as economic and productive unit of society, whose members typically share income and expenses according to local tradition and are regarded as a household by members of their village. This definition of household is consistent with the Senegalese statistical service and the USAID Demographic and Health Survey (DHS).

called the treatment effect. As mentioned above, however, this inferential framework is weakened when assignment to project and comparison groups is nonrandom.

Specifically, the quantitative component measures whether any of the following impact outcomes were observed in beneficiary households and, if so, whether they were measurably different from changes observed in households not benefitting:

- Improved nutritional status among children and women of reproductive age;
- Adoption of better household practices related to nutrition, water, sanitation, and hygiene; and
- Investment of effort and resources in improved agriculture, broadly defined to include horticulture and livestock.

It is important to note that while the comparison group is comprised of villages where Yaajeende did not operate, these comparison villages may have benefited from other technical services, donors, or NGOs with a similar agenda. To achieve maximum coverage of development interventions across its territory, the Government of Senegal often disperses projects with similar goals. Therefore, it is important to note that the treatment effects discussed in this study reflect the difference between treatment and comparison villages as events actually transpired, and not a randomized control trial where the comparison villages receive no interventions of any kind.

The purpose of the qualitative component is to engage experts and beneficiaries in direct discussion about project activities. It ascertains whether participants understand core Yaajeende activities; assesses beneficiaries' contextual knowledge about the skills, techniques, and behaviors extended; verifies the causal pathways that are implicit in the Yaajeende theory of change; and searches for alternative explanations for observed changes in behavior, project participation, and key indicators during the period of performance.

Households in the project and comparison groups are not assigned to those groups at random. The selection of households from within project and comparison zones is random, but participation in Yaajeende itself is not randomized. Villages were selected for project packages based on participatory community assessments, and required a certain level of potential to benefit from the project in the eyes of the project staff. This potential is related to whether the community had appropriate livelihoods, organizations, and resources to benefit from the specific techniques and expertise that comprise the project packages. This lack of randomization complicates the evaluation, because it is difficult to tell whether the comparison cohort would have had the same change over the period of the study as the project cohort, resulting in some statistical challenges. The project might have systematically chosen to work in places more likely to improve (or deteriorate) during the course of the study. The treatment groups might be systematically different from the comparison group with regard to livelihoods, community assets, intangibles, and their exposure to particular economic shocks during the period of study. Such differences could lead the DD methodology astray.

The technique used to address concerns about non-random recruitment (particularly endogeneity and selection bias) is propensity score matching (PSM). PSM estimates the *propensity of households to be selected* into the project group in the first period. The households in the project group are then matched to a set of households in the comparison group with similar propensities to be included. While these households are not identical in all respects, their propensity for inclusion in Yaajeende is explicitly modeled. The propensity matching model predicts the probability that each household from both the treatment and control group would have been assigned to participate in the intervention. Without propensity score matching, it is possible that exogenous differences between treatment and comparison groups could be misattributed to the project.

3.2 Intervention Packages

Yaajeende works on many different and mutually reinforcing activities within beneficiary villages. In the monitoring and evaluation database, the activities can be organized according to a variety of traits: the technical team that works on the projects (elevage, agriculture, horticulture, nutrition, sustainability, or governance) or by the modality of the intervention, such as an MtM group, producer's group, committee, or CBSP. This evaluation uses the project's definition of "packages" to get at the broadest possible organization of Yaajeende activities. The objective of the evaluation is to understand the impact of the project as a whole, rather than the individual technologies and interventions that comprise it.

If every agriculture and nutrition technique promoted by Yaajeende were investigated, numbering over one hundred, one would need an impractically large sample to identify the effects of each specific activity. Even then, because project components are selected on a participatory basis (i.e., villagers selected from a menu of available interventions), selection bias would cloud the results to a considerable degree. It would be difficult to argue that a specific project activity would yield a marginal impact of known size on an average individual or household, independent of all the other project activities. Therefore, we have grouped activities into three broad packages, assuming that within each package, the project activity mix was adjusted to reflect local conditions, ecosystems, and resources.

The following describes the three intervention packages referenced throughout the analysis:

Package A: *Core Nutrition Package*

This package is essential for any change in nutrition and impact on malnutrition indicators. These activities are therefore foundational. Package A should result in near-term impacts as it is a direct nutrition intervention with core target groups. Activities related to WASH and essential nutrition fall under Package A. The main components are:

1) Key behavior change: MtMs, ENAs, community meals, social marketing;
2) Fortified foods: enriched flours, iodized salt, bio-fortified crops, wild foods, and household fortification; and

3) Clean potable water: WASH and clean water.

Package B: *Agriculture Production Package*
This package is essential for medium-term and sustained impact on malnutrition as it affects the structure and quality of food production systems within communities, thereby affecting health. Although slower in achieving impact and more indirect in their effects on health, these activities feed into the direct interventions in the core nutrition package, such as inputs for locally created enriched flours. Activities related to horticulture, arboriculture, and livestock fall under Package B:

1) Energy dense cereals (carbohydrates): conservation agriculture, flood recession agriculture, and irrigated cereal agriculture including rice and maize;
2) Micronutrient rich vegetables and fruits: commercial, community, and nutritional gardens, arboriculture; and
3) Animal protein and lipids: livestock placements and POG, livestock enterprises.

Package C*: Governance and Markets Package*
This package ensures increased market access to commercial products and services that improve overall food and water supply along with the enabling environment. It maximizes the use of food and water resources and increases access to resources and assets. Governance improves anticipation of climate change-induced crises and provides a mechanism to plan, coordinate, and evaluate community-level interventions. Implementation of this package increases resilience and reduces a community's susceptibility to shocks, including those broadly predicted to be associated with climate change. Activities related to local markets and governance fall under Package C. The main component activities are:

1) Increased access to quality products and services: sales by CBSPs in both agriculture and nutrition; and
2) Improved coordination and resource use through good governance: local government, CWGs, Local Steering Committees (LSCs), land tenure, and presence of CWG or LSC.

3.3 Project Intensity and Packages

Participation in Yaajeende is observed at the village level. All households in a village where the project implements a package, such as nutrition or agriculture, are part of the treatment group for that package. Every household in the village has the same status of participation in this evaluation, regardless of whether the individuals in that household personally participated in project activities. Although the project has extensive monitoring data on the number of individuals that attend specific trainings, meetings, meals, and groups, the survey itself does not use this data to specify intensity or duration of project activity in the survey villages. Instead, the project's monitoring and evaluation staff generated a comprehensive list of the packages that each project village received during the duration of the project. Measures of participation are binary: all villages that received package A have the same score for participation in package A. There is no attempt to measure either the headcount or prevalence of participation in the package, or whether the village participated in key institutions such as MTM groups and CBSPs.

In order to investigate Study Question 1, the MIE compares project households that received any Yaajeende packages, regardless of which or how many, to the comparison group that received none. Under Study Question 2, the MIE compares households exposed to the nutrition package (A) to the same comparison group. Under Study Question 3, the MIE compares households exposed to the agriculture package (B) to the same comparison group. Under Study Question 4, the MIE searches for additional, synergistic effects of exposure to all three packages (nutrition, agriculture, and governance) beyond the marginal effects of nutrition taken alone and agriculture taken alone. The PSM models are fit using *only* households exposed to all three packages and the comparison group that received none. The term "high intensity" villages is shorthand for exposure to all three packages: nutrition, agriculture, and governance. The concept of project intensity refers to the breadth of project activities, not expenditures or participation rates.

Based on the packages that the project provided to each village, the village also received an intensity score. The intensity score is identical for all households in the village. The intensity score could be low, medium or high, based on how many of the packages the village received. The high-intensity villages, which received all three packages, received special focus in this evaluation. They were used to test whether the nutrition and agriculture components of the project were more effective together than would be expected from their marginal treatment effects; in other words, whether taken together they create synergy. The measures provided by the project staff (low, middle, and high) correspond roughly to the number of packages received (1, 2, and 3). Low-intensity villages received either agriculture or nutrition but not both. Middle intensity villages received nutrition and one other, either agriculture or governance. High intensity villages received all three packages: nutrition, agriculture, and governance. According to Yaajeende M&E data, 40% of villages in the program are high intensity. This breaks down to 42% in Matam, 37.5% in Kédougou and 53% in Bakel. Middle intensity villages are not studied separately from low-intensity.

In order to qualify as having received a package, such as nutrition, the village must have received at least two specific interventions within the domain of that package. Those two interventions must be drawn from at least two of the three intervention categories within package A. To be classified as a package B village, a community must have implemented activities in at least two of the three Package B categories. To be classified as package C village, a community must have implemented activities in at least one of the two Package C categories (see categories above).

Finally, because Yaajeende largely targets villages rather than individuals, many project activities are designed to operate at the village or CR level. This includes the work of CBSPs, CNVs, and all activities in package C that fall within the domains of public health and food security. While some project activities, such as trainings and MtM groups, are aimed at the individual level, project exposure is tracked at the community level. Therefore, for the MIE, all households in the same village are considered to “possess” the same project intensity and package classifications.

3.4 Sampling

A multi-stage cluster sampling approach was used to select households to be included in the population-based survey (PBS). The first stage of sampling involved selection of treatment villages in the program CRs and selection of control villages from the non-program CRs in each zone. The second stage of sampling involved a random selection of households from each village using household listings.

Villages sampled at baseline were classified as project or comparison villages based on their geographic location. This is appropriate because nutrition and agriculture packages can have effects on local markets beyond the village where participants reside, through both market and nonmarket channels. Agriculture inputs, agriculture markets, enhanced food products, and norms related to ENAs can reach beyond participants’ villages of residence. At baseline, the differentiation of the project into packages was not fully incorporated into the designation of project and comparison group villages. Villages at baseline could be classified into project or comparison groups based on whether their municipalities were slated to participate in the Yaajeende project. By the time of the midterm sample, the project’s monitoring data enhanced the measures of village participation in two ways. First, it provided accurate data on village participation in the project based on records of specific project activities and participation, rather than plans for those activities at baseline. Second, it differentiated among the three packages of intervention at the village level. As a result, it became possible to address the study questions, which differentiate between the individual effects of agriculture and nutrition packages and investigate synergies between them. This approach would have been more difficult without the village classifications, relying on noisy survey data to assess which project packages were active in specific villages.

To account for nonrandom treatment assignment, therefore, a sampling approach is used that controls costs and optimizes the applicability of the DD framework under observational conditions. Because villages within each CR shared the same designation of treatment or comparison at baseline, the MIE team used a sampling approach in which comparison villages were selected from CRs adjacent to project CRs, in which the parallel trends assumption was most likely to hold. Specifically, climate, markets, infrastructure, agriculture, and politics are most likely to be similar in adjacent CRs. Using this selection method, the sample limits exogenous variation between the treatment and comparison groups that might threaten the parallel trends assumption.

There were some limitations in the sampling approach. The composition of the baseline sample and midterm sample were not the same in their regional distributions of project and comparison groups. In the baseline sample, two-thirds of Matam households were expected to be in project zones, versus less than half of Kédougou households. At midterm, 77% of Matam households were located in project zones versus just 35% of

Kédougou households. As a result, the control sample is drawn more than 50% from the region of Kédougou, which has a distinct climate and different livelihoods from the other two regions. The project sample is drawn 78% from northern regions (Matam and Bakel), and half from the Matam region alone.

While ideally the MIE would involve only households covered by the 2011 baseline survey, making a full longitudinal panel analysis possible, it was necessary to adapt the approach to the practical constraints encountered in the course of the evaluation. For instance, households containing a woman of childbearing age in 2011 might not contain such a person in 2015. The following section describes the 2011 baseline and 2015 midterm sampling strategies.

Baseline. Baseline data collection took place between May and June of 2011 in the Yaajeende program area as well as outside of the program area. It covered five specific zones: Bakel Department, Matam Region, Kédougou Region, Kolda Region, and Tambacounda Department. Within these zones, the survey was conducted in 274 villages and within each village, 10 households were surveyed. Thus, a total of 2,740 households representing a population of 29,000 individuals were surveyed. The total population of the five zones is estimated to be 92,000 households and 1 million persons.

At baseline, households were selected randomly from a list maintained by the village chief, who is the sole public official responsible for the list on behalf of the Senegalese government. Households sampled were eligible to participate in the survey if either women aged 15-49 years or children aged 0-59 months resided within the house. At the time of selection, 15 households were chosen in each village, and were visited in order of selection until 10 interviews were complete.

Midterm. Between 2011 and 2013, Phase 1 of the Yaajeende program was implemented in three zones: Bakel Department, Matam Region and Kédougou Region. As a result, the MIE survey focuses on these three zones. The other two zones sampled at baseline, Tambacounda Department and Kolda Region, were excluded from the midterm survey due to the absence of project activity. In the three zones retained for the midterm survey, a total of 1,330 households residing in 133 villages had been surveyed at baseline. Based on the criteria for classifying villages by project package participation described above, the distribution of these 133 baseline villages, households, and persons is presented in Table 5.

Table 5. Baseline Sample Allocation by Packages and Intensity

Packages Implemented	Intensity	Frequency (villages)	Frequency (households)	Persons
None	Non-project	65	650	5,833
ABC	High	41	408	4,719
AB	Medium	6	61	729
AC	Medium	13	131	1,533

Packages Implemented	Intensity	Frequency (villages)	Frequency (households)	Persons
A	Low	6	60	546
B or C	Low	2	20	206
Total		**133**	**1,330**	**13,566**

Note that raw project data did not distinguish between villages that received only package B and villages that received only package C. Therefore, we treat all the villages in the "B or C" category as if they received package B, the agriculture intervention.

In baseline villages, two groups of households were interviewed. The first was comprised of the ten households per village that had been interviewed in 2011. These households were contacted and interviewed again, regardless of the current residence of either the women or children who had qualified them for interview at the time of the baseline survey. If a household was not found, the reason why it had moved away or dissolved was recorded. A power analysis[21] indicated that additional households per village were needed to ensure that a sufficient number of households with children aged five and younger and women aged 15-49 were surveyed. There was also the constraint of children below age 5 and women aged 15-49 "aging out", making a strict longitudinal panel approach unfeasible. Therefore, in baseline villages, after the original ten households were identified and re-interviewed, seven additional households were selected at random and interviewed.

The power analysis also indicated that simply revisiting baseline villages would result in an insufficient number of villages in the high, medium, and low intensity classes. Therefore, 27 "new intervention villages" were randomly selected from project villages that were not covered by the baseline sample. Like the baseline villages, these were located in the three administrative zones of Senegal where the project operated for the longest period of time and where the impact of activities should be the greatest: the region of Matam, the department of Bakel, and the region of Kédougou. Randomization was stratified and equally allocated by intensity category.

The evaluation team implemented the following randomization procedure to select households.[22] Wherever possible, the village chief's list of households in each village, which is used for census and tax purposes, was used as the complete list of households in the village. In Senegal, there may be multiple households within a concession and multiple huts within a household. Using a computerized randomization procedure, households were selected from each list without replacement. The number of households selected was greater than the target number of complete interviews per cluster. Villages from the baseline survey required 17 complete interviews, including the ten original

[21] A statistical analysis of the likelihood of a given sample size giving rise to statistically significant results.

[22] For the purposes of the MIE, a household is defined as economic and productive unit of society, whose members typically share income and expenses according to local tradition and are regarded as a household by members of their village. This definition of household is consistent with the Senegalese statistical service and the USAID Demographic and Health Survey (DHS).

households where available. Therefore, in villages interviewed at baseline, 25 households were selected from the list. In new villages, 40 households were selected. In both baseline and new villages, households were contacted in order until the target number of complete interviews was obtained (regardless of the number of baseline households reached in baseline villages). In baseline villages, new households were screened for either (1) the presence of a woman between the ages of 15-49, or (2) the presence of a child aged 0-59 months. Finally, in villages where the village chief's list was unavailable, a random walk methodology was used to take a geographically random sample of households within the village's borders.

As outlined in Table 6, a total of 2,720 households were sampled from 160 villages - 133 baseline villages and 27 'new intervention' villages - in Bakel, Kédougou, and Matam. A full breakdown of the sample by region is outlined in Table 6 below. The sample may be considered a reasonably representative sample of the households and individuals residing in areas that were eligible for the project, and of the treatment and comparison populations.

Table 6. Geographic Allocation of Midterm Sample

Region	Total Sample		Baseline Villages		New Villages[23]	
	Villages	HHs	Villages	HHs	Villages	HHs
Bakel	38	646	32	544	6	102
Kédougou	58	986	52	884	6	102
Matam	64	1088	49	833	15	255
Total	**160**	**2720**[24]	**133**	**2261**	**27**	**459**

In the end, 2,514 interviews were completed. A full breakdown of completed interviews by project packages received and intensity category is outlined in Table 7 below.

Table 7. Midterm Sample Allocation by Project Packages and Village Intensity

Project Packages Received	Intensity	Completed Household Surveys
None	Non-project	1020
ABC	High	857
AB	Medium	113
AC	Medium	283
A only	Low	139

[23] All new villages were from Yaajeende project zones, and not comparison zones.

[24] The sample allocation describes the sampling plan, which does not correspond to the number of records in the raw data or the number of complete interviews. Due to the requirements for new households and the definition of cluster sizes using completed interviews, it is possible to have more than 17 contacts sampled in the raw data collection. It is also possible to have fewer than 17 completed interviews in the final dataset. The final frequency counts are available in the statistical appendix.

Project Packages Received	**Intensity**	**Completed Household Surveys**
B or C	Low	102
Total		**2,514**

The baseline survey includes 1,330 interviews from 160 villages, yielding a combined total of 3,844 records. The rate of attrition from the baseline sample to the midterm was 15.5%. Of the original 1,330 households sampled, 1,124 completed interviews in the midterm period.

3.5 Survey Instrument

The midterm survey questionnaire contained three components, each targeted to a different respondent:

1. Household and Agriculture Questionnaire: the respondent was the head of the household or a person assigned by the head of household;
2. Nutrition Questionnaire: the respondent was the woman in charge of the household; and
3. Women and Children's Health Questionnaire: respondents were each woman in the household with children below age 5.

Taken together, the survey consisted of ten modules: 1) list of persons; 2) household goods and furnishings; 3) revenue sources; 4) surface area cultivated; 5) agriculture and livestock; 6) debts and financial services; 7) participation in Yaajeende activities; 8) food consumption; 9) nutrition and health; and 10) anthropometry. Administering the survey to a household took, on average, four hours. At every point in the survey, from enumerator training to data cleaning, a comprehensive data quality assurance (DQA) program was implemented, described below.

3.6 Data Quality Assurance

All phases of data collection were quality controlled. Survey procedures were observed and critiqued during training and in the field. Survey data were copied and transferred to a secure server prior to analysis. All raw field data files are encrypted in every location where they are stored. Furthermore, all tablets and cloud drives used to store files were rigorously inventoried and de-duplicated, and a final archive of unique interview files was created and stored. A number of damaged interview files were corrected using the SurveyBe desktop software, and a small number of files were sent to the vendor's technical support team. No interview files were lost during the survey.

The quality control measures implemented by the evaluation team were successful in their goals: to prevent data loss, to ensure the integrity of field research data, to ensure households and villages were accurately identified, to safeguard the privacy of respondents and the confidentiality of their data, to prevent the loss of interview data through partial and/or duplicate interview files, and to ensure the accuracy of transcripts and translation documents.

The following section details data quality measures taken during each stage of surveying:

Enumerator training. Enumerators received an eight-day training in Dakar. They learned the survey procedure and survey manual in the classroom. Both paper and electronic questionnaires were provided to them for training purposes. Enumerators received training in anthropometric measures of height and weight for adults, children, toddlers, and infants. The training included one day to pilot the survey under field conditions in a village outside of Thies, Senegal. Enumerators took a competitive exam at the conclusion of training. The top 85% of trainees were selected for field research, and the rest were retained as alternates.

Field supervision. Field staff worked in teams of six, with a driver, a supervisor, and four enumerators. The supervisor was the sole individual assigned to take anthropometric measures. Each enumerator was the sole individual to enter data for an interview. During the anthropometry section, the supervisor would take measures from the apparatus and pronounce the heights and weights to be recorded in the tablets. Thus, each interview in its entirety was recorded by a single enumerator on a single tablet. At the end of the day, supervisors reviewed enumerators' files and any associated validation reports.

Software. The survey software, SurveyBe, validates all responses according to predefined validation conditions. Individual questions can be validated for data types, such as numeric or string entries. Questions can also be validated based on the range of numbers submitted. Validation conditions can also generate error messages when incompatible combinations of answers are entered, specifically related to age, sex, family relationships, and marital status.

SurveyBe prevents inappropriate data entry through automated questionnaire logic. Questions can be skipped or enabled based on responses to previous questions. Rosters of questions appropriate to a topic can be populated based on responses to survey questions. Automated controls prevent surveyors from incorrectly following the order of questions on the survey. The survey questionnaire did not use any randomization of question order or question filters. Furthermore, validation of survey responses occurs on every screen of every interview file captured using the survey tablets. Comments can be placed in the SurveyBe software anywhere that validation errors and warnings have been noted. Both surveyors and field supervisors independently review the validation report before survey files are transmitted to cloud backup servers.

Data pipeline. At the end of each day, field staff transferred interview files from the enumerators' tablets to the supervisor's tablet using Bluetooth. Bluetooth connections were preconfigured to ensure that supervisors could receive the raw JavaScript Object Notation (JSON) files without manually editing them.[25] No copy and paste procedure was

[25] JavaScript Object Notation (JSON) is a simple data format well suited to loosely structured data.

necessary. Interview files were automatically named such that they were unique to the enumerator and household taking the interview, minimizing the risk of overwriting or deleting interview data.

Supervisors' tablets were also configured to automate the upload of encrypted JSON files to a cloud server whenever there was Internet connectivity. Supervisors also had 3G data connections to facilitate the upload of interview files from any location where mobile Internet service was available. This data pipeline included redundant local backups of encrypted JSONs on two tablets, with a copy of each file stored on the cloud. Additionally, the survey technical support team visited each field research team regularly to collect raw, encrypted JSON files. All JSONs received in this manner were uploaded to the cloud-based server on a daily basis, and stored separately from the copies uploaded by enumerators. As a result, the project had a third copy of each encrypted JSON file on its own hardware. Copying of files from supervisors to technical support used a Windows utility called robocopy that copies files and leaves the originals untouched. It is virtually impossible to delete or alter the original copy of a file if the robocopy script is correctly configured.

As a result of this data pipeline, the technical support personnel inventoried and de-duplicated all copies of raw, encrypted JSON files in every location. These files were compared using industry standard software. The file with the most complete interview was taken for the accurate record of the interview in every case. Any files flagged as corrupt by field personnel were remedied by technical personnel in Washington, with the assistance of the vendor's technical support in London. Most of the flaws in interview files were due to bugs in the survey software that prevented further data entry in the field. Final data entry was completed in Excel and merged to the dataset.

3.7 Data Cleaning

Following data collection, the final, de-duplicated, and debugged dataset was exported to raw text using SurveyBe Designer, the desktop version of the software. The raw text files were also accompanied by a script that imports the raw data into Stata with variable names, labels, and value labels. Once in Stata, the data were rigorously cleaned to ensure plausible and coherent answers for all components of the interview, including personal identifiers, demographics, anthropometry, food and nutrition, agriculture and livestock.

Due to flaws in the survey interface, it was possible for field staff to make transcription errors in the entry of data, such as (for example) entry of height in meters rather than centimeters, transposition of height/weight, and double-entry of digits. Data that fell outside of acceptable bounds for human height and weight as entered, but that could be rapidly remedied by correcting for specific types of field data entry errors, was corrected using data cleaning algorithms. Data entry also benefited from real-time controls on data entry, preventing, for instance, combinations of marital status and family relationships that could not be true. The complete data cleaning and analysis code in Stata will be submitted to USAID with the confidential master and raw datasets for the interested analyst.

Particular care was given to reconciling field supervisory control sheets and the interview files ultimately imported into Stata. This process prevented mistaken identity or location of households that had been selected for participation. Once the control sheets and interview files were reconciled, the counts of households on the village chief's register and households sampled determined the household weight in the sample. The number of individuals present from the adult household roster determined the individual weight in the sample.

Missing data are a common problem in household surveys. The missing data may be the result of the absence of a particular respondent on the day of the survey; respondents' inability or unwillingness to reply; or errors in the implementation of the survey interview. The reasons why data are missing are fundamentally important. The nature of missing data determines both what the likely effect of missing data will be on the accuracy of parameter estimates, as well as the efficacy of strategies to remedy missing data.

The consequences of missing data in regression analysis can be relatively serious. By default, most regression software will estimate parameters using only subsets of the data for which complete observations are available. Since data are almost never missing completely at random, elimination of observations from regression analysis on the basis of missing data can introduce bias into parameter estimates. Simply leaving out incomplete survey questionnaires is a second-best strategy for accurate estimation of project impact. This procedure, sometimes called listwise deletion, is not recommended. The name listwise refers to ignoring all information received from one respondent on the list if a single variable necessary to the regression calculation is missing. Therefore, parsimonious models are used in this evaluation to limit the danger of listwise deletion.

3.8 Statistical Approach

General

The DD methodology seeks to correlate project activity with changes in levels of indicators, as it is unlikely that villages in a given treatment and comparison group resembled each other in 2011. The regression analysis tests whether individuals and households in treatment villages had significantly more favorable changes in key indicators than those residing in comparison villages.

One of the principal advantages of DD regressions is that they analyze only changes in key indicators over the period of study. Therefore, it is crucial that the sampling procedure be as similar as possible in the first and second periods of the study. To the extent that residents of a village are more similar to one another than to the rest of a municipality or region, it is desirable to return to the villages where the baseline survey was conducted. In the MIE, because some different households were sampled at midterm and baseline, the data are cut in three ways.

First, the DD statistical analysis is run using only households from baseline villages, both those originally surveyed and the seven additional households surveyed at midterm. Of the 2,514 households in the midterm sample, 83% belong to the baseline villages. Regressions using the baseline village cohort take all midterm observations from these villages. Since the study relies on anthropometry and dietary data for children under age 5, it is possible that households with children in 2011 would not have them in 2015 and vice versa. The hybrid sample (10 returning households and 7 new households) is designed to circumvent this problem.

Second, the same models are estimated using all households in the survey, including those from villages that were sampled at baseline and “new treatment” villages (17% of the midterm sample) that were not. This cohort includes 3,844 households, comprised of 2,514 in the midterm sample and 1,330 at baseline. If all clusters at midterm had exactly the 17 completed interviews, the full sample would have numbered 4,050 observations. The ultimate sample size is slightly smaller, reflecting only those households with completed interviews.

No baseline data is imputed or estimated for households that did not belong to the sample in 2011. The DD methodology looks at the entire cohort of baseline and midterm households and estimates the treatment effect of project components. The calculation procedure does not take first differences of the values of key indicators between the baseline and midterm survey; so the concern that new households at midterm lack baseline data is not an issue.[26] Some values for baseline data are computed from recollections of survey respondents at midterm, but this approach is uniform for all respondents and not specific to new households in the midterm sample.

Third, the statistical analysis is run a final time using only the individuals and households residing in villages from the baseline sample with high intensity project participation, and individuals and households from a set of comparison villages chosen on the basis of PSM. PSM, as described above, corrects for endogeneity by estimating the propensity of households to be selected into the study in the first period. The households in the treatment group are then matched to a set of households in the comparison group with similar propensities to be included in the study. While these households are not identical in all respects, their propensity for inclusion in the study is explicitly modeled and found to be high. The propensity matching model predicts the probability that each household from both the treatment and control group would have been assigned to participate in the intervention. Without propensity score matching, it is possible that exogenous differences between treatment and comparison groups could be misattributed to the treatment effect. Further details on the statistical procedure implemented can be found in Annex VI. The PSM procedure begins with a sample of 408 baseline households from high-intensity villages. These households are matched with a weighted sample of comparison group households from the baseline study that are located in non-project villages. The pattern of Kédougou’s over-representation in the comparison group is also present in this cohort prior to PSM.

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[26] Such is not the case for the PSM regression.

Weighting

Sample weights reflect the probability of selection into the survey sample. Since the survey selected CRs without randomization, the likelihood of selection is identical for all CRs in the survey. Villages newly included in the study at midterm had identical probability of selection, resulting in uniform village sample weights. Households within a village have nearly identical probability of selection using the sample procedure, which exhaustively lists the households in the village and then selects households at random from that list.[27] However, differences in village counts (within the CR), village sizes (number of households), and response rates led to potentially higher probability of selection for certain households, such as those from very small villages. The sample weights compensate for probability of selection in order to avoid undue influence of households favored by the survey design.[28] Adjustments for both stratification and survey weights were completed in Stata using the {survey} package.

Key indicators observed at the household level are weighted by the inverse of their probability of having been included in the sample:

$$W_{hf} = W_h * A_{nr} = \frac{N_v}{n_v} * \frac{N_h}{n_h} * \frac{n_s}{n_r}$$

where

- W_{hf} denotes **f**inal **h**ousehold weight.
- W_h denotes **h**ousehold weight.
- A_{nr} denotes a **n**on**r**esponse adjustment.
- N_v denotes number of **v**illages in the municipality (CR).
- n_v denotes number of **v**illages sampled in the municipality (CR).
- N_h denotes number of **h**ouseholds in the village.
- n_h denotes number of **h**ouseholds sampled in the village.
- n_s denotes number of in-**s**cope dwellings, among sampled households in the village.
- n_r denotes number of **r**esponding households, among in-scope dwellings in the village.

Variables observed at the adult individual level require, in addition, person weights. Final person weights adjust by the number of adults in the household:

$$W_{pf} = W_{hf} * N_p$$

where

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[27] There were three villages for which the list of households from the village chief was not available. In those villages, the survey teams followed an appropriate randomized selection procedure (called a random walk) that was detailed in the surveyors' field manual, and that preserved equal household weighting in the final survey data.

[28] For example, consider what would happen in a survey of two villages if the cluster sizes were identical but one had a vastly larger population that the other. The households in the smaller village would have a higher probability of selection and thus a lower sample weight.

- W_{pf} denotes **f**inal **p**erson weight.
- W_{hf} denotes **f**inal **h**ousehold weight.
- N_p denotes number of **p**ersons (adults over age 18) in the household.

Finally, variables observed at the individual level among children require child weights. For example, prevalence of underweight among children aged 6-59 months requires child weights. Final child weights are not adjusted by a similar household size:

$$W_{cf} = W_{hf}$$

DD Model

The standard DD regression model follows, with dummy variables (T) for time and (X) for project status. A full presentation of the models estimated appears in Annex VI.

$$Y = \beta_0 + \beta_1 T + \beta_2 X + \beta_3 XT + \varepsilon$$

where

- Y is the weighted value of key indicator Y in household *i* or for individual *i* at time *t* (baseline and midterm).
- T is the midterm dummy, equal to 1 if the observation is at midterm, 0 if at baseline.
- X is the one of four treatment dummies described below, equal to 1 if the household or individual resides in a village that received the treatment and 0 if not.
- XT is the product of the treatment dummy and midterm dummy, equal to 1 only for project households at midterm.
- ε is the statistical error term.

In the generic DD model given above, β1 captures a secular time trend. It estimates what would have occurred to members of the treatment group if there had been no treatment, on the assumption that they would have had the same experience as the members of the comparison group without the treatment. If the observation is taken from the comparison group, then Xi = 0 and therefore the terms with β2 and β3 drop out. β1 is the expected difference in Y between baseline and midterm, among the comparison group.

The coefficient β2 captures the ex-ante difference (ie. at baseline) between treatment and control groups. When the value of T is zero, the terms with β1 and β3 drop out. Hence β2 is the expected difference in Y between the project and comparison groups, evaluated at baseline.

The coefficient of greatest interest is β3, which estimates the treatment effect of Yaajeende. Project, Nutrition, Agriculture, and HighIntensity. For the binary indicators, this will have the interpretation of being marginal impact of the treatment on the prevalence of the indicator, measured over the entire sample and observed over households (e.g., proportion of households using iodized salt) or over individuals (e.g., proportion of infants less than six months exclusively breastfed). By treatment effect, we mean the expected increase in Y among the project group during the period of study, beyond the change experienced by the comparison group.

The constant term β0 has no meaningful interpretation, and the final term is statistical error, with an expected value of zero under common regression assumptions.

The specific dummy variable used to measure X in the equation above is different in each of five regression models. In order to answer the study questions, it was necessary to distinguish between villages that: 1) participated in any project activity; 2) participated in the nutrition project package; 3) participated in the agriculture project package; and 4) participated in all project packages (high intensity). As described above, Yaajeende provided the impact evaluation with a list of project activities aggregated into three packages. Each village was scored independently with four dummy treatment variables corresponding to these packages. The treatment dummy Project is equal to one if the village received any project intervention, and zero otherwise. A one indicates that the village was in the treatment group relevant to the model being estimated, while a zero indicates that it was in the comparison group. The treatment dummy Nutrition is equal to one if the village received adequate nutrition interventions and zero otherwise. The variable Agriculture is equal to one if the village received adequate agriculture interventions and zero otherwise. The variable HighIntensity is equal to 1 if the village received the complete "ABC" package and zero otherwise.

The treatment and comparison groups for the four basic models are illustrated in Table 8. Each cell in the left hand column represents a possible combination of Yaajeende packages that a single village may have received. The columns “Project,” “Nutrition,” “Agriculture”,” and “HighIntensity” reflect four different regression models designed to test for independent impacts of each Yaajeende package. In the “Project” regressions, all households are included in the analysis. In “Nutrition” regressions, low-intensity Yaajeende villages with no Nutrition package are excluded from the regression, since they differ systematically from the comparison group and yet did not receive the Nutrition package. By the same token, low-intensity villages that did not receive the agriculture or governance packages are excluded from the “Agriculture” regression. And finally, the “HighIntensity” regression model excludes all low- and mid-intensity Yaajeende villages in order to show the treatment effect of a high-intensity Yaajeende program relative to the comparison group.

Table 8. Project vs. Comparison Group Assignment by Project Packages

	Treatment (T) vs Comparison (C) Assignment			
Packages Received	***Project***	***Nutrition***	***Agriculture***	***HighIntensity***
A, B, C	T	T	T	T
A, B	T	T	T	none
A, C	T	T	none	none
A	T	T	none	none

	Treatment (T) vs Comparison (C) Assignment			
Packages Received	***Project***	***Nutrition***	***Agriculture***	***HighIntensity***
B or C	T	None	T	none
None	C	C	C	C

Table 9. Frequency of Treatment Intensity at Baseline vs. Midterm

Packages Received	Households in 2011	Households in 2015
ABC	408	857
AB	61	113
AC	131	283
A	60	139
B or C	20	102
None	650	1020

Model Specification and Coefficient Interpretation

Five different versions of the generic model have been implemented in order to test independent and joint effects of the various treatments. The five models are designed to test different hypotheses about the nature and scope of project impact and, most importantly, revolve around different treatment and comparison groups. Ideally, strong treatment effects would be apparent in results from all five models.

Model 1 tests whether the project (i.e. *Project*) as a whole had impacts on key indicators, independent of the processes by which those results were obtained. The comparison group consists of households and individuals (depending on the indicator) in villages that were excluded from the project altogether, while the treatment group consists of households and individual in villages that received either the nutrition or agriculture package, or both. There are two control variables. The first is the ex-ante (i.e., at baseline) difference between the comparison and treatment groups. For example, if the individuals and households in the treatment group were much better off than members of the comparison group, it might not be surprising if the treatment effect over the project period was small due to diminishing marginal returns. The second is secular trend, i.e. the difference in the average value as observed in the comparison group at midterm and baseline. Thus, the model estimates the average impact on project beneficiaries, controlling for initial conditions and what would have happened in the absence of any project.

Model 2 conducts similar tests of the nutrition package alone. In the tables in **Section 4. Findings** that present summaries of treatment effects, the treatment effect presented under the column heading “Model 2” is a univariate, OLS, difference-in-difference regression model that compares respondents that received the nutrition intervention to respondents that received no interventions. It is the key statistical indicator that answers whether the nutrition package had an observable treatment effect on each key indicator.

In the annex of complete statistical results, the full results of all five models are included for both baseline and full cross-section samples, and where appropriate, with nonlinear models (logistic or Poisson).

Model 3 conducts similar tests of the agriculture package alone. In the tables in **Section 4. Findings** that present summaries of treatment effects, the treatment effect presented under the column heading "Model 3" is a univariate, OLS, difference-in-difference regression model that compares respondents that received the agriculture intervention to respondents that received no interventions, using the baseline villages sample. It is the key statistical indicator that answers whether the agriculture package had an observable treatment effect on each key indicator. In the annex of complete statistical results, the full results of all five models are included for both baseline and full cross-section samples, and where appropriate, with nonlinear models (logistic or Poisson).

Model 4 conducts similar tests of the high-intensity villages alone, but does not explore synergy between nutrition and agriculture. Model 4 treatment effects are excluded from the tables in **Section 4. Findings.** The interpretation of model 4 is the aggregate treatment effect of the entire high-intensity Yaajeende intervention. It makes no attempt to distinguish nutrition programs from agriculture programs, governance, or synergy effects. In the annex of complete statistical results, the full results of all five models are included for both baseline and full cross-section samples, and where appropriate, with nonlinear models (logistic or Poisson).

Model 5 looks for synergy between agriculture and nutrition. In the tables in **Section 4. Findings** that present summaries of treatment effects, the only treatment effect presented is the synergy effect between nutrition and agriculture programs. The synergy coefficient is not the total effect of Yaajeende on high-intensity villages (for that, see model 4 above). Instead, the synergy coefficient only asks whether high intensity villages display treatment effects that are larger than predicted by the independent treatment effects of nutrition and agriculture. If the synergy effect is positive, the high intensity villages showed greater effects than the sum of the nutrition and agriculture treatment effects. This is the main statistical indicator for Study Question 4, which asks whether nutrition-led agriculture is more effective than nutrition and agriculture programs independently.

In the same tables in **Section 4: Findings**, we also report an F-statistic for Model 5. This F-statistic compares two statistical models, called the restricted and unrestricted models. The unrestricted model includes the synergy effect term; and the restricted model drops that term. When the F-statistic is in the critical region (i.e., the p-value is low), the result of the test indicates that, for high-intensity villages, the unrestricted model including the synergy term is a better fit for the underlying data than the restricted model, which includes only independent effects for nutrition and agriculture.

Remedy for Limitations

Geographical distribution of results. The statistical tests described below assume uniform differences between project and comparison groups, and within those groups, between baseline and midterm. A variety of economic and climatic features differentiate the Matam, Bakel, and Kédougou regions. Effectively, this is the same reasoning used in deciding not to employ the Kolda and Tambacounda samples as comparison groups for the project's activities in other regions. If, after regression analysis, errors are non-uniformly distributed across the regions, it is appropriate to test whether regression results are robust to resampling: in other words, whether the results hold within each regional subsample. While the evaluation team has conducted *ad hoc* regional sensitivity analysis, those results are not presented systematically. It is also possible to include a variety of regional dummy variables in the regression models that allow levels and trends of indicators to vary across regionally defined groups; but generally these models are harder to interpret.

Absence of baseline data. For a number of indicators, no baseline data were collected. With one-period data, the standard DD model cannot be estimated. When a one-period dataset is fit with the same statistical model, there are no observations for the baseline period. Therefore, there can be no estimate of the secular trend or any of the usual treatment effects. Instead, all that the model can show is differences between the averages among beneficiaries and non-beneficiaries at midterm. The coefficients that would ordinarily correspond to the differences between beneficiaries and the comparison group at baseline (called the *ex-ante* differences in the DD model) now characterize the differences between the two groups at endline. While this does give some indication of the differences between project and comparison groups, it cannot tell us anything about the impact of the project in creating those differences. The one-period regressions do not meet the standard of counterfactual impact evaluation.

Interpretation of Results. The following table explains what each regression model can tell us about the nature of treatment effects. Each of the five models below can be fit with baseline villages alone; or with the full cohort of baseline and midterm villages. Some of the models, for which we have both baseline and midterm data in panel format, can also be estimated with PSM.

Table 10. Hypotheses under Investigation in Cross-Sectional Regression Models

Model	Hypothesis
Cross-sectional model, any project participation	Did the residents of project villages see greater change than comparison villages?
Cross-sectional model, any villages that participated in nutrition	Did the residents of villages where the Yaajeende nutrition package operated see greater change than comparison villages?
Cross-sectional model, any villages that participated in agriculture	Did the residents of villages where the Yaajeende agriculture package operated see greater change than comparison villages?
Cross-sectional model, only high-intensity villages	Did the residents of villages with all Yaajeende packages (agriculture, nutrition, and governance) see greater change than comparison villages?
Multivariate model	Did the residents of high-intensity villages show greater improvement than would be expected from either nutrition or agriculture packages alone? In other words, were there synergies between nutrition and

Model	Hypothesis
	agriculture in Yaajeende?

All regression models except the PSM treat the data in cross-section, comparing the whole baseline sample to the whole midterm sample. For robustness, each of those models is repeated once with only baseline villages included, and once with the new midterm villages included as well. Both sets of results appear in the Annexes.

For technical reasons, the PSM can only work with a panel dataset. Households report the difference between indicator values at baseline and at midterm, rather than their values at each point in time (sometimes called first differencing). The PSM regression analyzes the variation in the first difference of the indicators, rather than comparing indicator values at baseline to indicator values at midterm. Both use appropriate survey weights and stratification.

3.9 Qualitative Approach

General

The quantitative analysis above is complemented and supplemented by 54 KIIs and 14 FGDs. These were conducted by a qualitative research field team, consisting of six persons with differing language skills: three Pulaar speakers, two Mandingue speakers, one Bambara speaker and one Soninké speaker. All of the researchers spoke French and Wolof. A geographic sample was determined prior to field work according to level of Yaajeende activity in each region and the region's size. Upon arrival in each region, the Qualitative Research Field Team met with Yaajeende regional staff to get an overview of the project activities particular to that region and in order to plan the breakdown of KIIs and FGDs, rather than interview an equal number of stakeholders in each region. A list of KIIs and FGDs is given in Annex IV. Table 11 contains an overview of the MIE qualitative research sample.

Table 11. Qualitative Research Sample

Region	Sampled CRs	Survey villages	Qualitative Villages	KIIs with stakeholders	KIIs with Yaajeende staff	FGDs
Kédougou	8	24	12	12	5	5
Bakel	5	20	15	13	5	4
Matam	11	33	12	12	5	5
Dakar	0	0	0	0	2	0
TOTAL	**24**	**87**	**39**	**37**	**17**	**14**

Prior to field work, the Qualitative Research Field Team developed KII and FGD discussion guides to follow in the field. Guides were constructed asking questions about the behavior change in the population due to Yaajeende as related to the project activities given in Table 12 below. A combination of expert (Yaajeende personnel), participant, and beneficiary stakeholders were identified for KIIs and FGDs. Participant stakeholders are local change-makers like Large Producers, CBSPs, CNVs, Veterinarians, CWGs, and Emerging Breeders. They have a stronger relationship and interact more often with Yaajeende than beneficiaries. Beneficiary stakeholders are people who have participated in trainings by Yaajeende or are members of the MtM groups.

Table 12. Distribution of KIIs and FGDs per Project Activity

DISCUSSION FORMAT	STAKEHOLDER	PROJECT ACTIVITY	REGION	TOTAL
FOCUS GROUP	MtMs, women aged 15 to 49	Nutrition: « Eat Orange », wild foods, biofortified foods (biofortified millet, orange flesh sweet potato…), diverse foods, Breastfeeding practices, Children's Diet from 6 months to 5 years; use and consumption of iodized salt; Gardening: commercial, nutritional; Husbandry: Passing on the Gift, vaccination, direct subsidy; Water and sanitation; Access to credit; Biorestoration of degraded lands (BDL); Access to land; Implication of men in household nutrition and hygiene	Kédougou Bakel Matam	7
FOCUS GROUP	Male Head of Households	Conservation Agriculture, Water and sanitation, Livestock Vaccination, Irrigation, Flood recession agriculture, Seed production, Implication of men in household nutrition and hygiene	Kédougou Bakel Matam	7
KEY INFORMANT INTERVIEW	Large Producers	Marketing, finance, soil preparation (tilling, leveling) Conservation agriculture, Biorestoration of degraded lands (BDL), inputs (seeds, fertilizer, phytosanitary products, etc), compost, commercialization & consumption of products, nutritious value of crops	Kédougou Bakel Matam	6
KEY INFORMANT INTERVIEW	CBSP	Labor, Water and sanitation, Insurance, Credit, tilling, Livestock vaccination, commercialization of products, inputs (seeds, fertilizer, phytosanitary products, etc)	Kédougou Bakel Matam	6
KEY INFORMANT INTERVIEW	CBSP/CNV	Transformation of grains/fruit/vegetables; MTM; Nutrition, nutritional products, hygiene products, other products; gardening	Kédougou Bakel Matam	3

DISCUSSION FORMAT	STAKEHOLDER	PROJECT ACTIVITY	REGION	TOTAL
KEY INFORMANT INTERVIEW	CNV	Nutrition, nutritional products, hygiene products, other products, behavior change communication	Kédougou Bakel Matam	6
KEY INFORMANT INTERVIEW	Veterinarian	Vaccination, breeder groups, animal health, medicine supply	Kédougou Bakel Matam	3
KEY INFORMANT INTERVIEW	CWG	Food security plans for climate change, Relationship between Citizen Working Groups and Elected Leaders (Collectivités Locales, mayors…), Access to land, quality inputs, role of Community Based Service Providers in the community	Kédougou Bakel Matam	3
KEY INFORMANT INTERVIEW	Emerging Breeders	Livestock Entreprises, Poultry Promotion	Kédougou Bakel Matam	3
KEY INFORMANT INTERVIEW	Yaajeende Staff	Mother to Mother Groups; Yaajeende's implementation strategy; activities; Community Based Service Provider; Governance, Institutional communication	Kédougou Bakel Matam	16

Quality Assurance

KII and FGD discussions were translated into French, transcribed onto paper, and recorded in Microsoft Word. Each transcription was verified by listening to the accompanying audio file. Where more than one error was observed for a randomly selected five-minute period of audio recording, the entire transcription was corrected.

KII/FGD Approach

The approach adopted is a hybrid of traditional positivist logic and "grounded theory." In the former, existing theory – in this case the theory of change discussed above – is taken as the basis for analysis. Thus, the statistical models are designed to test the theory of change. In research based on grounded theory, by contrast, instead of being used to test pre-existing theoretical hypotheses, data, in this case data gathered from KIIs and FGDs, are used to construct theory "from the ground up." The qualitative research design is a hybrid. In the first step, KIIs and FGDs were used to test the causal pathways embedded in the statistical analysis. From then on, KIIs and FGDs were used in theory development and, in line with standard grounded theory techniques, probing and testing as further qualitative data became available. Respondents' beliefs about the actual consequences of Yaajeende techniques and activities were elicited taking special note of unintended consequences. Respondents' beliefs about the actual causes of observed outcomes were recorded taking special note of omitted causes.

KIIs were designed to address in-depth knowledge of beneficiary skills, learning, adoption, barriers to adoption, and competing explanations for change as follows:

Knowledge. What do beneficiaries know?
- Probe for specific knowledge about the problems addressed and techniques extended by Yaajeende.
- Probe: where did you learn that? Where do most people learn that?
- Finally: did Yaajeende transfer that knowledge?

Skills. How well do beneficiaries know the skills extended?
- Probe for specific techniques essential to success.
- Probe: where/when did you learn how to do that? Where do most people learn that?
- Finally: did Yaajeende teach that skill?

Adoption. Do beneficiaries use techniques and services in their daily lives?
- Probe for the reasons why to adopt.
- Probe for barriers to adoption.
- Probe for the results of adoption.
- Finally: did you adopt the technique because of a Yaajeende intervention?

Efficacy. Does the technique, service, or behavior change work?
- Probe for effects and outcomes
- Note whether key indicators are among the outcomes
- Probe for unintended effects
- Probe for competing explanations for symptoms of change
- Finally: did Yaajeende have results tied specifically to the relevant key indicators?

Materials related to the qualitative component are given in Annex IV and Appendix III.

Qualitative Data Analysis

The focus groups and interviews were either transcribed directly into French or simultaneously translated into French and transcribed. For this reason, the qualitative analysis mostly refers to summaries of the qualitative research sessions rather than transcripts and coding.

Excerpts of the analysis were tagged with themes related to the key indicators and project activities. These metadata tags were subsequently used to cross-reference quantitative results, particularly the regression results in cross-section, with the qualitative summary themes. The qualitative data were thoroughly queried for appropriate metadata tags on each of the quantitative results. Analysts inventoried the themes that surfaced during discussion, with reference to the rubric above. Representative quotes were then selected for discussion once the rubric had been analyzed, taking into account of the full spectrum of themes that had surfaced. The qualitative findings suggest nuances of program implementation that may have influenced program outcomes, as well as trends in the comparison group that determine the threshold for treatment effects.

4. FINDINGS

4.1 Overview

While the Yaajeende project shows varying level of progress in achieving targets by the end of the project, the most clear-cut evidence of change was in areas, such as food diversity, water and sanitation, and poverty. However, the picture of impact is further complicated by sizeable secular trends among the comparison group. For a number of indicators, this means that even statistically significant baseline- to midterm change among beneficiaries did not result in a measurable treatment effect under the DD framework.

The discussion of results proceeds by examining the indicators related to each study question in turn: first, nutritional status; second, nutritional activities and techniques; and third, agriculture and livestock. For each of the study questions, each of the related key indicators is discussed with a series of methods: namely, the change among beneficiaries, the DD models, decomposition of variance by region and by components of the indicators, and finally, supporting qualitative research.

Each of the DD models 1-5 have been estimated in several ways. The summary tables of treatment effects in this section present coefficients from ordinary least squares (OLS) regressions. Models whose dependent variable is a binary (0/1) have also been estimated as Linear Probability Models (LPM) as well as using the logistic (logit) functional form. The former has the advantage of resulting in immediately interpretable marginal prevalence impact coefficients. The latter avoids the problems of coefficient estimates that, given extreme values of the independent variables, could result in an estimated prevalence of less than zero or greater than 100 percent, but also results in coefficients that are more difficult to interpret. The logit model has been implemented mostly as a robustness and consistency check on the LPM models.

As an additional robustness check, all models were estimated over two sets of observations: those from the baseline villages only and those from the expanded full sample including villages that were first included at midterm. In this section, estimation results based on both samples are presented. Finally, selected models were estimated over samples obtained from the PSM procedure, which is limited to households surveyed both at baseline and midterm. Results from logit regressions, the expanded sample, and the PSM sample are essentially similar to those from the LPM as applied to the baseline sample. In summarizing results, we therefore concentrate on the linear probability model unless otherwise noted.

4.2 Secular Trends, Changes among Beneficiaries, and Attributable Effects

In the discussion that follows, the evaluation decomposes changes from baseline to midterm in three ways. First, the simplest measure of **change among beneficiaries** is the difference between the value of any given indicator at baseline and at midterm. The term "change among beneficiaries" refers to the change among the whole population of residents in beneficiary villages, from baseline to midterm. Differences are calculated at the population level, not at the household level.[29] Change among beneficiaries is not the change in the sample mean, but rather an estimate of the change in the beneficiary population's true average of the variable in question. The difference between the maximum likelihood estimates of the indicator mean among beneficiaries at baseline versus at midterm is the method used to estimate the change among beneficiaries. The sample mean differs systematically from the population mean in that the households do not all have an equal chance to participate in the study, based on the populations of villages and municipalities. The survey estimation package in Stata, survey, addresses the effects of stratification and survey weights on parameter estimates and the variance thereof.

We can use these changes among beneficiaries to **test the null hypothesis** that no change occurred among beneficiaries between baseline and midterm. Depending on the size of the average change among beneficiaries, the true variance of the changes among beneficiaries, and the particulars of the survey design, we can estimate both the size of the average change and its variance. These determine a confidence interval for the average change. If the confidence interval for the average change among beneficiaries is reasonably far from zero, it is safe to reject the null hypothesis (that no change occurred). Even once that test is passed, two caveats are in order. First, the change refers to the difference in the beneficiary population from baseline to midterm, not the change within a specific group of households from baseline to midterm. Second, the change has no counterfactual dimension. Because the data is observational, we cannot tell what is responsible for that change: the project intervention, measurement error, or the endless variety of local conditions that can affect outcomes irrespective of project efficacy. The dearth of direct causal evidence requires the evaluation to adopt a counterfactual approach. Two more measures of change are required to decompose observed change into attributable treatment effects.

Second, the change among non-beneficiaries, i.e. the comparison group, is called the **secular change** throughout this evaluation. All of the indicators might be expected to exhibit some exogenous change between baseline and midterm. The term secular denotes the change between baseline and midterm only; it does not measure the dispersion or volatility of those indicators during the period of study. By the parallel trends assumption detailed above, we use the non-beneficiaries as the measure of the change that would have occurred among beneficiaries in the absence of the project. It is the baseline scenario in our counterfactual analysis. In reality, we could not replicate the non-implementation of the project for the villages treated, and it is not possible to use a truly blind, experimental design, where assignment is random and even the participants are

[29] The PSM results are different. Because of the household matching algorithm, households report first differences in the key indicator from baseline to midterm. Those first differences represent the change in the indicator value for the same household. First differencing is used only in the PSM.

uncertain whether they have participated in Yaajeende.

However, the secular change is not the quantity of greatest interest. The third and most important change reported in the study is the **treatment effect**, defined as the additional change in the beneficiary population above the secular trend. The treatment effect can be positive or negative when the secular trend is positive, and the same is true when the secular trend is negative. The DD framework ascribes the additional change beyond the secular trend to the treatment effect of the project on beneficiary populations.

Practitioners use different language to describe combinations of treatment effects and secular trends. When the secular trend is improving and the treatment effect is beneficial, the project is considered **highly effective**. This is considered strong evidence of project impact under favorable conditions. With a favorable secular trend and no evidence of a treatment effect, it is common to infer that the **treatment effect was "washed out"** by factors beyond the project's control. This inference may or may not be supported by qualitative research. When exogenous change appears to be concentrated in comparison zones, then it may be appropriate to make such claims. Otherwise, a skeptic would be correct to argue that, by the parallel trends assumption, such changes would have occurred even in the absence of the project; and so the project should not take credit for a "happy accident". When the change among beneficiaries is deteriorating and the treatment effect remains beneficial, practitioners will speak of resilience. **Resilience** refers to the project's effect in mitigating the deterioration experienced in the comparison group. Sometimes, however, the estimated **treatment effect will be close to zero** with a much smaller variance than those of the other estimates in the model. That is statistical evidence in favor of near-zero effect of the project. The problem is not statistical noise, or that the variance of the estimator makes it hard to distinguish positive from negative effects. Rather, the analysis shows a relatively precise estimate of negligible impact.

Table 13. Interpretation of Constellations of Statistical Evidence

Constellation of statistical evidence	Interpretation
Favorable secular trend Beneficial treatment effect	Evidence clearly supports favorable treatment effect.
Favorable trend among beneficiaries Harmful treatment effect.	Beneficiaries experienced improvement overall; but the difference in difference analysis does not demonstrate project impact.
Favorable trend among beneficiaries No significant treatment effect	Project impact may have been washed out; or may simply be too small to measure.
Nearly identical changes among beneficiaries and comparison group. Small variance in estimated treatment effect.	Project impact very likely close to zero.
Deteriorating trend among beneficiaries. Beneficial treatment effect.	Project promotes resilience to negative shocks among beneficiaries.

Constellation of statistical evidence	Interpretation
Deteriorating trend among comparison group. Pernicious treatment effect	Project exacerbated vulnerability to shocks.

It is worth reiterating here the counterfactual framework. When the trend among the comparison group is unfavorable (for example, a rise in wasting), the corresponding trend among the project group does not need to be positive in order to achieve statistical significance. All that needs to be shown is that the trend was more favorable than for the comparison group. Therefore, even a smaller rise in malnutrition would have constituted evidence of a beneficial treatment effect. The project group only needs to clear whatever benchmark is set by the comparison group. It is possible, therefore, to see an absolute deterioration of an indicator among beneficiaries, and simultaneous evidence of a beneficial treatment effect.

As we shall see with other indicators below, the principle of benchmarking against the comparison group can also cut the other way. When the comparison group experiences a favorable outcome (such as increases in the use of potable water), the improvement among the project group must exceed the change observed in the comparison group. Therefore, it is also possible to see an absolute improvement in the outcome of interest among the project group and still not meet the level of counterfactual evidence. This is because the improvement cannot be attributed to the effect of the project. The DD framework only works if the parallel trends assumption holds, and the project and comparison groups experience different changes over the period of study.

In the discussion below, the analysis first treats whether or not beneficiaries experienced discernible change during the MIDE. Second, it discusses whether such changes can be attributed to the project, and how.

4.3 Summary of Changes in Key Indicators

During the period of study, beneficiaries exhibited changes in some but not all of the key indicators. Table 14 characterizes the changes in averages of selected key indicators among beneficiary populations. It does not specify whether that change was attributable to project activities in the counterfactual framework. Columns indicate means of the variables as labeled in the baseline period (2011), midterm period (2015), whether a statistically significant change occurred, and whether that change was beneficial or harmful.

Table 14. Changes in Key Indicator Means from Baseline to Midterm among Beneficiaries

Indicator	Baseline	Midterm	Statistically Significant Change?[a]	P-value[b]	If Significant, Beneficial (B) or Harmful (M)?
Nutrition Indicators					
1.1 Wasting, ages 6-59 months	15%	17%	No	.381	.
1.2 Stunting, ages 6-59 months	23%	16%	Yes	.008	B
1.3 Underweight, ages 6- 59 months	23%	20%	No	.296	.
1.4 Underweight, female 15-49 years	30%	26%	No	.313	.
1.5 Minimum acceptable diet, ages 6-23 months	13%	6%	Yes	.028	M
1.6 Soudure (month)	2.7	3.7	Yes	<.001	M
1.7 Fewer than two meals per day	1%	6%	Yes	<.001	M
Healthy household practices indicators					
2.1 Kitchen hygiene	89%	88%	No	.634	.
2.2 Cold and covered food storage	61%	63%	No	.376	.
2.3 Water treatment	7%	27%	Yes	<.001	B
2.4 Food conservation techniques	87%	65%	Yes	<.001	M
2.5 Salt iodation and storage	20%	18%	No	.475	.
2.6 Exclusive maternal breastfeeding	1%	24%	Yes	<.001	B
2.7 Food diversity score	7.3	6.6	Yes	<.001	M
2.8 Handwashing station in common use	5%	8%	No	.209	.
2.9 Drinking water from an improved source	74%	77%	No	.355	.
2.10 Cooking water from an improved source	72%	77%	No	.153	.
Agricultural practices and production indicators					
3.1 Poverty rate	35%	33%	Yes	.004	B
3.2 Surface area planted (ha)	1.7	2.8	Yes	<.001	B
3.3 Gardening surface area (ha)	.04	.35	Yes	<.001	B
3.4 Surface area irrigated (ha) [c]	..	0.06	..	..	..
3.5 Surface area for flood plain agriculture (ha)[c]	..	0.095	..	..	..
3.6 Agriculture production (kg)	1241	833	Yes	<.001	M
3.7 Agriculture revenue (F CFA)	22413	16982	Yes	<.001	M

Indicator	Baseline	Midterm	Statistically Significant Change?[a]	P-value[b]	If Significant, Beneficial (B) or Harmful (M)?
3.8 Seed purchases	49%	8%	Yes	<.001	M
3.9 Fertilizer purchases	3%	22%	Yes	<.001	B
3.10 Index of Agriculture Investment[c]	..	0.92	..	..	..
3.11 Household uses an improved seed source[c]	..	39.3%	..	..	..
3.12 Household uses CBSP [c]	..	16.9%	..	..	..
3.13 Household uses an improved fertilizer source[c]	..	20.3%	..	..	..
3.14 Trainings in Agriculture	.20	.29	No	.426	..

(a) The change in values is reported on the estimated average among beneficiaries, including all villages sampled at baseline and midterm, and with survey weights and strata.
(b) The p-value is reported for a Pearson chi-square test whether the mean among beneficiaries changed between period 1 and period 2.
(c) No data was gathered at baseline. Changes from baseline to midterm are undefined.

Table 14 presents a mixed picture. In 15 cases, the baseline-to-midterm change was statistically significant. Where statistically significant change was observed, this was split 7 to 8 between beneficial and harmful changes.

The following table summarizes intertemporal change among non-beneficiaries. *No statistical inference is based upon this table.*

Table 15. Secular Change among Non-Beneficiaries[30]

Indicator	Baseline	Midterm	Statistically Significant Change?[a]	P-value[b]	If Significant, Beneficial (B) or Harmful (M)?
Nutrition Indicators					
1.1 Wasting, ages 6-59 months	10.5%	12.6%	No	.129	..
1.2 Stunting, ages 6-59 months	31.7%	29%	No	.525	..
1.3 Underweight, ages 6- 59 months	26.4%	23%	No	.314	..
1.4 Underweight, female 15-49 years	16.4%	16.9%	No	.779	..
1.5 Minimum acceptable diet, ages 6-23 months	13.4%	6.4%	Yes	.054	M
1.6 Soudure (month)	2.2	3.3	Yes	<.001	M

[30] This table was inserted at the request of the Mission. **No analysis elsewhere in the report is based on the contents of this table.** The tests used in this table differ significantly from the results in Annex V; and the results in Annex V are definitive.

Indicator	Baseline	Midterm	Statistically Significant Change?[a]	P-value[b]	If Significant, Beneficial (B) or Harmful (M)?
1.7 Fewer than two meals per day	2.1%	7.4%	Yes	.005	M
Healthy household practices indicators					
2.1 Kitchen hygiene	81.5%	86.2%	No	.013	..
2.2 Cold and covered food storage	53.1%	51.8%	No	.785	..
2.3 Water treatment	7.5%	34%	Yes	<.001	B
2.4 Food conservation techniques	86.8%	72.5%	Yes	<.001	M
2.5 Salt iodation and storage	13.7%	13.6%	No	.962	..
2.6 Exclusive maternal breastfeeding	2.9%	23.2%	Yes	<.001	B
2.7 Food diversity score	6.02	4.94	Yes	<.001	M
2.8 Handwashing station in common use	1.3%	15.3%	Yes	<.001	B
2.9 Drinking water from an improved source	60.9%	68.3%	No	.167	..
2.10 Cooking water from an improved source	63.4%	69.6%	Yes	.067	B
Agricultural practices and production indicators					
3.1 Poverty rate	37.56%	37.97%	No	.204	..
3.2 Surface area planted (ha)	2.4	4.3	Yes	.008	B
3.3 Gardening surface area (ha)	0.03	0.07	Yes	.010	B
3.4 Surface area irrigated (ha)[c]	..	0.01	..	..	..
3.5 Surface area for flood plain agriculture (ha)[c]	..	0.12	..	..	..
3.6 Agriculture production (kg)	1,595.01	1,161.31	Yes	.010	M
3.7 Agriculture revenue (F CFA)	58,889.61	28,478.73	Yes	.007	M
3.8 Seed purchases	54.1%	3.8%	Yes	<.001	M
3.9 Fertilizer purchases	11.3%	28.2%	Yes	<.001	B
3.10 Index of Agriculture Investment[c]	..	0.71	..	..	..
3.11 Household uses an improved seed source[c]	..	27.9%	..	..	..
3.12 Household uses CBSP[c]	..	4.3%	..	..	..
3.13 Household uses an improved fertilizer source[c]	..	20%	..	..	..
3.14 Trainings in Agriculture	0.21	0.24	No	.724	..

(a) The change in values is reported on the estimated average among beneficiaries, including all villages sampled at baseline and midterm, and with survey weights and strata.
(b) The p-value is reported for a Pearson chi-square test whether the mean among beneficiaries changed between period

Indicator	Baseline	Midterm	Statistically Significant Change?[a]	P-value[b]	If Significant, Beneficial (B) or Harmful (M)?
1 and period 2. (c) No data was gathered at baseline. Changes from baseline to midterm are undefined.					

In the following sections, we describe findings organized by Study Question. Study Question IV on synergy, a cross-cutting question, is reported throughout the text. Summary tables present treatment effect coefficients for Model 2 (the univariate effect of the nutrition package), Model 3 (the univariate effect of the agriculture package), and the multivariate Model 5 designed to test for synergies between interventions. The F-statistic in the right-hand column refers to the synergy coefficient in Model 5, and is the proper test statistic to test whether models that do not take synergy into account are mis-specified. Univariate treatment effect coefficients for any project participation (Model 1) and high-intensity participation (Model 4), sometimes referred to in the text, are available in Annex III. Detailed statistical results are presented in Annex V where, in addition, coefficient plots from logistic regressions are presented. The confidence bars correspond to the 95 percent confidence interval. A description of the PSM approach implemented and results is given in Annex VI.

Under each Study question in the following sections, we proceed on an indicator-by-indicator basis. For each indicator, we use the results of qualitative research to contextualize and explain the quantitative findings, particularly when there is evidence of either beneficial or harmful project impact.

4.4 Study Question 1: Nutrition

Did households and individuals located in project treatment intervention areas see greater improvement in nutritional status indicators than those residing in non-project areas?

In the midst of poor rainfall and harvest during the period of the study, households and individuals living in villages located in project intervention areas generally saw improvement in nutritional status indicators more than comparison villages, but not to a statistically significant extent. Overall, the data do not conclusively support a uniform and beneficial effect of the project on nutritional status. Instead, there is a high variance among the villages within the beneficiary cohort.[31]

[31] The geographic distribution of the changes is important because respondents are grouped into sampling units (villages) for regression analysis. Villages share the same project exposure. They also belong to strata, each of which has an independent estimate of the variance of the treatment effect. While it is unrealistic to expect that the project villages would all see the same change (or percentage change) in nutritional status indicators, the final treatment effect estimates will have greater variance (and lower chance of statistical significance) when the variance of trends among beneficiary villages is high. The higher the variance of the treatment effect, the less likely it is that the null hypothesis can be ruled out.

Table 16. Study Question 1: Summary of Treatment Effects, Baseline Villages Only

Indicator	Model 2	Model 3	Model 5	
	Nutrition treatment	**Agriculture treatment**	**Synergy coefficient**	**F-statistic**
1.1 Wasting, ages 6-59 months	-0.008	-0.015	-0.091	2.64
1.2 Stunting, ages 6-59 months	-0.043	-0.044	0.016	0.15
1.3 Underweight, ages 6-59 months	0.006	-0.001	-0.113 **	5.29**
1.4 Underweight, female 15-49 years	-0.031	-0.036	0.008	0.01
1.5 Minimum acceptable diet, ages 6-23 months	-0.008	-0.006	-0.148 **	4.29
1.6 Soudure (month)	-0.149	-0.349 *	-0.196	0.34
1.7 Fewer than two meals per day	-0.003	-0.006	0.002	0.01

Asterisks indicate confidence that coefficient estimates differ from zero: * p<10%, ** p<5%, *** p<1%.

Treatment effects for binary outcome indicators are reported as decimals using ordinary least squares (OLS) estimates. The interpretation of the treatment effect is a linear contribution to the probability of the binary outcome. For instance, -0.008 nutrition treatment effect implies 0.8 percentage point decline in prevalence of wasting among the baseline project group during the period of the study, beyond the change experience by the baseline comparison group.

Nonlinear models, such as logistic regressions with odds ratio (OR) treatment effects, are presented in Annex V.

Table 17. Study Question 1: Summary of Treatment Effects, Full Cross Section Sample

Indicator	Model 2	Model 3	Model 5	
	Nutrition treatment	**Agriculture treatment**	**Synergy coefficient**	**F statistic**
1.1 Wasting, ages 6-59 months	-0.012	-0.015	-0.079	2.00
1.2 Stunting, ages 6-59 months	-0.042	-0.043	-0.004	0.01
1.3 Underweight, ages 6-59 months	0.004	-0.004	-0.107**	4.02**
1.4 Underweight, female 15-49 years	-0.040	-0.046	0.012	0.02
1.5 Minimum acceptable diet, ages	0.002	-0.009	-0.135*	3.06*

Indicator	Model 2	Model 3	Model 5	
	Nutrition treatment	Agriculture treatment	Synergy coefficient	F statistic
6-23 months				
1.6 Soudure (month)	-0.102	-0.286	-0.417	1.11
1.7 Fewer than two meals per day	-0.001	-0.004	0.007	0.06

Asterisks indicate confidence that coefficient estimates differ from zero: * p<10%, ** p<5%, *** p<1%.

Treatment effects for binary outcome indicators are reported as decimals using ordinary least squares (OLS) estimates. The interpretation of the treatment effect is a linear contribution to the probability of the binary outcome. For instance, -0.012 nutrition treatment effect implies 1.28 percentage point decline in prevalence of wasting among the project group during the period of the study, beyond the change experience by the comparison group.

Nonlinear models, such as logistic regressions with odds ratio (OR) treatment effects, are presented in Annex V.

Wasting (Indicator 1.1), Stunting (Indicator 1.2), and Child Underweight (Indicator 1.3)

As shown in Table 14, stunting experienced a statistically significant improvement among beneficiaries, a decline from 23% at baseline to 16% at midterm. The decline in the prevalence of underweight among beneficiaries under 5, from 23% to 20%, was not significant (*p*=0.296). Wasting rates may have increased somewhat during the period of study, but the trend was inconclusive (*p*=0.381).[32]

The decline in stunting among beneficiaries was pronounced, but could not be attributed to the project definitively. Among beneficiaries alone, the decline in stunting was 7 percentage points, corresponding to a 30% decline in the baseline prevalence. The decline in the beneficiary group was larger than the decline in the comparison group. However, the treatment effect was not significantly different from zero. In the linear model, the treatment effect was 0.043 (*p*=0.367). In the nonlinear model, the treatment effect was a 28% decline in the odds ratio (OR) of stunting (*p*=0.195). Among non-beneficiaries, the decline in stunting was not statistically different from zero. The data clearly show a drop in the rate of stunting among beneficiaries, but cannot definitively attribute that change to the project.

No statistically significant univariate treatment effects on stunting among children aged 6- 59 months were found (Table 16 and Table 17). However, the size of the coefficient estimates (about 4 percentage points) would have been promising if their variance had been smaller. Similar treatment effects were observed for all measures of project intensity: any project packages, the marginal effect of nutrition, the marginal effect of agriculture, and high intensity villages (in Annex V). There was no evidence of synergy

[32] The chi-squared test for statistically significant change among beneficiaries between baseline and midterm has a null hypothesis of no change. When the p-value is large (above 10%), the null hypothesis cannot be rejected and the change among beneficiaries is not significantly different from zero.

between nutrition and agriculture. The initial conditions at baseline among beneficiaries were much better than among the comparison group, with odds ratios of stunting 38% lower (p=0.008) and prevalence 9.2 percentage points lower (p=0.009). During the period of study, there was no significant decline in stunting among comparison villages.

It should be noted that the decline among beneficiaries can be significant, but not the treatment effect. This can seem particularly confusing given the supposed absence of a significant change among the comparison group. Both results are accurate. The difference has to do with the nature of the statistical tests being fit. The test for intertemporal change among beneficiaries is a relatively low bar to meet. There are only two samples to compare (baseline vs. midterm), each of which has a mean and standard deviation. The test asks how far apart the means are, measured by the standard deviations, and then calculates a single test statistic based on the shapes of those two distributions. The DD model has many more parameters, each of which has a standard deviation. When we fit the DD model, we estimate the means of four groups (baseline vs midterm, beneficiary vs comparison) and calculate the differences between all those means. The test statistic is only the confidence with which we can reject the null hypothesis. The maximum likelihood estimate of change is clearly not zero.

We can illustrate the effect of stratification as follows, using a logistic DD model of stunting over any project treatment (Model 4). We will fit the model *without survey weights* and using clustered standard errors. The treatment effect estimate is the same regardless of the locus of clustering. The treatment effect of Yaajeende is an odds ratio of 81%, or a 19% decline in the odds ratio of stunting. But is that estimate significant? When we call the model estimate in Stata, we can set the clusters at the level of regions, CRs, or villages. The model estimate with village clusters has a p-value of 0.17; not significant. The model estimate with CR clusters has a p-value of 0.21; not significant. But the model estimate with region clusters has a p-value far below 0.001; highly significant. We could fit all the models in the study with region-level clusters, and perhaps obtain different results, since there are fewer cluster variances to estimate. But in so doing, we would be pretending that the respondents were selected at random from across the whole region, which is not the case. The p-values are contingent on the evaluation design as well as the data.

One possible source of variance in the estimated size of the treatment effect is the phased start date of the Yaajeende project in different sample strata. The survey sample is stratified by CRs, which are uniform with respect to their participation assignment in the sample (treatment versus comparison). Since stunting is a cumulative process and beneficiaries did not share a common duration of exposure to the project, treatment effects might be non-uniform within the beneficiary population, leading to a high estimate of the variance of the treatment effect, which raises the likelihood of an inconclusive difference-in-difference test. Because the variance of the treatment effect estimate is high, the confidence interval is more likely to overlap with zero.

The causes and etiology of stunting are poorly understood, although the pattern of growth is well documented.[33] Among healthy children in the sensitive period for stunting, frequent saltations of growth punctuate periods of no growth, meaning growth occurs in bursts and not continuously. Stunting's symptoms are the cumulative result of weakened or missed growth saltations, and are thus cumulative in nature. The course of disease is not necessarily reversed through appropriate treatment. Causal links have been established to chronic undernutrition, poor intrauterine growth, and intergenerational effects.[34]

Key informant interviews indicated that the duration of the project was short, relative to the period of sensitivity and the age cohort of the stunting sample, in parts of the beneficiary population. Key informants expected that stunting results would be attenuated, and particularly in these CRs with later project start dates. Hypothetically, if the project had been active for just two years in a CR, and had saturated the population of new and lactating mothers within the first year, there might be only be one year of project exposure by the time the midterm sample was collected. Thus, the younger end of the cohort aged 6 to 59 months might have been fully treated, but children aged more than 24 months at the time of the midterm study would have partially passed through their sensitive period for stunting before the project's local start date.[35]

Site visits and beneficiary focus groups revealed that mothers experienced rapid and widespread declines in diarrheal illness as a result of the project. By improving food selection, exclusive maternal breastfeeding, maternal nutrition, and household WASH behaviors, the project could plausibly have affected rates of stunting in beneficiary populations. It is not clear why stunting would have showed stronger treatment effects than wasting and underweight.

It is important to note that there is not a predetermined sequence of impacts on nutritional status. Underweight and wasting treatment effects need not precede stunting effects, nor need they exceed stunting treatment effects. There is no scientific basis to expect that stunting would be the last or least of the treatment effects. Stunting is cumulative in its effects. Wasting and underweight can fluctuate in the same individual.

The lean season (*periode de soudure*) is the least likely time of the year for either nutritional or agriculture programs to be effective in changing nutrition, due to a combination of supply and demand factors. Therefore, the evaluation, which was conducted in May and June 2015 to correspond with the baseline, is less likely to show improvement in nutritional status than similar comparisons at other times of year.

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[33] Frongillo E.A. Jr (1999) Symposium: causes and etiology of stunting. Introduction. *The Journal of Nutrition* 129 (2S Suppl.),529S–530S.

[34] Rosado, Jorge L. "Separate and joint effects of micronutrient deficiencies on linear growth." *The Journal of nutrition* 129, no. 2 (1999): 531S-533S.; Stephensen, Charles B. "Burden of infection on growth failure." *The Journal of nutrition* 129, no. 2 (1999): 534S-538S.; and Ramakrishnan, Usha, R. Martorell, D. G. Schroeder, and R. Flores. "Role of intergenerational effects on linear growth." *The Journal of nutrition* 129, no. 2 (1999): 544S-549S.

[35] To illustrate, consider an intervention that diffuses linearly through the beneficiary population in year 1 and successfully achieves 80% uptake of the intervention by the end of year 1, remaining constant at that level. At the end of year two, just 20% of the cohort aged 6-59 months will have been exposed to the intervention since birth. The expected cumulative exposure of the same cohort during the sensitive period for stunting is just 44%.

Reviewers argued that strong results on stunting and weak results on underweight and wasting during the lean season are consistent with the resilience hypothesis. By resilience, they mean that beneficiaries were protected from a portion of episodes of stress (such as by nutrition or illness) that left evidence in beneficiaries' height for age. At the same time, both supply and demand effects on local food markets might have caused a decline in beneficiaries' weight and dietary diversity. The evaluation finds no flaw in this argument. The evaluation has no evidence to evaluate whether the underweight and wasting indicators would have shown greater treatment effects at a different time of year.

During the period of study, the proportion of wasting among children under 5 from the comparison group rose from 10.5% to 12.6% (p=0.095). That corresponds to a rise in the odds ratio for wasting among children in comparison zones of approximately 27%. Children in project villages were significantly different from comparison villages, with odds ratios of wasting more than 50% higher at baseline (p=0.043). Nutrition and agriculture treatment effect are beneficial at 0.8 percentage points (p=0.76) and 1.5 percentage points (p=0.59) respectively but these results are not statistically significant. Therefore, there is little evidence to suggest that the project reduced the rise in wasting.

The counterfactual standard of evidence is met when an estimate of the treatment effect differs from zero with reasonable confidence. Several pieces of circumstantial evidence favor the efficacy of the project on acute undernutrition. Taken together, they are insufficient to show that Yaajeende has a beneficial effect on wasting among children aged 6 to 59 months. The rise in acute undernutrition among non-beneficiaries was statistically significant, using both the regression analysis and a chi-squared test. The change among beneficiaries could not be shown to differ from zero. The counterfactual statistical test makes several important corrections, based on the way that data was gathered. It accounts for the differences between project and comparison samples at baseline. It calculates the trend among beneficiaries from baseline to midterm, and it subtracts out the change experienced by non-beneficiaries. It accounts for the way that the sampling procedure (meaning, taking many individuals form the same village and arbitrary numbers of villages from the same CR) affects the variance of beneficiary outcomes in each group. The result of that test was inconclusive; meaning we cannot reject the null hypothesis. The data are not strong enough to state with confidence that Yaajeende had a beneficial effect, either in terms of resilience to shocks or improved outcomes. The maximum likelihood estimate of effect size is a 20.6% (p=0.367) reduction in the odds ratio among high intensity villages, but the confidence interval of this estimate overlaps zero.

The statistical evidence on nutritional status does not prove that Yaajeende beneficiaries saw better outcomes over the period of study, but it does suggest that the nutrition led agriculture approach works better than unrelated nutrition and agriculture programs. The statistical test used to show this is the synergy effect in model 5. The synergy effect compares the observed changes among high intensity villages to the predicted effects of nutrition and agriculture packages alone. In the univariate analyses of Models 2 and 3, the nutrition and agriculture treatments, taken alone, had no statistically significant effect on wasting (nor did project participation; see Annex V).

However, according to the multivariate analysis and using the baseline villages sample, the synergy effect for wasting is estimated to be a 9.1 percentage point reduction (p=0.107). While the synergy effect does not meet the standard for statistical significance, the effect size is consequential. The F-statistic, 2.64, falls outside the critical region, meaning the data do not conclusively support a model with synergy between nutrition and agriculture packages.

Child underweight (Indicator 1.3) showed no effects of project intervention significantly different from zero. The synergy effect for child underweight, 11 percentage points (p=0.024) is favorable and highly significant. Using a nonlinear model, the synergy effect for underweight is an odds ratio just 52% (p=0.021) of its predicted value. That means that, after accounting for the odds of underweight at baseline and the effects of the nutrition and agriculture programs, the high intensity villages saw a further reduction of the odds ratio for child underweight. High intensity villages experienced much more favorable changes to underweight and wasting than we would expect, based on the independent effects of nutrition and agriculture packages.[36]

More favorable results were obtained with regression of beneficiaries' z-scores of weight-for-age (underweight), length-for-age (stunting), and weight-for-length (wasting). Z-scores characterize the respondent's position on a distribution of WHO reference data. Each unit on the z-score represents one standard deviation above (or below) the mean. Binary measures such as stunting are defined as a z-score falling below a specific threshold. Because the binary measure only calculates whether the respondent's z-score falls below a threshold, it does not consider the average z-score of the sample. Regression analysis of the threshold indicator does not measure how the z-score average changes over time. The project had favorable treatment effects of 0.34 units on the z-score of weight-for-age (p=0.004), the distribution from which underweight is calculated. The project had favorable treatment effects of 0.41 units on the z-score of length-for-age (p=0.038). Both findings were robust to estimation using either the baseline-only or full dataset. Both findings were robust to specifications that included regional dummy variables (Bakel, Matam, Kédougou). Neither showed evidence of synergy between nutrition and agriculture.

Table 18. Treatment Effects with Z-Scores Instead of Headcount Indicators for Nutritional Status

Z-distribution	Treatment effect†	P-value‡
Weight for length (wasting)	0.15	0.134
Length for age (stunting)	0.41	0.038**
Weight for age (underweight)	0.34	0.004 ***

[36] This is logically consistent with no significant treatment effects for the project as a whole, the nutrition program, the agriculture program, and high intensity villages. When the low-intensity villages experience a relative deterioration and the high intensity villages experience a trend similar to the comparison group, the synergy coefficient appears positive.

Z-scores for length and weight are calculated from survey responses and WHO reference data, using the software {igrowup} for Stata. Weight-for-length is the curve from which wasting is estimated. Length for age is the curve from which stunting is estimated. Weight for age is the curve for which underweight is estimated.
† Treatment effect is measured in standard deviations above (or below) the average of the reference data distribution.
‡ Asterisks indicate significance at confidence levels of 10% (*), 5% (**), and 1% (***). P-values refer to the probability of obtaining the estimated treatment effect and standard error if the null hypothesis is true.

Variables derived from anthropometry for children under five are sensitive to misreporting of age data. In this region of Senegal, documentation of children's age is frequently unavailable, even with adequate notice of the interview. This study used community calendars to mitigate inaccurate age reporting for children under age 5. The survey teams used calendars of holidays and local events for the preceding five years to assist with birth date precision. Respondents without documentation of birth dates were prompted to refer to the calendar, in order to ensure month-level accuracy of ages. The calendar is designed to limit the phenomenon of "age heaping," whereby when respondents anchor their estimates of children's age in months to the nearest half year (6, 12, 18, 24, ...). The midterm study was slightly more effective in mitigating this problem than the baseline study, but not perfect. At baseline, there were 2.2 times as children reporting 24 months of age as for 23 months and 25 months combined. In the midterm study, the same ratio was 1.67. At baseline, 36% of children reported exact half-year ages (6, 12, 18, …), versus 30% at midterm.

The positive yet statistically insignificant impact of nutrition programming on reduction of stunting, wasting, and underweight is validated by both FGDs and KIIs. Qualitative approaches provide important additional insights that illustrate beneficiary and expert views of learning and behavior changes that support project outcomes. FGD participants generally agreed that children's nutrition and weight are improving in the project areas as a result of the Yaajeende program. With regard to children's nutritional status, according to a participant of an MtM FGD in Matam:

> *There are changes [since Yaajeende began] because before my child was malnourished, lazy physically and intellectually. He was always sick. Now all is well because we eat iodized salt and we're healthy. At birth the children are healthy with a good weight (FGD, MtM, Matam)*

Similarly, in an MtM FGD in Kédougou, one mother explained:

> *[Yaajeende staff] advised us to give 'Gniri' with fish if possible, also sweet potato. If you give these foods to a child, it permits him to have good growth. In a few months, the child will grow fast and obtain a perceptible height and weight (FGD, MtM, Kédougou)*

According to several FGDs in all study regions, Yaajeende also has successfully transferred knowledge to families on the importance of introducing diverse, nutrient-rich, and specifically orange foods to children to support their growth. Other practices mentioned for their positive impacts on child health include using iodized salt and regularly visiting health clinics.

> *Previously, we only gave porridge and peanut to the child. Thanks to the advice from Yaajeende [we] started to diversify. Now we make peanut paste, fruits such as bananas, and other vegetables and it has had a positive impact on the growth of our children. And if the child is doing well, the mother will be in a good mental state (FGD, Kédougou)*

> *The child who diversifies their food and one who does not is not the same. The difference is at the clinic weigh-in. The one whose diet is not diversified is always lighter (FGD, Bakel)*

> *In addition to things like millet, the child must eat items such as fruits, vegetables, and yellow sweet potatoes, which are very good for the child. We boil the sweet potatoes and it is combined carrots and pumpkin. This strengthens the child and helps them gain weight (FGD, Matam)*

Qualitative discussions also revealed the contribution of Yaajeende's community groups to nutrition information sharing and accountability, particularly in Matam. FGDs discussed how families utilize group meetings as opportunities to weigh their children, verify the quality of their crops, and share food. Meetings promote collective investment in community meals by providing benefits such as cooking classes and seeds for personal use. These activities are viewed by respondents as directly impacting family nutrition in the short term and promoting health awareness in the long term.

> *We organize weigh-ins during group meetings. It also allows us to check the quality of the food being prepared. Whether are improvements in children's weight or in yellow or red zone... we learnt all this from Yaajeende and will continue even after they are gone (FGD, Matam)*

> *Yaajeende provided seeds for our gardens… after the harvest, we organize meetings in neighborhoods and prepare meals. We call everyone and provides meals from our harvest. We share the food and children are also served. We also organize cooking demonstration… if we learn to prepare these dishes then we can carry on in our homes so our families eat better and there is no malnutrition (FGD, Matam)*

Finally, several KIIs demonstrated awareness around Yaajeende's theory of change and specifically the synergistic impact of nutrition and agriculture programming on the prevalence of underweight women and children. One interview, for instance, discussed how the POG program helps women to save money, which can then be applied to nutrition interventions such as hygiene.

> *Livestock ownership can indirectly benefit the nutritional status of women as they can use the revenue from livestock to purchase nutritional and other products. Nutrition… it is not just about food, it also involves*

> *everything related to hygiene and health... Surveys have shown that women that received animals and were able to generate extra revenue from these were also able to take charge of the family's needs in terms of nutrition, health and education for the children… they could use the extra income to purchase seeds for the garden (KII, Governance, Matam)*

Other MtM FGD participants described the ways in which Yaajeende has seemingly contributed to decreased prevalence of underweight children in intervention areas. According to participants of an MtM FGD in Bakel, since the inception of the Yaajeende program, underweight children are more regularly brought to health centers and several mothers have acknowledged the benefits of exclusive breastfeeding. This finding was supported by the quantitative analysis, which showed a substantial rise in exclusive breastfeeding among children below 6 months of age between the two survey years.

There was also quantitative evidence of synergy between agriculture and nutrition regarding Indicator 1.3, underweight among children aged 6-59 months. The overall univariate treatment effects from nutrition and agriculture were very small (less than 1%). High intensity villages did much better (11.3% based on the baseline village sample; 10.7% based on the entire sample) than would have been expected based on the marginal effects of nutrition and agriculture taken alone. The decline of 11% means that, at the margin, the odds of underweight among children in the study were about 50% lower than predicted by the separate nutrition and agriculture effects. This shows that the high-intensity group showed marked improvement relative to the low-intensity group, but not relative to the comparison group. Finally, the synergy coefficient in Model 5 was statistically significant for the minimum acceptable diet variable (Indicator 1.5) in both baseline and full-sample estimation, but the critical F-statistic was significant only in the full-sample case.

The study design was appropriate to capture large changes in wasting, stunting, and underweight in accordance with project goals and baseline survey data. Yaajeende's goals were ambitious. The PMP specifies a 20% decline in stunting and a 25% decline in underweight. It specifies a 50% fall in the prevalence of fewer than two meals per day, and an 80% prevalence of improvement in the household food diversity score. As described in the Yaajeende MIE Inception Report, the minimum detectable effect size (MDES) was dependent on the rate of project "uptake," meaning the fraction of respondents in beneficiary areas that actually benefited from Yaajeende intervention. In the best case, where Yaajeende completely saturated the beneficiary villages, the MDES could have been as good as 0.19. If uptake was only 40%, the MDES would have been much larger, 0.47. The baseline survey data was somewhat diluted from its original design. Only 1,330 of the 2,690 households that responded at baseline were located in the geographic regions studied at midterm, as explained above at **Section 3.4 Sampling**. The households sampled at baseline but not used in the midterm study were drawn from 46 villages in 14 collectivités. At midterm, the evaluation team studied three alternatives to increase the power of the study within the regions where Yaajeende ultimately operated: increasing the number of households per village, increasing the number of villages from beneficiary populations, and increasing the number of villages from nonbeneficiary populations. The second alternative, increasing the number of beneficiary villages, provided the greatest statistical power for the evaluation study questions. By selecting a mixture of high- and low-intensity villages, the midterm impact evaluation could have the greatest chance to distinguish between the independent effects of nutrition and agriculture, and any possible interaction between the two.

Adult Female Underweight (Indicator 1.4)

The statistical results for underweight among women aged 15-49 years (Indicator 1.4) are inconclusive. The decline among beneficiaries in the prevalence of underweight was not statistically significant (*p*=.313). The size of this trend, however, was much larger than the trend in the comparison group, where the prevalence of underweight women increased from baseline to midterm by 0.5 percentage point, essentially unobservable.

Univariate treatment effects for the project, nutrition, and agriculture packages were of the desired negative sign and not insubstantial when compared to the sample mean of 24%. They failed, however, to attain statistical significance. The effect size estimated was much larger than the trend among comparison groups, but it had a large variance. The effect size was also consistent across several measures of project participation, showing a possible treatment effect in the range of 3-4 percentage points, with about one quarter of women in the study having a clinically low BMI. The estimated reduction in the odds ratio (OR) of underweight for women of reproductive age attributable to the project was about 13% (*p*=.499), roughly equivalent to a 9% drop in the relative risk (RR).

Qualitative research results from the FGDs indicated that, while women knew to take care of themselves, especially during pregnancy, they sometimes lacked the means to do so. There was a widespread impression, according to the qualitative analysis, that women had learned basic lessons about nutrition from the Yaajeende program, and could recite them, but were not necessarily putting them into effect.

Minimum Acceptable Diet (Indicator 1.5), Length of Soudure (Indicator 1.6), and Meal Frequency (Indicator 1.7)

A worrying trend in the data is the decline in MAD. The change among beneficiaries was clearly negative for this indicator. The proportion of beneficiaries with MAD fell by half, from 13% to 6%. The secular trend in the comparison group showed declines of some 7% for children aged 6-23 months. The data show that very few of the children in this age range are receiving a MAD. Two troubling pieces of evidence come from this indicator. First, the secular trend among children in the comparison group is a marked decline in MAD, representing a decrease in the odds ratio of more than 50%. The second is that the only statistically significant treatment effect is a pernicious synergy between nutrition and agriculture components (Table 16 and Table 17). The data suggest a rise in MAD among low-intensity agriculture villages, with marginal rise in the odds ratio of 2.9 (*p*=0.22). Net of the secular decline and using a relative risk model, the data suggest a 17% increase the probability of MAD among low-intensity agriculture villages. This analysis shows that high intensity villages experienced the worst changes of any cohort in the study. At the margin, after controlling for the secular trend and the independent effects of Yaajeende's nutrition and agriculture programs, the high intensity villages suffered an increased risk of unacceptable diet among children 6-23 months. The synergy coefficient represented a decline of 82% (*p*=.027) in the MAD odds ratio.

Yaajeende programs should have had several, distinct, positive effects on the MAD, identified as an area of concern in the quantitative analysis. Yaajeende works on access to food through the horticulture, arboriculture, and livestock programs. It addresses utilization through MtM groups, food conservation techniques, community meals, and community nutrition volunteers. The decline in MAD is worthy of careful attention from project staff.

Yaajeende's treatment effect on minimum acceptable diet for children aged 6-23 months was inconclusive. The treatment effect estimates were negative. Synergy between nutrition and agriculture programs was negative and significant (p=0.04). Although the overall minimum acceptable diet indicator did not show a statistically significant treatment effect, the project did contribute to an increase in the share of respondents that meet the dietary diversity criterion of the indicator. Among breastfed babies aged 6 to 23 months, the dietary diversity requirement is four of seven groups of foods: grains, roots and tubers; legumes and nuts: dairy; meat; eggs; Vitamin-A rich fruits and vegetables; and other fruits and vegetables. Among non-breastfed babies, the requirement is again four food groups, but the list of groups omits dairy.

The Minimum Acceptable Diet (MAD) indicator is a binary indicator: either sufficient or not. Two conditions must be fulfilled for the MAD indicator to be met: meal frequency and dietary diversity. Each of those conditions is itself binary indicators, either sufficient or not; and the same is true of the child's current breastfeeding status. For breastfed babies, the meal frequency requirement is lower and the dietary diversity criterion is more relaxed. There are fewer acceptable food groups for non-breastfed babies, and the meal frequency must be higher to meet the threshold.

Table 19. Difference in Difference Logit Regression for MAD Sub-Indicators

VARIABLES	Breastfeeding Currently	Meal Frequency	Dietary Diversity
Secular Trend	1.429 (0.192)	1.142 (0.433)	0.252*** (2.07e-05)
Project Ex Ante	0.801 (0.516)	0.875 (0.539)	0.607 (0.278)
Project Treatment Effect	0.713 (0.357)	1.028 (0.918)	3.152*** (0.00833)
Observations	2,203	1,867	2,448

Odds Ratios (p-values in parentheses)
Asterisks indicate confidence that coefficient estimates differ from zero: * p<10%, ** p<5%, *** p<1%.

Breastfeeding criterion

Breastfeeding among the comparison group rose during the period of study, but was constant among beneficiaries. By region, trends differed widely. Breastfeeding rose among beneficiaries in Kédougou from 78% to 87% (F=5.02). No increase occurred in Matam, but there was a sharp rise in breastfeeding among the comparison group. No increase occurred in Bakel, but there was a decline in breastfeeding among the comparison group. The breastfeeding criterion itself is not the determinant of minimum acceptable diet. Rather, it governs the way subsequent calculations are made. Using a logit regression model, the project group was neither different at baseline nor showed any evidence of a treatment effect.

Meal frequency criterion

Both beneficiaries and non-beneficiaries showed slight improvements in the prevalence of sufficient meal frequency. However, overall, meal frequency was disappointing. Just 45% of toddlers at midterm had 3 or more meals and bottles per day among beneficiaries. Neither group attained 50% in this category in either baseline or midterm. The rise of 4% in the average was not statistically significant (F=0.58). A logit difference-in-difference regression of meal sufficiency on project exposure showed a nearly zero treatment effect size (p=0.918). Regardless, the meal frequency criterion was not principally responsible for the broad failure of MAD. Access to and utilization of food groups other than cereals remains limited during the period of *soudure*.

Dietary diversity criterion

While the beneficiary group's dietary diversity criterion was significantly better than the comparison group, it was markedly lower than sufficient meal frequency, thus making it the main driver of failing the MAD indicator. Among the beneficiaries, the prevalence declined by 2 percentage points from 11% to 9% (F=0.52), which was not statistically significant. But among the comparison group, the decline from baseline to midterm was 12 percentage points, falling from 17% to 5% (F=7.27). Using a logistic difference in difference regression, the treatment effect of project involvement on dietary diversity is an increase of 3.2 in the odds ratio (p=0.008). This effect is robust to regional samples in the Matam and Kédougou regions, but not in Bakel. The secular trend coefficient shows that the odds ratio of dietary diversity at midterm is just 25% of its baseline value.

The dietary interviews showed evidence of greater meat and dairy consumption in project areas. The proportion of children aged 6-23 months (called *toddlers* for convenience in this paragraph) that consumed meat in the past 24 hours was approximately twice as high among beneficiaries as in the comparison group. The ratio was similar for dairy products and eggs. These foods were not all equally common in toddler diets. Meat was eaten by about one quarter of beneficiary toddlers at midterm. Dairy products were eaten by about one third of the same group, although eggs were eaten by fewer than one in ten. This is consistent with Yaajeende's extensive livestock programs. The evaluation team visited many sites with successful POG livestock subsidies. Mothers described in detail the nutritional benefit of livestock ownership.

Site visits also identified successful fruit grafting programs, including both mangoes and 'Apples of the Sahel'. MtM groups promoted fruit consumption. The proportion of beneficiary toddlers consuming fruit, at 29%, was again about double that of the comparison group.

Evidence from the FGDs and KIIs in all three regions support the quantitative finding that there was no statistically significant treatment effect on MAD among children aged 6-23 months in Yaajeende target villages. While lack of "means" was mentioned as an explanation for this trend in several FGDs, a need for increased programming focused at the household level was also cited. According to a KII with a Yaajeende Program Manager:

> *We need to focus on communication activities and behavior change in terms of our target population: the Yaajeende baby… we really need to focus our interventions at the household level. We need reinforcement within homes so that children are well nourished and healthy (KII)*

There was limited evidence that mothers continue to breastfeed after the first 6 months, which is an element of a diverse diet. Nevertheless, the results of FGDs suggest that women in project areas generally do have increased awareness of the importance of a diverse diet. According to a respondent from a FGD in Matam:

> *After six months, Yaajeende told us to take navet, sweet potato, cabbage, carrot; we mix all of these with fish and cook them and give this to the children. After they gave us wheat, butter that we cook and give to the children (FGD, Matam)*

FGDs in Matam and Bakel confirmed the importance of household level trainings on the improvement of child dietary behaviors. Specifically, several discussions highlighted that knowledge around fortification of flour, healthy recipes, and the importance of these interventions to the health of the child have been successfully transferred to families that have received household trainings or attended MTM groups. According to a MTM FGD in Bakel:

> *Before the arrival of Yaajeende, children were fed the same food as adults. But since then we have found that certain foods made them sick children. Now we make porridge made from millet, groundnuts and beans. It is this mixture which roast and made into porridge. Also those who can afford it buy carrot, turnip, and potato. You cook the mixture [and] give… to your child (FGD, MTM, Bakel)*

Despite the apparent positive impact of training interventions, FGDs confirmed that MAD among infants has experienced a negative secular trend over the past four years because of the compounding effects of poverty and resistance to growing the new food varieties, particularly in Kédougou:

It is because of poverty. A child of 1-2 years should not have the same food as us adults. But with poverty we can only give children what we eat (MTM FGD in Kédougou)

Here it is with porridge and a little peanut – provided you have it – that you are going to feed the child. Or rice with sauce ("mafe"), but in terms of fruit, those do not exist here… Children eat it all, we have no bananas, orange and others. It is mainly porridge and rice, so this is what they eat (MTM FGD in Kédougou)

Therefore, qualitative evidence supports the disconnect between successful knowledge transfer to families around MAD by Yaajeende programming and the consistent behavior change necessary to curb secular declines.

The duration of reduced food intake may have improved due to Yaajeende's efforts, and in particular among the agriculture and high intensity villages. Using a Poisson specification (appropriate in this case, though admittedly a lower bar to clear), the treatment effects were clearly beneficial and the secular trend showed a clear deterioration. All in, however, the treatment effects were smaller than the secular trend. Taken together, that suggests that project households were worse off in 2015 than in 2011, but the decline was more pronounced among the comparison group. In particular, the treatment effect of Yaajeende was equivalent to about one-third of a month in the high intensity group, relative to the comparison group. That is, participants in either the agriculture or high-intensity group appear to have seen a change in the duration of reduced food intake that is one-third of a month less than the increase among the comparison group. At the margin, the treatment effect of the different packages (nutrition, agriculture, and high intensity) could not be distinguished from one another.

Furthermore, it was found that due to adverse weather, the length of the *soudure* (Indicator 1.6), or the time of the year when food intake is reduced, underwent a substantial secular deterioration, from 2.2 to 3.3 months in the comparison group. In univariate analysis (Model 3), the agriculture package reduced this by 0.349 months and in multivariate analysis (Model 5) by 0.614 months.[37] These treatment effects occurred in the context of strong ex-ante differences between treatment- and non-treatment villages.

FGDs and KIIs highlighted the direct contribution of community-based food and money saving interventions to a reduced period of food scarcity across intervention areas. A theme of collective responsibility as a result of Yaajeende Women's Groups and food storage programming appeared in FGDs and KIIs in Bakel and Matam, supporting the quantitative finding of a decreased lengthening of the soudure in treatment villages as compared to control villages. According to a MTM FGD in Matam:

[37] See Annex VII. Indicator 1.6, linear DD regression with survey weights, baseline villages cross-section sample.

> *We have a Women's Group where each person contributes 100 CFA. During cold periods we do not buy vegetables because we have them in our gardens. Currently, we are in the dry season where nothing works and we are forced to buy vegetables and other food items with the money contributed for meal preparation. The weigh-ins are much better as there are fewer children in the yellow and red zones health wise (FGD, MtM, Matam)*

In this example, Women's Groups likely directly contributed to a shortened period of reduced food intake for participants. By teaching gardening techniques, the Groups enabled increased monetary savings, and by promoting contribution to a collective pool when money was available, they provided women with a resource from which to buy vegetables during periods of scarcity. Similarly, in the following example, Yaajeende's promotion of communal food storage allowed for preparation of community meals during periods of reduced food intake.

> *They set up a granary for children. Each household contributed food items for the granary. These were then stored for use in preparing community meals during periods of reduced food intake (KII, Nutrition Supervisor, Bakel)*

KIIs also reinforced the contribution of the agriculture package, and specifically CWGs, to increased millet storage for use during the soudure among households with agricultural livelihoods in Bakel.

> *We said that every farmer should store some of his crop at the store because some farmers cannot manage their supply and they must be helped to a better use of crops. We want to store millet for lean periods in collaboration with the CBSP (CWG Coordinator, Bakel)*

<u>No significant treatment effects could be found for Indicator 1.7, Fewer than Two Meals per Day, at present.</u> Very few of the households contacted for this survey admitted consuming fewer than two meals per day. The difference between baseline and midterm is pronounced among beneficiaries in Table 14, about five percentage points and an increase in risk of three to four times baseline levels. Given the low prevalence and large secular trend, it is disturbing to see the pernicious signs on the Yaajeende treatment effects for this measure, even if the coefficients are not statistically significant.

On the other hand, a number of factors may mitigate. First, it is well established that successive droughts create greater food stress as coping measures are exhausted. Yaajeende may therefore be (1) operating in the municipalities where it is most needed, and (2) an innocent bystander, as it were, when the rains fail. The apparently detrimental treatment effect could arise from low rainfall in project zones, rather than the effects of the project on livelihoods and behavior. Anecdotally, project managers attest to the near total failure of rains in northern Senegal during the period of study. The project cohort is concentrated in the more arid northern region of Senegal and the comparison group in the wetter eastern region. As a result, the variance in rain may hurt project households (concentrated in Matam) more than it hurts comparison households (concentrated in Kédougou).

For robustness, we tested the independence of parallel trends for a variety of key indicators in Kédougou, as compared with the other regions. We relaxed the assumption that Kédougou shared initial conditions and trends with the northern regions of Senegal. Fitting this model reduces the statistical power of the sample somewhat because it introduces more groups with independent initial conditions and trends. The model with separate initial conditions and trends for Kédougou did not produce any stronger evidence of project impact. The baseline sample shows that almost nobody in Matam or Bakel consumed just one meal per day, and all of these individuals were located in the project zone. By 2015, some 8% of respondents admitted consuming fewer than two meals in the past 24 hours, of whom 65% were located in project zones. As a result, the rise everywhere in Indicator 1.7 was serious and of concern. Due to the extremely low prevalence at baseline, treatment effects are indeterminate. While the qualitative results did not highlight reasons for the low prevalence of consumption of fewer than two meals per day at the baseline, FGDs did support the finding that there was a significant worsening of this indicator in treatment areas. Reasons for this decline include lack of rainfall and lack of irrigation equipment in treatment areas, particularly in Matam and Bakel. As a result of severe droughts, households were unable to adequately feed their families over the study period, despite successfully grasping Yaajeende's farming techniques. According to a head of household in Bakel:

> *They came into the village, they talked and we listened… to grow, you need water. Crops cannot grow without rainfall. Here we lack the machines to access water. If the rain stops and we do not have a machine for water, what do we harvest? Really, we have not been able to succeed because of the lack of rainfall and no irrigation equipment (FGD, Bakel)*

FGDs emphasized that adverse weather conditions caused more food stress in areas dependent upon agricultural livelihoods than areas dependent upon pastoral income:

> *[A] key project strength for Matam are animal breeding and horticulture. Challenges are access to water and irrigation equipment. While project does not work directly on access to water particularly for gardening, they have come to view it as a critical issue (KII, Matam)*

Another explanation cited for a lack of improvement in indicators including meals per day was a general lack of follow up by Yaajeende program staff. Project staff, however, are based overwhelmingly in regional offices, and were largely present in the normal course of business during the evaluation team site visits to the regional offices. In Bakel and Kédougou, respondents explained that they many people forget lessons taught by Yaajeende because techniques are not reviewed:

> *There is none better than Yaajeende, but when you teach someone in*

the village… and then return to ask him after seven months what he learnt, he will not respond because he has forgotten everything. What we wish is that you stay in Kédougou and visit us every month to follow up on our progress… we need them to show us and correct our mistakes" (FGD, Head of Household, Kédougou)

Yaajeende works well, but has no representatives here, we can say that! They have no representatives here who can follow the work of farmers and advise them. It is just that!" (FGD, Head of Household, Bakel)

4.5 Study Question 2: Healthy Household Practices

Did households living in villages located in project treatment areas see greater adoption of healthy nutritional and WASH practices than those residing in non-project areas?

The second set of questions asks whether Yaajeende improved outcomes intermediate to food security in the domains of nutrition, water, sanitation, and hygiene. Several ENAs fall under Question 2, including salt iodation, consuming fruits and vegetables, consuming orange fruits and vegetables, and exclusive maternal breastfeeding. The presumption here is that Yaajeende's nutrition package will be the primary channel of effect on these variables. On the other hand, Yaajeende's agriculture and governance packages could also have treatment effects on indicators that fall under Study Question 2. For example, Yaajeende programs in horticulture and livestock could have an important effect on household dietary diversity. The same five models as in the previous section are used to test for independent effects of Yaajeende's nutrition and agriculture packages in this section. The same approach to linear (ordinary least squares, or OLS) and nonlinear (logistic) models is used, where both models are fit and the results of each discussed separately.

Table 20. Study Question 2: Summary of Treatment Effects, Baseline Villages Only

Indicator	Model 2	Model 3	Model 5	
	Nutrition treatment	Agriculture treatment	Synergy coefficient	F-statistic
2.1 Kitchen hygiene	-0.053	-0.064	0.195*	3.51*
2.2 Cold and covered food storage	0.025	0.035	0.027	0.44
2.3 Water Treatment	-0.08*	-0.083*	0.003	0
2.4 Food conservation techniques	-0.084	-0.075	-0.29	0.03
2.5 Salt iodation and storage	-0.021	-0.045	0.019	0.07
2.6 Exclusive maternal breastfeeding	0.044	0.0457	0.054	0.026

Indicator	Model 2	Model 3	Model 5	
	Nutrition treatment	Agriculture treatment	Synergy coefficient	F-statistic
2.7 Food diversity score	0.529**	0.408*	0.567	0.92
2.8 Handwashing station in common use	-0.119***	-0.131***	-0.052	0.051
2.9 Drinking water from an improved source	-0.025	-0.028	0.037	0.074
2.10 Cooking water from an improved source	-0.019	-0.022	0.014	0.09

Asterisks indicate confidence that coefficient estimates differ from zero: * p<10%, ** p<5%, *** p<1%.

Treatment effects for binary outcome indicators are reported as decimals using ordinary least squares (OLS) estimates. The interpretation of the treatment effect is a linear contribution to the probability of the binary outcome

Nonlinear models, such as logistic regressions with odds ratio (OR) treatment effects, are presented in Annex V.

Table 21. Study Question 2: Summary of Treatment Effects, Full Cross-Section Sample

Indicator	Model 2	Model 3	Model 5	
	Nutrition treatment	Agriculture treatment	Synergy coefficient	F-statistic
2.1 Kitchen hygiene	-0.065	-0.077*	0.180*	3.20*
2.2 Cold and covered food storage	0.029	0.04	-0.073	0.44
2.3 Water Treatment	-0.080*	-0.074	0.017	0.11
2.4 Food conservation techniques	-0.084	-0.07	0.021	0.02
2.5 Salt iodation and storage	-0.016	-0.035	0.035	0.22
2.6 Exclusive maternal breastfeeding	0.043	0.059	-0.002	0
2.7 Food diversity score	0.478**	0.397**	0.784	1.7
2.8 Handwashing station in common use	-0.111***	-0.117***	-0.058	0.65
2.9 Drinking water from an improved source	-0.018	-0.02	0.044	0.73
2.10 Cooking water from an improved source	-0.016	-0.014	0.023	0.19

Asterisks indicate confidence that coefficient estimates differ from zero: * p<10%, ** p<5%, *** p<1%.

Treatment effects for binary outcome indicators are reported as decimals using ordinary least squares (OLS) estimates. The interpretation of the treatment effect is a linear contribution to the probability of the binary outcome

Nonlinear models, such as logistic regressions with odds ratio (OR) treatment effects, are presented in Annex V.

Kitchen Hygiene (Indicator 2.1), Cold and Covered Food Storage (Indicator 2.2), Water Treatment (Indicator 2.3), and Food Conservation Techniques (Indicator 2.4)

Indicator 2.1 is the prevalence of at least one hygienic practice, such as hair covering and handwashing, in the kitchen (not to be confused with Indicator 2.8, on a handwashing station in regular use). The prevalence of these behaviors is above 80% at baseline (see Table 14), so treatment effect sizes are likely to be small. The change among beneficiaries was not statistically significant, with an estimated change of just 1%. The Pearson chi-squared statistic for change among beneficiaries was just 0.23, meaning that the data are consistent with the null hypothesis of no change from baseline to midterm. The comparison group showed modest trends to improvement.

According to the quantitative analysis, the Yaajeende program had minimal statistically significant impacts on the adoption of nutrition-promoting kitchen hygienic practices. Program impacts may be muted by the fact that Yaajeende tended to be implemented in villages where these were already in use. Treatment effects for Indicator 2.1 were indeterminate, except for a pernicious treatment effect of 7.7 percentage point (*p*=.074) for the agriculture program.

High intensity intervention may have been more successful than low-intensity intervention in changing kitchen hygienic practices. The places where kitchen hygiene declined the most during the study were in low-intensity project zones. From baseline to midterm, there was a clear improvement in the comparison group that narrowed the gap between treatment and comparison groups by the time of the midterm study. Outright declines among the treatment group's kitchen hygiene were concentrated in low-intensity areas. No comparable decline occurred among high-intensity beneficiaries.

The synergy effect of high-intensity intervention was large: 19.5% marginal increase in the linear probability model with a p-value of 0.064. A test of the restricted model (no synergy) versus the unrestricted model (with synergy) was decidedly in favor of synergy, with a F-statistic of 3.51. But the size of that synergy was just enough to balance out the comparable deterioration of hygiene in low-intensity villages. In other words, the low- intensity villages deteriorated and the high-intensity villages remained similar to the comparison group. The logistic model showed a high synergy effect, a rise of 5.15 in the odds ratio (*p*=.044), but not enough to overcome the declines predicted by nutrition and agriculture alone.

A crucial circumstance for hygiene indicators at midterm was the Ebola outbreak in Guinée. At the time of the midterm survey, some residents of villages near the border required visitors (such as the survey teams) to wash their hands with soap and water before entering the compound. While the practices were far from universal, the acute public health crisis certainly influenced norms and practices related to handwashing during the period of the midterm survey. This change was brought about by local government, NGOs, and residents of the villages acting in solidarity to protect public health and prevent the infection of Senegalese populations with the Ebola virus. The virus was not a threat at the time of the baseline study. It is extremely likely that favorable trends in handwashing during this period in the Kédougou region in particular were caused by factors beyond the scope of the study. Estimates of secular trends and treatment effects were likely contaminated by this change. Indicator 2.1, as well as Indicators 2.3, 2.9, and 2.10, were likely all biased as a result.

The second important circumstance related to kitchen hygiene (as well as the use of handwashing stations, see Indicator 2.8 below) is the successive droughts in northern Senegal during this period. To the extent that water is scarcer during this period, handwashing practices, water sources, and water treatment may normally deteriorate during periods of water stress. The more arid northern region may perhaps be at greater risk. Thus, there are two exogenous sources of variance that could affect treatment effect estimates in hygiene during the period of study.

Several KIIs and FGDs, meanwhile, did indicate increased awareness raising and understanding around hygiene as a result of Yaajeende, even when inconsistently implemented. According to a participant from an MtM FGD in Bakel:

> *Before we didn't take care of anything, our children didn't wash themselves with soap, same for the mother. Now, you wash your hands before cooking, you wash the hands of your children with soap before eating… It's thanks to Yaajeende that we have this hygiene (FGD, Bakel)*

Other FGDs suggested that constraints to increased prevalence of hygienic kitchen behaviors include limited access to water or resources to purchase soap. In Kédougou, it was mentioned in interviews that when women leave for gold digging, or *aurifère*, for part of each year, they often stop practicing the WASH activities that they have learned from Yaajeende.

While interviews in all three regions confirmed that handwashing during food preparation and the use of handwashing stations is common across intervention areas, this cannot necessarily be directly attributed to Yaajeende programming. Many FGDs discussed general kitchen hygiene improvements over the past several years, such as consistent use of soap for handwashing, without mentioning from whom these practices were learned or how long they have been in use. Other discussions specifically noted that community members picked up handwashing techniques from other organizations including WEPSA, and discussed the increased presence of NGOs throughout the Ebola crisis, particularly in Kédougou.

> *We respect good hygiene practices. We have the can in the house that we handle with our foot (Tippy Tap) to wash their hands. After using the toilet, we use soap to wash our hands. We also use bleach. Before and after the meal we properly wash our hands. When we return from the fields we wash our hands before touching anything (FGD, Head of Household, Kédougou)*

The Tippy Tap is very helpful... It was the project WEPSA that worked with us on sanitation, and setting up toilets and tippy taps. Yaajeende continues to raise awareness in this area using skits etc. We have seen a reduction in ailments like diarrhea, stomach ache, and vomiting (FGD, Head of Household, Matam)

Another complication is that during 2014 due to Ebola other organizations distributed soap in the project zone (KII, CNV, Kédougou)

Meanwhile, several FGDs in Matam revealed a decline in the use of Tippy Taps and handwashing stations over time. Several respondents noted that while knowledge around the importance of handwashing has increased, Tippy Taps are often viewed as being inefficient, easily damaged by the sun, wasteful, and expensive to maintain; a perspective in part attributable to the water crisis in northern Senegal during this period. As a result, it is possible that while the popularity of handwashing stations promoted by other NGOs may have increased, use of Tippy Taps may have simultaneously decreased, resulting in the seemingly pernicious treatment effect seen in intervention areas.

There are some issues under WASH in terms of adopting certain technologies, the Tippy Tap for example. While it has been successful in some zones, we also realized its adoption was not widespread... it gets very hot and the plastic cans have to be changed fairly often, the soap gets eaten by goats or children steal them (KII, Project Coordinator, Matam)

I have no need for a Tippy Tap, I use a kettle and a can. There are twenty people in the house and the water is likely to run out very quickly if a Tippy Tap is installed… each household will have to adapt a technology to suit their needs. I know of households that started using Tippy Taps and abandoned them for cans with holes instead (KII, Nutrition Specialist, Matam)

Regardless of information source, however, it is clear from interviews that families in treatment areas generally had a strong understanding of kitchen hygiene and handwashing at the time of the MIE. Practices mentioned include covering utensils with nets, using soap, and avoiding communal handwashing bowls.

One thing Yaajeende taught was within the Sonninke community where a single bowl is used in which all the guests wash their hands; they prohibited it. Because it is only the first person that washed their hands who has clean hands. As for the second, they will have taken microbes from the first. They recommend a bowl and a kettle. (FGD, MTM, Bakel)

<u>No statistically significant treatment effects were observed for the use of cold and covered food storage (Indicator 2.2) or for food conservation practices (Indicator 2.4).</u> Indicator 2.2 is measured by whether or not the respondent reports covering or using cool storage for leftover foods. Indicator 2.4 is measured by whether or not the respondent uses at least

one of five food conservation techniques promoted by the project: drying, smoking, sprouting, fermenting, and enriching foods.

The beneficiary group abandoned food conservation practices in large numbers between baseline and midterm (see Table 14). Although Indicator 2.2 exhibited no statistically significant change among beneficiaries from baseline to midterm, the proportion of those reporting none of the food conservation techniques ("no" to Indicator 2.4) more than doubled, with clear statistical significance. The design-based Pearson chi-squared statistic for the difference in IND2-4 between baseline and midterm among beneficiaries was 27.6, with an associated p-value below 0.001.

Torrefaction (peanut roasting) was responsible for most of the decline in food conservation techniques. The rate of decline was striking: from 76% of households in 2011 to 23% in 2015. This decline was so large that it points to either an astonishing rise in the cost of inputs for that technique, peanuts and charcoal, or some type of systematic error in one of the survey instruments.

Mixing foods to promote nutrition became more popular over the course of the study, but the change could not be attributed to the project. Beneficiaries reported 55% of households used the technique at midterm, up from 29% at baseline. Using the DD framework, however, only pernicious treatment effects could be discerned. That is, the comparison group saw an even larger rise in the rate of food enrichment (*mélange*). At baseline, the comparison group used *mélange* less, but they had overtaken the treatment group by midterm. The region of Matam was least likely to adopt *mélange* and the least likely to use torrefaction.

The *mélange* practice was further analyzed for patterns of adoption. Yaajeende does not seem to be correlated with adoption of *mélange*. A simple treatment vs. comparison DD logit regression yielded pernicious treatment effects with borderline statistical significance at the 5% level. A univariate DD regression of the nutrition package alone yielded a pernicious treatment effect, significant at the 5% level. The size of the effect was a 45% reduction in the odds ratio of adoption when beneficiaries received the Yaajeende nutrition package. The multivariate DD regression turned up no evidence of synergy and corroborated the finding that the nutrition package is associated with smaller rises in the adoption of mélange. More complicated models controlling for variance among the regions of Bakel, Matam, and Kédougou turned up no new and significant effects. Regardless of the model specification, Yaajeende is never associated with positive treatment effects in *mélange*, drying, and torrefaction, whether or not we control for geographic differences and program intensity.

One possible interpretation of this finding is that producers of conserved foods are specialized and commercial. In other words, the prevalence among households might drop when local supplies become commercially available. Food conservation is comprised of labor-intensive practices such as torrefaction, drying, fortification, fermentation, and germination. Long ago, Adam Smith pointed out that it is the baker's and the brewer's self-interest that promotes them to commercialize. It is, similarly, rational for the household to abandon brewing and baking at home when time is scarce and bread and beer are for sale. The midterm impact evaluation team visited market sites where fortified, dried, and preserved foods were available for sale by Yaajeende trainees. The Yaajeende monitoring and evaluation staff would have reliable estimates of the total value of these sales by project affiliates, and some insight into whether Yaajeende trainees are the primary providers of these goods.

Qualitative research corroborated the decline in food preservation techniques. FGDs and KIIs suggested that there have been no discernable changes in food storage or conservation as a direct result of Yaajeende. Little mention was made of either practice in discussions in Bakel. In Matam, reasons for lack of proper food storage included unfamiliarity with the practice and having insufficient space for storage.

> *Enriched flour is a mixture of millet, peanut and bean… If we use it and it stays in the jar for a day, we throw it away and replace with a fresh serving (FGD, Matam)*

> *It is very difficult to store the things we have to sell. The major problem is with onions as we have nowhere to keep them (FGD, Matam)*

Food conservation is closely related to food transformation. Lack of using food transformation techniques was mentioned most frequently in FGDs in Kédougou, for reasons including the inability to grow certain beans for enriching flour in this region and not possessing the machines necessary for processing.

> *One of the constraints to adopting enriched flour is that it is difficult to grow niebe in Kédougou. You typically have to purchase it if you want to incorporate it into your mixture (FGD, Nutrition Supervisor, Kédougou)*

> *They came two or three times to show us how to conserve food. But apart from that they have not brought us anything else; machines for processing and others, they have not brought (FGD, MTM, Kédougou)*

FGDs, particularly in Matam, revealed that while prevalence of food transformation did not increase in treatment villages at a statistically significant level, certain techniques are in fact being practiced. Germination, fermentation, and drying were mentioned in several discussions, reinforcing that the binary nature of the variable may be masking increased adoption of individual techniques. Several interviews highlighted that families in treatment areas are making enriched flour using Yaajeende's techniques.

> *We made enriched flour, and in making this flour we use germination and fermentation techniques. If you do germinate cowpea, you'll both reduce its toxicity and enhance its use… These techniques are widely adopted because people can see results when they consume nourishing food (KII, Matam)*

> *Yaajeende taught us how to preserve the extra okra from our farm by*

> *drying it. After drying we extract the seeds and keep them for planting during the next farming period (FGD, MTM, Matam)*
>
> *Yes, we take hibiscus and transform it into jam that we store in bottles. We do the same with mangoes, after cooking we transform it into jam (FGD, MTM, Matam)*

Finally, a few interviews indicated that food preservation and transformation techniques are being brought to treatment areas by other organizations, which may also contribute to the indeterminate treatment effect observed.

> *Other NGOs are bringing enriched flour to the area for free and creating competitor for women selling Yaajeende version in Bakel (KII, CBSP, Sinthiou Fissa)*
>
> *We never received training on food preservation but we learnt about onion preservation from the radio (FGD, MTM, Matam)*

A significant increase in water treatment (Indicator 2.3, prevalence of at least one of the following: bleach, filters, or silver filters) among the comparison group led to pernicious treatment effects. The rise in rates of water treatment according to our survey data is some 27 percentage points in the comparison group, or a six-fold increase in the odds that water is treated. This is an astonishing rate of growth and surely driven by some exogenous circumstances. Neglecting the counterfactual framework, among beneficiary households the survey shows a rise from 7% to 26% of households consuming treated drinking water. Depending on the model estimated, the secular increase in Indicator 2.3 between 2011 and 2015 is estimated to be on an order of 25-30 percentage points. Under such circumstances, the presence of statistically significant negative effects for project treatment is not surprising; the trend was being driven by factors exogenous to the project.

Households with running water in the home may not believe that tap water needs to be treated, particularly in the Matam region of Senegal. This study did not test the water quality of households with running water.

In the tables that follow, we investigate the correlations between region of residence, year, project exposure, and drinking water sources, with water treatment. The variable summarized in each case is Indicator 2.3, Water Treatment. In the questionnaire, this refers exclusively to the practice of treating water in the home for drinking, such as with filtration or bleach.

Table 22 shows that the greatest subpopulation shift in water treatment occurred in the Kédougou region. During that period of time, no correlation was observed between the practice of treating water and the use of an improved water source. A well-documented exogenous shock in epidemiology, namely the Ebola epidemic, is thought to have influenced handwashing practices in the Kédougou region. This might have also influenced the prevalence of water treatment. There was no difference in baseline prevalence of water treatment. The Kédougou region has a sample with greater representation of non-beneficiaries. Within the Kédougou region, project zones were not statistically more likely to treat water either at baseline or at midterm, and the increase in both groups was of a similar size. To test whether the treatment effect of Yaajeende was significant ignoring these regional differences, we fit the logistic difference in difference specification separately with the Kédougou subsample and the Matam and Bakel subsample. No treatment effect was statistically significant with either subsample.

Table 22. Percent of Households Treating Drinking Water by Year, Region and Project Status (total sample)

Water treatment prevalence within category	Period	
	Baseline	**Midterm**
Region		
Bakel	7.4%	12.4%
Matam	5.5%	24.1%
Kédougou	9.6%	45.3%
Received Project Package (A or AB or ABC)		
No	7.5%	34.0%
Yes	7.5%	26.2%
Total	**7.5%**	**21.1%**

† **How to interpret this table**: The percentage in each cell is the percentage of households that treat their drinking water, as with bleach or chlorine tablets. The population to whom that percentage refers is defined by *period of study* in the columns, and by *region* in the top half of the table rows. In the bottom half of the table, the population is defined by *period of study* in the column and *project status* in the rows, meaning whether the village received the nutrition package that covers water treatment.

Water sources for drinking were chosen from Improved water sources (Indicator 2.9) are either covered, bottled, or running water among the options of the following list: tap water in the home, bottled water, public spigot, drilled wells, covered well, river, open well, and “other.” Water treatment is independent of water source, and only satisfied when water is treated in the home or bottled water is drunk. Households with tap water, public spigots, and drill wells do not satisfy the treated drinking water criteria unless they practice filtration or disinfection.

Table 23 illustrates a reviewer’s comment that water sources differ regionally and that regional difference in water source may correlation with the prevalence of water treatment. Indeed, even a casual observer to the region will notice how many villages in the Kédougou region have covered wells. However, within the Kédougou region; there is no correlation between the use of an improved water source and treatment of drinking water. Within Bakel and Matam, water treatment is more prevalent among those with improved water sources.

Table 23. Percent of Households Treating Drinking Water, by Drinking Water Source, Region and Project Status (total sample)

Water treatment prevalence within category	Drinking Water from an Improved Source (Indicator 2.9)	
	No	**Yes**
Region		
Bakel	8.1%	11.7%
Matam	11.8%	19.4%
Kédougou	33.2%	32.1%
Received Project Package (A or AB or ABC)		
No	19.2%	26.2%
Yes	16.4%	20.6%
Total	**17.6%**	**22.4%**

† **How to interpret this table**: The percentage in each cell is the percentage of households that treat their drinking water, as with bleach or chlorine tablets. The population to whom that percentage refers is defined by the column and row labels. The column headings refer to whether households use an improved drinking water source (covered well, drill well, or running water), "no" in the left column and "yes" in the right column. The rows refer to region in the top half of the table, and project status in the bottom half of the table. Rows 4 and 5 compare populations that did not receive the nutrition packages versus those that did. Detailed definitions presented in Annex I.

The reviewer's comments refer to tap water in particular. The menu of responses for improved drinking water sources included both infrastructure (well, covered well, drill well) and the consumer's point of access (tap water in the home, tap water outside the home). Since the response "forage" could potentially overlap with the response "robinet," we present here the correlations with drinking water separately and together, broken down by region.

Treatment of water does decline in the population as a whole, but the trend is reversed in the Matam region where prevalence increases among those with running water. Matam is also the region with the highest rate of tap water use for drinking, with 39% of responses. Drill wells were the most popular response overall, with 38% of the sample and 59% of responses in the Kédougou region. The trends are perfectly reversed with drill wells: water treatment rises with the prevalence of drill wells, but in the Matam and Bakel regions that correlation is reversed.

Combining the two sets of responses (tap water and drill well water), we see very little if any difference in the prevalence of the water treatment. Among those with one or the other, the prevalence is 21.4% versus 20.5% without. Within regions, the only significant difference is a decline in the Bakel region.

Table 24. Prevalence of water treatment by tap water use, deep borewell, and region

Water treatment prevalence within category	Region			
	Bakel	**Matam**	**Kédougou**	**All Regions**
Tap water (either in-home or public)				

Water treatment prevalence within category	**Region**			
	Bakel	**Matam**	**Kédougou**	**All Regions**
No	12.3%	14.4%	33.6%	23.0%
Yes	7.1%	20.2%	19.6%	16.7%
Forage (drill well)				
No	11.5%	18.0%	28.7%	18.7%
Yes	8.8%	12.5%	34.9%	25.5%
Either tap water or tubewell				
No	15.2%	15.1%	31.3%	20.5%
Yes	8.0%	18.5%	32.9%	21.4%
Total	**10.7%**	**17.2%**	**32.4%**	**21.1%**

† **How to interpret this table**: Each cell contains a percentage of households that treat drinking water, as with chlorine or bleach. The population to which that percentage refers is determined by region (in the column) and the specific water source used by the household (rows). Rows 1 and 2 compare those with tap water versus without. Rows 3 and 4 compare those with drill wells versus without. Rows 5 and 6 compare those with either drill wells *or* tap water versus without.

In light of these conditions, the absence of a treatment effect in water treatment is shown not to be a product of the high prevalence of running water, but rather of exogenous shocks in the Kédougou region and comparison group. The project was very likely not responsible for the disparity in intertemporal improvement between project and comparison groups.

FGDs demonstrated widespread knowledge of effective water treatment practices at the time of the MIE. Many participants described how they were filtering their water, using Lifestraws, and treating water with bleach, after learning about the benefits of these behaviors from Yaajeende staff. However, this improvement may be due to factors exogenous to the project. While some FGDs in Matam, Bakel, and Kédougou mentioned the positive impact that Yaajeende's VNCs have had on improving norms around water treatment by encouraging the use of bleach, Aquatabs, and Lifestraws, others mentioned learning filtration techniques from different NGOs. One FGD in Kédougou discussed how water treatment practices were already in place but were improved upon by Yaajeende.

> *Before Yaajeende, we drank any type of water, even from the river. We even considered tap water potable. With the arrival of Yaajeende, all of these practices have disappeared. We treat water before drinking. I was trained as CNV and share what I learn (FGD, CNV, Bakel)*
>
> *Another NGO, Women Health Education and Prevention Strategies Alliance (WHEPSA), is also distributing Aquatabs in the project zone. In general, it is difficult to determine how much water is being treated in practice (FGD, MTM, Matam)*
>
> *We practiced this before but it has improved with Yaajeende's arrival as we were advised to add bleach. Previously…we simply filtered the water before putting in containers. We are now putting in bleach as well, thanks to Yaajeende's advice (FGD, MTM, Kédougou)*

Salt Iodation and Storage (Indicator 2.5), Exclusive Maternal Breastfeeding (Indicator 2.6) and Food Diversity (Indicator 2.7)

Although the vast majority of salt consumed in project zones is iodated, it is poorly stored. This led to low prevalence of Indicator 2.5 (purchased, stored, and field tested). Prevalence during both periods in project zones was markedly higher than in comparison zones. As a result, all of the change observed (a decline) is attributed to a treatment effect, but the prevalence is not so different as to demonstrate a significant treatment effect.

However, respondents from FGDs in Matam cited an increase in the prevalence of iodized salt in intervention areas as a result of household visits by CNVs to ensure that salt is properly stored. Qualitative evidence also established that knowledge of the importance of iodized salt is now near-universal. According to one participant:

> *Yaajeende brought us testers to verify. If the salt has a certain coloring, it's good or bad. The CNV taught us to store away from the sun, humidity, and to close the bag it's in to maintain the iodine. It's a good salt that protects us from diseases and deficiencies (FGD, Matam)*

The qualitative results demonstrate that most respondents were familiar with the benefits of iodized salt to general health and pregnancy. While some individuals mentioned learning these benefits from Yaajeende program staff, others did not mention the source of information and some mentioned learning about iodized salt from the radio.

> *If a pregnant woman uses iodized salt, it allows them to avoid a miscarriage. The use of this salt promotes good health… It is Yaajeende that advised us that iodized salt is the right salt (FGD, MTM, Kédougou)*

> *I have not attended… the trainings but we always hear people on the radio talking about iodized salt (FGD, Bakel)*

> *People in the Zone of Influence may be hearing messages on the radio to consume iodized salt (FGD, Kédougou)*

The Yaajeende intervention most commonly mentioned by respondents as contributing to increased prevalence of iodized salt was salt testers introduced by CNVs.

> *Yaajeende brought us testers to verify. If the salt has a certain coloring, it's good or bad (FGD, MTM, Kédougou)*

> *Since we started using the testers, there has been less health problems related to the use of salt. Before, we had more cases of goiter in the population (FGD, MTM, Matam)*

Meanwhile, findings on proper storage of iodized salt were less discernable. FGDs confirmed that while CNVs have provided trainings on keeping iodized salt stored in dry, temperature controlled locations and in sealed containers, understanding and uptake of these practices are varied.

> *They advised us to store it dry in the shade and not in the sun, and also keep it out of the wind so it does not evaporate. There are some that know this but others may not. (FGD, MTM, Bakel)*

> *Previously, we used salt that was left in the sun outdoors… Now with iodized salt, it is the opposite, we were advised to keep it in a place away from heat and cold, in a stable temperature and away from children. If we leave the salt in an open bag, it loses its value. If left in an open container… [it] deteriorates. (FGD, MTM, Kédougou)*

<u>An enormous shift in exclusive maternal breastfeeding (Indicator 2.6) took place during the period of study, but cannot be attributed to the Yaajeende project.</u> The comparison group's eightfold increase in exclusive maternal breastfeeding, or 20 percentage points, constitutes a very challenging benchmark for evidence of impact. The corresponding rise in the odds ratio of breastfeeding among the comparison group was 10.2 ($p<0.001$). A linear model of impact (OLS) cannot distinguish between the 20 percentage point rise in the comparison group and the 23 percentage point rise in the project group. Nonlinear models, which test hypotheses about the rise in odds ratios or relative risk, uniformly showed positive treatment effects. The nutrition treatment effect was an odds ratio rise of 3.7 times ($p=0.07$), nearly equal to that for any project exposure, which was 3.6 (p=0.07). The agriculture treatment effect was 6.0 (p=0.02) and the high intensity treatment effect was 6.2 (p=0.04). Treatment effects were robust to baseline versus full cross-section, but were not uniform across regions of the study. The number of cases of exclusive breastfeeding at baseline is extremely small (15). The Bakel and Matam regions each had fewer than five observations of exclusively breastfed children at baseline, which renders estimates of the relative odds of breastfeeding fragile.

Qualitative research indicated that the importance of exclusive breastfeeding is now practically universal knowledge among mothers, although mothers who are not well may find it difficult to practice. FGDs and KIIs confirm the large secular increase in exclusive breastfeeding. While knowledge about the relationship between exclusive breastfeeding and reduced prevalence of disease and diarrhea was widespread, the source of this information varied. Several respondents indicated learning about the benefits of breastfeeding from Yaajeende program staff during MtM meetings, others from health centers, and some respondents did not mention a source. This confirms the quantitative finding that this increase cannot necessarily be attributed solely to Yaajeende programming.

> *Before, we gave babies water right after birth. Now, all that has stopped. Yaajeende has sensitized us on this and have asked us to only give the newborn babies breastmilk for the first six months. Now we wait six months before giving newborns water (FGD, MTM, Kédougou)*

> *Exclusively breastfeeding a child for the first six months allows them to have good health. If the child drinks and eats other foods… they will have frequent diarrhea problems, become sickly and fragile (FGD, Bakel)*

> *Health centers in project areas are independently educating women about importance of exclusive breastfeeding at the same time (FGD, CBSP)*

Other reasons provided for the indiscernible treatment effect of exclusive breastfeeding programming on behavior change include the popularized misconception that children need water during extreme heat and the reluctance of grandmothers to deviate from traditional practices. Several interviews also mentioned that some mothers who understand the benefits of exclusive breastfeeding are not healthy enough to partake.

> *If the child is born in periods of extreme heat, mothers will have real difficulties in meeting the requirement of exclusive breastfeeding for 6 months, notwithstanding their promises. They openly say sometimes that they are not able to meet this requirement for the sake of protecting the child. They become afraid when there is excessive heat and it happens that they give water to the child (KII, CNV)*

> *Grandmothers constitute a real obstacle to exclusive breastfeeding (FGD, CNV, Matam)*

FGDs demonstrated that although women in Yaajeende treatment areas have learned about the relationship between breastfeeding and child growth, many mothers are unable to exclusively breastfeed their children because of their own food intake. According to FGD participants in Kédougou:

> *The difficulties are, before the mother can breastfeed, she has to eat well first. Thus, if the mother is satisfied her breasts will have enough milk so her child can breastfeed. But, if you haven't eaten enough you have to give your child something to eat (FGD, Kédougou)*

> *The main difficulty is that the mother has to eat well before breastfeeding. When the mother has access to enough food with good nutrients then she can produce milk and her baby will be breastfed properly. But if you are not able to eat properly then you will have to give your baby something to eat. (FGD, MTM, Kédougou)*

A qualitative debriefing with a FGD facilitator similarly discussed the impact of declining food security on malnourishment, feeding practices, and infant weight:

> *It's nice to only breastfeed your child but for someone of little means and you notice your child is losing weight and you don't have enough*

> *milk. A woman, for example, her child is only three months old, you breastfeed… [and] you know it's not going to be sufficient, what do you do? This is what pushes women to give something else like cow's milk or another liquid very early (FGD Facilitator)*

FGDs also cited pressure to work as a primary constraint forcing them to wean children before age two.

> *It is the weight of the work that forces us to stop breastfeeding before the child is 2 years old. Everyone has a small trade today. If not for these activities, you would stay with your child. Weaning a child off breastmilk at age 2 is a very good thing, but it is always the mothers' other activities that prevent them from waiting until the recommended age is attained (FGD, Matam)*

<u>The nutrition treatment effect was favorable and statistically significant in the case of food diversity (Indicator 2.7) in both univariate and multivariate models.</u> The nutrition treatment effect of Yaajeende is about half a point on the food diversity score, 0.592 (p=0.012). Using a Poisson framework (which treats each of the food groups as an independent draw from a common distribution), the p-values are lower than 1% for both the Yaajeende project and the nutrition package alone. The agriculture package also contributed to food diversity. There was no evidence of synergy between the nutrition and agriculture packages; and in the multivariate model there was no independent benefit of the nutrition package. FGDs reinforce that the Yaajeende project contributed to increased dietary diversity through education related to nutritious foods (introduction, incorporation of local and wild foods, and recipes using nutritious foods). It was explained that during community meals, CNVs teach participants about the nutrition values of the foods that they are consuming and techniques on how to cook or preserve the vitamins in these foods.

Specifically, in Bakel and Matam, lack of rainfall was cited as a reason for declining rates of food diversity in treatment and control villages. In the context of this reduction, interviews revealed, however, that high intensity areas receiving nutrition and agriculture programming saw less of a decline than control and low intensity areas. In areas that received both interventions, respondents cited using profits from increased harvests to purchase nutritious foods for their families, and applying the knowledge acquired from CNVs and MTM groups to diversify their gardens and take better advantage of livestock production.

> *You can buy what you do not have after selling some of your harvest. Like dried fish and tomatoes, which you can add to your 'maffe' (FGD, MTM, Kédougou)*

> *Yes, after harvesting the women say their pots are full. You see them filling up the plates with a lot of vegetables and there are many varieties (FGD, Head of Household, Matam)*

> *Yaajeende taught us to grow okra and bissap. After that it was gardening with carrot and lettuce. Then comes the poultry project which helped us with eggs. Yaajeende really helped families. My husband was once sick, I prepared him a big chicken which he enjoyed (FGD, MTM, Bakel)*

In a KII in Sinthiou Dialoguel, a CNV explained the extent to which she has taught MTM groups about food diversity:

> *Yaajeende… gave me a tool [knowledge], which is precious. I also transfer this knowledge to people in my group without difficulty. The women participate in feedback sessions on their intake of millet, cowpea, maize, groundnuts, etc. I insist that they use the methods for preparing enriched flour at home, and mention its benefit for children (KII)*

Handwashing Station in Common Use (Indicator 2.8), Drinking Water from an Improved Source (Indicator 2.9), and Cooking Water from an Improved Source (Indicator 2.10)

We have already touched on factors concerning these water-related indicators in discussing Indicators 2.1 (Kitchen hygienic practices) and 2.3 (Water treatment), especially the former. Although handwashing was higher among project households in the midterm study, 8%, than at baseline, 5% (p=0.209; see Table 14), it could not be shown conclusively that handwashing rose among all project villages. The rise in handwashing rates resulted almost entirely from changes in the Kédougou region, both in project and comparison groups. We should not be too worried over the negative treatment effects for the project as a whole, for nutrition, for agriculture, and for high-intensity treatment (p=0.001). In Model 5, all statistical significance disappears. For robustness, the handwashing models were re-estimated using regional subsamples. Within the Kédougou subsample, the secular trend remained strong (p=0.001) but the treatment effect was approximately zero. No significant results occurred within the Bakel subsample. Within the Matam subsample, the secular trend was negative, with the midterm odds ratio just 64% of baseline ($p<0.001$) and the treatment effect was positive, with an odds ratio of 2.3 ($p=0.046$). Similar results for Matam were obtained with both the restricted (baseline) and full samples.

Indicators 2.9 and 2.10 are concerned with the sources of water used to obtain water for drinking and cooking, and as such reflect community resources. The project activities are suited to household practices, livelihoods, and markets. While it is possible that Yaajeende's governance programs will result in effective advocacy for improvements to wells and running water, in the short term, Yaajeende does not invest directly in these supply-side infrastructure projects. Perhaps unsurprisingly, no significant treatment effects emerged from statistical analysis. Some mildly favorable secular trends did not rise to the level of statistical significance. The only subgroup with significantly improved water sources during the study was the Kédougou portion of the comparison group.

KIIs reinforced that improvements to water sources for cooking and drinking have been minimal. Reasons given for this resistance to change were that retrieving water from rivers takes less time than using covered wells, and that Yaajeende's interventions have not been in place long enough to change norms at the community level.

> *Here [at the borehole] you have to wait for an hour to have a bucket of water, I prefer to go to the river where I can have a bucket of water in a minute… others prefer to drink water from the river... they do not realize that this is a problem. We need to spend some time working on this... they must have enough time to digest and understand what they are being told (KII, Nutrition Specialist, Matam)*

While Yaajeende does not currently invest directly in supply-side infrastructure projects, interviews with program beneficiaries do confirm that CNVs are working to raise awareness about the importance of cleaning water sources and covering wells in communities, reaching out to village chiefs and community leaders to gain traction.

> *We recently brought women together in front of the village chief to raise awareness and increase understanding on the usefulness of water hygiene. The meeting was organized to reach this target population and to eradicate cases of diarrhea that was spreading in the village. It was the local water source that caused this diarrhea. With the help of the facilitator for hygiene services in Kidira, we were able to thoroughly clean the water source… Our wells are open. Tomorrow we have a meeting with the owners of the wells to see how to cover them. All wells have lids, the problem is in their management (KII, CNV, Bakel)*

Some improvements to water sources that were cited in interviews, including the use of water taps and wells, but were generally attributed to other NGOs.

4.6 Study Question 3: Agricultural Practices and Production

Did households living in villages located in project intervention areas see greater use of improved agriculture and livestock than households living in non-project areas? Did those practices lead to greater agriculture production and greater productivity?

Yaajeende had mixed results with regard to livelihoods. The overall theme of the quantitative results is that livelihoods improved, but not due to the success of extensive commercial or subsistence agriculture. The nature of agriculture investment changed. Beneficiaries focused on specific technologies in keeping with the project's goals: livestock, horticulture, arboriculture, conservation agriculture, improved seed, and composting. The indicators selected, however, do not fully capture improvements to productivity in these specific domains, as demonstrated by qualitative research. <u>Therefore, the central puzzle of the agriculture impact is a robust beneficial impact on</u>

poverty without concomitant benefits in agriculture production or revenue.

Some indicators focus on the total production in agriculture. During the course of the project, individuals that invested in Yaajeende tillage services saw a rise in production on a per-acre basis, while market penetration of related services remained low. Too few farmers used Yaajeende technology in millet, maize, and rice among the sample to demonstrate a rise in productivity for the whole municipality.

Rather than output, the indicators focus on investments of acreage and inputs. For instance, the horticulture indicators include surface area planted, fertilizer, compost, and seed. Where horticulture is strong, there are a number of local business models. Horticulture may be in a community tract with pooled plots; in a community tract with individual plots; or in microplots inside the home. The vegetables may be for domestic consumption, for sale in local markets, or for donation to local schools. Local market conditions are sensitive to supply; when too many producers enter the market, supply can outstrip demand, leading to spoilage and financial losses. When households invest more in horticulture and arboriculture, the gains to productivity may not appear in the total farm productivity or total farm income measures used in the survey. These indicators are most sensitive to rain-fed field crops, which suffered drought during the period of intervention. Rain-fed field crops are cultivated much more extensively, with larger yields in tonnage per household.

Due to the uneven geographic distribution of the project and comparison groups, exposure to drought varied. Project groups concentrated in the north generally plant different crops than do project groups concentrated elsewhere. They see much less rain in a normal year than do the comparison groups, concentrated in the south. At baseline, livestock was a larger component of their livelihoods. Water, a crucial input to Yaajeende programs in horticulture, flood plain agriculture, and irrigation, was too scarce in much of the north for the duration of the project.

Livestock is a crucial project area whose impact is documented by qualitative research, but was difficult to measure in the survey data. Site visits showed saturation of beneficiary lists with the POG program. This is a livestock lending program whereby three small ruminants (or a number of fowl) are lent to a family, who then repays the community from the animals' natural increase. There is no interest and no fee. Borrowers must take insurance and veterinary care for the animals. The animals are both assets and nutrition to the borrowers, who increase their consumption of dairy products and learn value-added skills in dairy production. Beneficiaries articulated both the financial and nutritional benefits of the animals. They claimed repayment rates well in excess of 90% and saturation of targeted populations in just a few years.

The main measures of farm income in the study are agriculture production and agriculture income, neglecting enhanced productivity in livestock. Agriculture revenue (Indicator 3.7) neither rises nor falls when the POG animals are borrowed nor repaid. This is a very important area of program impact that is poorly captured in the key indicators. The tight evaluation calendar precluded more extensive questioning to measure livestock investment, productivity, and impacts.

Table 25. Study Question 3: Summary of Treatment Effects, Baseline Villages Only

Indicator	Model 2	Model 3	Model 5		Units
	Nutrition treatment	Agriculture treatment	Synergy coefficient	F statistic	
3.1 Poverty (Estimated)	-2.570***	-2.844***	-0.197	0.02	
3.2 Surface Area Planted	-0.652	-0.57	0.192	0.15	
3.3 Surface Area for Horticulture	0.124***	0.128***	-0.057	0.33	
3.4 Surface Area for Irrigation†	0.079**	0.095**	0.116***	7.86***	
3.5 Surface Area for Flood Plains†	-0.009	-0.005	0.100*	2.99*	
3.6 Agriculture Production	127	82	-70	0.25	Kg
3.7 Agriculture Revenue	27.6**	26.4**	-1.97	0.02	CFA 000
3.8 Seed Purchases	0.102***	0.118***	-0.028	0.04	
3.9 Fertilizer Purchases	0.006	0.03	-0.042	0.18	
3.10 Agriculture Investment†	0.183	0.16	-0.069	0.08	
3.11 Improved Seed Source†	0.103***	0.109***	-0.014	0.07	
3.12 Use of CBSP†	0.126***	0.140***	0.001	0	
3.13 Improved Fertilizer Source†	-0.025	-0.001	0.079	0.84	
3.14 Trainee Head Count†	0.009	0.008	0.190***	11.16***	
Asterisks indicate confidence that coefficient estimates differ from zero: * p<10%, ** p<5%, *** p<1%. Treatment effects for binary outcome indicators are reported as decimals using ordinary least squares (OLS) estimates. The interpretation of the treatment effect is a linear contribution to the probability of the binary outcome. Nonlinear models, such as logistic regressions with odds ratio (OR) treatment effects, are presented in Annex V.					
† Certain indicators lack baseline data. Rather than treatment effects, the models estimated for these indicators are simple correlations between project exposure and the levels of the indicators at midterm. Because of the absence of baseline data, DD models cannot be estimated.					

Table 26. Study Question 3: Summary of Treatment Effects, Full Cross-Section Sample

Indicator	Model 2	Model 3	Model 5		Units
	Nutrition treatment	Agriculture treatment	Synergy coefficient	F-statistic	
3.1 Poverty (Estimated)	-2.382***	-2.697***	-0.424	0.11	
3.2 Surface Area Planted	-0.765	-0.717	0.233	0.2	
3.3 Surface Area for Horticulture	0.281	0.129***	-0.237	1.11	
3.4 Surface Area for Irrigation†	0.068**	0.086**	0.098**	5.79**	
3.5 Surface Area for Flood Plains†	-0.013	-0.011	0.094	2.18	

Indicator	Model 2	Model 3	Model 5		Units
	Nutrition treatment	Agriculture treatment	Synergy coefficient	F-statistic	
3.6 Agriculture Production	105	29	-57	0.12	kg
3.7 Agriculture Revenue	26.5	25.1	0.9	0	CFA 000
3.8 Seed Purchases	0.096**	0.112**	-0.033	0.04	
3.9 Fertilizer Purchases	0.032	0.052	-0.004	0	
3.10 Agriculture Investment†	0.221	0.228	0.234	0.01	
3.11 Improved Seed Source†	.115***	.123***	-0.023	0.17	
3.12 Use of CBSP†	0.131***	0.149***	0.023	0.08	
3.13 Improved Fertilizer Source†	0	0.022	0.098	1.18	
3.14 Trainee Head Count†	0.009	0.008	0.123	0.85	
Asterisks indicate confidence that coefficient estimates differ from zero: * p<10%, ** p<5%, *** p<1%.					
† Certain indicators lack baseline data. Rather than treatment effects, the models estimated for these indicators are simple correlations between project exposure and the levels of the indicators at midterm. Because of the absence of baseline data, DD models cannot be estimated. Treatment effects for binary outcome indicators are reported as decimals using ordinary least squares (OLS) estimates. The interpretation of the treatment effect is a linear contribution to the probability of the binary outcome. Nonlinear models, such as logistic regressions with odds ratio (OR) treatment effects, are presented in Annex V.					

Poverty Rate (Indicator 3.1)

<u>One of the most striking positive impacts of the project appears to be its impact on poverty as defined by the World Bank $1.25 per day criterion (Indicator 3.1).</u> In the univariate Models 1-4, project participation and the nutrition and agriculture treatments were statistically associated with reductions of the poverty rate of about 2.5 to 2.9 percentage points, to be compared with 38% poverty rate among the comparison group. This is not only statistically significant, but tangible in the real-world sense. It is important to note, however, that, judging from the ex-ante coefficients, perhaps the poorest villages were not selected for project interventions. There is no evidence of synergy in the high intensity villages; although the treatment effect size is marginally stronger there.

The treatment effect of the Yaajeende project lowers the odds ratio of any single household's likelihood of poverty by about 10% (*p*=0.001). The decline in poverty is also evident in the raw poverty score used to estimate household poverty, with a beneficial treatment effect of 3 points. Raw poverty scores on the scorecard range from 0 to 100, and are fitted to the poverty distribution in five-point intervals. The treatment effect of 3.1 points on the raw score corresponds to more than half of a bin width in the poverty scoring algorithm. Poverty at baseline was 2.5 percentage points more common among the comparison group than the project group; and about 2.9 percentage points more common than the high intensity villages. These differences were evident both in the raw scores and the fitted poverty estimates (see **Section 4.7** Further Discussion of Poverty Findings below for more information).

There are numerous possible mechanisms for the decline in poverty. The decline in poverty could result from new income sources, such as enhanced productivity of agriculture and livestock. Overall evidence favors the increase in household agriculture production and revenue in Yaajeende villages. Households that participated in livestock subsidy enjoyed both dietary and financial benefits of livestock ownership. The reduction could have also resulted from the creation of new markets within the village, such as for food products, agriculture inputs, horticulture products, arboriculture products, livestock products, health care, nutritional products and services, and veterinary services.

FGDs and KIIs generally support the finding that Yaajeende's nutrition and agriculture programming, both in tandem and independently, have had a direct effect on the reduction of poverty in treatment areas. All program activities that have resulted in improved nutritional behaviors and increased productivity are likely to have contributed to the observed reduction in poverty prevalence. While it is difficult to draw a direct relationship between Yaajeende programming and household poverty from FGDs and KIIs alone, several interviews specifically emphasized the benefits of POG and livestock activities. These programs tangibly improved livelihoods. According to a large scale producer in a KII:

> *Yaajeende has done a good job with its various interventions: donations of goats, chickens, sheep, etc. They helped us to move towards development. If we are at this level today it is thanks to them. They really fight against poverty... We ask them to increase their donations. Chicken donations is a good example of an immediate solution to a difficult situation (KII, Producer)*

> *It is Yaajeende that brought us goats. Each person has two goats and if it gives birth, the kid will be given to others in turn until everyone can have two goats. This has created some form of solidarity… we also have sheep that we bought with our own money. If the animals reproduce, you can sell them during periods like Tabaski and the extra revenue is good for us (FGD, Matam)*

> *The first donation we received were chickens, and unfortunately the gift of chickens failed. All the chickens were dead because of the rain. It is then that they brought the goats. And the goat gift is a success, because many women are still benefitting from it (FGD, Matam)*

Another intervention seen as having a direct impact on reduction of poverty was Citizen Work Groups (CWG). These groups provide a voice in community politics for many impoverished households, and particularly for women. One respondent describes how CWGs have made it possible for women to afford land by lobbying on their behalf, have increased transparency in seed distribution, and have enabled storage of crops and produce for future sales:

> *[In] Sinthiou Fissa, they organized a forum for the population to audit*

sale of subsidized seeds in order to increase transparency in the distribution of these seeds. They also advocate for better land ownership, especially by women. The price of procuring land was 25,000 CFA, which was expensive for women who had no income. So the Sinthiou Fissa CWG took the initiative to advocate for these women and the cost was reduced to 10,000 CFA. Following this victory, the same CWG took the initiative to rehabilitate a run- down warehouse they owned. Today, the warehouse allows other programs such as WFP to store its grains and this is something that was not previously available in this zone… Similarly, in a community in Kédougou where poverty is severe, the CWG went even further in lobbying local officials so women did not have to pay the 10,000 CFA required for procuring land. It was free for women. (KII, CWG, Matam)

Surface Area Planted (Indicator 3.2), Gardening Surface Area (Indicator 3.3), Surface Area Irrigated (Indicator 3.4), and Surface Area for Flood Plain Agriculture (Indicator 3.5)

Households in project villages did not increase the surface area planted (Indicator 3.2) as a result of the project. There was a strong upward secular trend in this indicator, as well as surface area devoted to horticulture (Indicator 3.3).

In the latter case (Indicator 3.3), a positive treatment effect for the agriculture package was found using both samples, equivalent to an increase of about one-eighth hectare on average in Yaajeende households (*p*=0.008). Among baseline villages, the nutrition package had a similar and beneficial treatment effect, but only in one specification of the models.[38]

It is notable that the surface area irrigated (Indicator 3.4) was higher by 0.1 hectares (*p*=0.010) in Yaajeende agriculture zones than the comparison villages and there was a synergy effect (*p*=0.006). However, this is an ex-post effect: since no baseline observations were available, the regressions analyze levels rather than trends in surface area irrigated. There are no estimates of the secular time trends and no control for differences between treatment and comparison villages ex-ante.

FGDs and KIIs reinforce the quantitative finding that Yaajeende has not had a discernible impact on surface area planted. While interviews confirm that Yaajeende has provided farmers with lessons on the importance of building fences around farmland and using improved irrigation techniques, a barrier to increased land cultivation is that families do not always agree about which new land to farm. In other words, because lands are often

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[38] The statistical test used to show the effect of the nutritional package is Model 2, which compares households exposed to the nutrition package against non-project households. Using the full sample of villages, meaning both villages sampled at baseline and those not sampled at baseline, the statistical significance of the treatment effect disappeared. That said, the absolute size of the treatment effect was approximately twice as large in the full sample estimate. And in the baseline sample only, the p-value on the estimate is very favorable, just 0.002.

cultivated communally, collective decision-making about where and how to expand farming often delays the process.

> *They had asked us to show them a piece of land where they can build a fence around before showing us how to cultivate it… But, it is the men who have not yet agreed on the right spot. But Yaajeende has spoken to us about this. (FGD, MTM, Bakel)*

In Bakel, FGDs revealed that another barrier to improvement of this indicator is lack of availability of additional farmland near lakes. While many families are effectively reallocating farmland to horticulture during the winter season, this alone is not increasing total surface area planted.

> *Our difficulty in terms of access to farmland is that the place where they want us to grow is far from the lake. We want to work next to the water, this is what they have not yet agreed to give us. If we could have this, then we would start work (FGD, MTM, Bakel)*

FGDs supported the finding that Yaajeende has had a positive impact on the total surface area used for horticulture in all seasons. Interventions that have directly impacted this increase are instruction on reallocating land already set up for cultivation during the winter, instruction on building fences, and assistance in drilling wells.

> *We do not own land. It is in fields where men cultivate millet or corn that we put fences up for gardening. During the rainy season, we remove our fencing and the owner will cultivate his field. (FGD, MTM, Bakel)*

> *We want to do gardening. We have a large field, unfortunately it is not fenced and there is no well. Yaajeende can help women put up the fence and to drill a well (FGD, MTM, Kédougou)*

Another important intervention mentioned in several interviews is that Yaajeende is advocating and negotiating on behalf of women to be able to formally lease land from men to undertake gardening activities. Yaajeende's promotion in the CWG system is therefore having an impact on the observed increase in surface area used for horticulture.

> *Women are very active in the gardening activity but the challenge is they do not own land. They have access but not control and this is not secure. It is the husband who lends land to them, or it could be a men's group or the local municipality that offers 2 or 3 hectares… Without proper documentation, you have nothing. So when we came, we embarked on this work to support women to at least have this land in spite of the social and cultural constraints… We decided to negotiate on behalf of these women so they can keep their land for at least 25 years. We did not tell the men that they would be transferring ownership to the women*

> *but rather leasing to them… so they can undertake medium term activities that are sustainable. This is an activity that we were able to undertake through the CWG. We are now negotiating with the municipality to release land to these women… At this time, we have been able to get 85 hectares allocated under this activity (KII, Food Security Governance Coordinator, Matam)*

While the quantitative findings highlight that irrigation is more commonly practiced in treatment than comparison villages, lack of baseline data makes it impossible to determine attribution. According to FGDs and KIIs, it seems as though Yaajeende is not yet increasing the surface area planted using irrigation, but that it has potential. Barriers highlighted in interviews were the high initial investment cost required to set up irrigation systems, and lack of enough irrigation equipment.

> *This work requires a lot of tools. If we had irrigation it will make us happy, particularly in the dry season we cannot work only with watering cans. As mentioned earlier our cattle suffer greatly from lack of food. No grass, every bush is burnt. We have no means to buy animal feed…. We ask a lot of support. (FGD, Head of Household, Kédougou)*

> *If you want to help us, you have to get inputs to us on time… and hardware too. Your help with irrigation equipment for gardening can help us to continue working after the winter. (FGD, Head of Household, Kédougou)*

> *We have not been able to achieve consistent results with irrigation interventions… Unfortunately, not all producers are ready to adopt it because it requires an initial investment of about 400,000 CFA per hectare and this is difficult in an area where producers do not usually invest this much financially as most of these facilities are provided by the state. (KII, Program Coordinator, Matam)*

<u>Finally, only rarely did either beneficiaries or the comparison group engage in flood plain agriculture (décrue) (Indicator 3.5).</u> Differences between beneficiaries and the comparison group were no more than about 0.01 ha. Only the high-intensity group practiced flood plain agriculture to a greater extent, on average, than the comparison group. The high-intensity group used approximately 0.1 ha more for flood plain agriculture than the low- and mid-intensity groups, and the difference was significantly different from zero. The coefficients estimated describe differences at midterm, however, rather than treatment effects, due to lack of baseline data.

Flood plain agriculture requires access to specific tracts of land in specific zones with regular flooding. It is difficult to establish the cross-section of sites where flood plain agriculture is possible at all or to disentangle the constraints of geography from the performance of the project. Since the data are only available at midterm and not baseline, the regressions analyze levels rather than trends in flood plain agriculture planting. Therefore, the geographic distribution of beneficiary and comparison sites has more to do with the appropriateness of flood plain agriculture than does the impact of the project itself. This indicator was chosen at the suggestion of the project to capture recent changes in agriculture extension practices, with the understanding that the evaluation methodology would limit estimation of impact.

Agricultural Production (Indicator 3.6) and Agricultural Revenue (Indicator 3.7)

Total production of field crops (Indicator 3.6) underwent a secular decline between 2011 and 2015 in spite of Yaajeende programming. Paradoxically, the project does appear to have contributed greatly to a strong positive trend in household agricultural revenue (Indicator 3.7). This indicator can be difficult to interpret because agriculture revenues are skewed, with many families having almost none and a few having substantial income from sales. The treatment effect of Yaajeende on household agriculture income was approximately CFA F 27 000 (USD $45). The effect was shared by all project groups, not only the agriculture or high intensity project households. The treatment effect was slightly smaller than the secular trend (a decline of about CFA F 30 000 or USD $50), and also smaller than the ex-ante difference between project and comparison groups. Comparison groups began the study with markedly higher income from agriculture.

Agriculture revenue comprises all monetary receipts reported by beneficiaries from crops cultivated in either rainy or dry season within the past twelve months. Respondents were asked to provide total receipts for up to three plantings with the highest total value. They were also permitted to discuss plantings that did not appear on the suggested list of crops. The list of crops includes most major plantings common in Senegal including grains, groundnuts, horticulture, arboriculture, and tobacco. Receipts included the total sales in both rainy and dry season.

While lack of baseline data on agricultural investments makes it impossible to attribute increased technology adoption to Yaajeende programming, FGDs and KIIs discuss several reasons why little difference was observed in adoption rates between project and comparison villages. Interviews reveal that while most villages were eager to try new agricultural technologies including zai, BDL, seed production, organic agrochemicals, plant protection products, Segue Bana, composting, and arboriculture, many stopped using these techniques over time. Reasons for this decline include the complexity of the methods, lack of Yaajeende staff follow up after trainings, high cost and lack of credit, limited water availability, and lingering pessimism following failed interventions by other nonprofits. Many respondents described Yaajeende's agricultural technologies as overly labor intensive. It is evident that while knowledge around these practices has increased over time, adoption has stagnated.

> *[Zai is] not an easy technique and very labor intensive. There has not been enough follow up from Yaajeende… they don't come to verify that people are practicing it correctly and this makes populations feel abandoned. Switching to this technique is a risk for farmers... the*

> *technique is minimally adopted due to the negative effects of projects preceding Yaajeende (FGD) We practiced BDL for 2-3 years. We were not able to continue with this due to the lack of water. My farm is 1km from the water source that I was told it would take 1.5 million CFA [approximately USD 2,550] to connect it to the water source, which is too expensive for me (FGD, MTM, Kédougou)*

> *At the very beginning of Yaajeende everyone loved the project… but their agricultural machinery is very complicated... Hundreds of people had adopted it but today there are only four people continue to use their farming techniques… The methods are not suitable to someone who is a poor peasant… there is something else… the credit problem. Bank loans scare us (KII, Kédougou)*

Nevertheless, interviews reveal that certain agricultural technologies have been more widely adopted than others. Respondents mentioned increased use of Segue Bana in Bakel as a result of Yaajeende training, along with BDL in areas where Yaajeende helped to fence BDL sites.

> *I made savings in fuel by using Segue Bana because I am able to water the entire farm with 40L, whereas with the old system I could only cover two rounds of watering with 20L of diesel… With the old system, the water went around into irrigation canals before reaching the field, but with Segue Bana, the water comes out of the pipes and waters the field directly… I went to Bakel for a 3-day training before installing the system [and] was trained on repairing the pipes. (KII, Bakel)*

Interviews support the finding that Yaajeende has not increased agricultural production at the household level in the context of a negative secular decline. Reasons for this finding include that families lack the land, water, or fencing necessary to sustain production, according to respondents. Ongoing droughts, particularly in Matam and Bakel, also account for the overall decline.

> *If we had enough land with water and the privacy provided by a fence, then we would do more gardening. What we need are pumps for irrigation because it is difficult to fetch water… We used to farm in the other people's fields but the landowners reclaim their land and sell back to us for residential use. (FGD, MTM, Kédougou)*

Other interviews mentioned the benefits of Yaajeende's credit activities, in which CBSPs help families to fill out loan applications and sustain positive relationships with local banks.

Overall, in Yaajeende project areas, poverty significantly decreased and beneficiaries profited from the livestock programs, but agricultural revenue has remained relatively consistent between the baseline and midterm. Respondents discussed ways that Yaajeende could help to increase agricultural revenue in the future: building fences around farms and gardens, providing additional trainings on agricultural transformation, and by creating new markets to help women generate income.

Seed Purchases (Indicator 3.8), Fertilizer Purchases (Indicator 3.9), and Adoption of Advanced Technologies (Indicator 3.10)

During a period of overall decline, Yaajeende had strong and positive impacts on beneficiaries' purchases of improved seeds (Indicator 3.8). Improved seed is scarce in eastern and northern Senegal. Creating sustainable markets for seeds of known quality is a major component of the Yaajeende agriculture project. The data indicate that although seed purchases were far less likely overall in 2015 than in 2011, the project group was more likely to have purchased seed. Univariate treatment impacts on purchases of agricultural seeds are favorable and statistically significant, but no synergy between nutrition and agriculture was evident.

Qualitative research concluded that project beneficiaries learned about improved seeds and began to use them. Moreover, while no baseline information was available on seed source, cross-section regression analysis indicates a strong positive effect of project, nutrition, and agriculture treatments on use of an improved seed source. Most of this effect disappears in the multivariate specification, however.

Creating sustainable markets for high quality seeds has been a priority area of Yaajeende. Yaajeende supports and strengthens CBSP networks, groups of small private business owners who provide services for farmers with a fee. By removing the obstacles of access to, and transport of, seeds, and strengthening relationships with seed sellers, CBSPs increase the availability of improved seeds to large scale producers and heads of household. The qualitative findings reinforce that Yaajeende has had a positive impact on the prevalence of households that have purchased seeds for agriculture. In the context of an improved seed scarcity in eastern and northern Senegal, KII respondents explained that households in treatment areas are better able to access and afford seeds due to Yaajeende.

> *They worked hard for us to have access to cheaper seeds. Before, we had to pay for expensive seeds from the local vendors. We were charged up to 35,000 CFA for a bag of seeds when the actual cost should be 20,000 CFA. All of this has stopped since Yaajeende showed us a better way. Yaajeende's contribution has been significant on the cost side (KII, CBSP)*

> *You can also buy seeds in the weekly markets but it is expensive. When you have the choice between paying over 1,000 CFA for a kilogram of seed or 325 CFA for a kilogram of rice, you would rather buy the rice (FGD, Head of Household, Bakel)*

> *There is great satisfaction among producers. Before one could cultivate and harvest only three sacks of rice per hectare due to lack of seeds… with accessibility producers harvest in quantity and quality (KII, CBSP)*

Because baseline data was not collected on the improved seed source indicator, Yaajeende programming cannot be directly attributed to where or how households obtain seeds. Improved sources include government technical services, NGOs, CBSPs, and other regulated services. While the quantitative findings do not demonstrate a significant difference in seed source between project and comparison groups at the midterm, KII and FGD respondents emphasized that many households in treatment areas have shifted from producing their own seeds to purchasing seeds from Yaajeende CBSP Network.

> *I buy my seeds from the Yaajeende CBSP network. We farmers benefit from cheaper price with them. (FGD, Head of Household, Bakel)*

> *We were used to seed production before Yaajeende. We produced our own seeds. But Yaajeende seeds were of good quality. Even the women have shown that Yaajeende's maize is good and results in very little waste. (FGD, Head of Household, Kédougou)*

> *They bring us seeds for planting; it is Yaajeende [via CBSP network] that provides the seeds. (FGD, MTM, Kédougou)*

Although no treatment effects could be shown related to fertilizer purchase (Indicator 3.9), the context was a strongly rising secular trend. Insignificant quantitative findings and qualitative results on the adoption of improved agricultural technologies (Indicator 3.10) suggest that, while knowledge was spread, actual adoption was modest. Direct field observations suggest that activities to promote animal husbandry through POG and animal health promotion are having a significant positive effect.

Qualitative interviews did not support an increase in fertilizer purchases among households in treatment areas. Households that have started purchasing fertilizer as a result of Yaajeende, however, credited increased accessibility and decreased transport costs. According to a Head of Household in Matam:

> *They helped us gain better access to fertilizer which was previously very difficult to find. The fertilizer stores supported by Yaajeende are much closer. Before we had to go all the way to Ourossogui (Head of Household, Matam)*

FGDs and KIIs did reveal increased use of homemade organic fertilizers using household waste and animal dung to save costs. A few households in Matam and Bakel mentioned compositing using ingredients such as chili and tobacco powder, but this practice was not mentioned in Kédougou and was generally described as being too expensive. While some households mentioned that they make their own fertilizer as a result of Yaajeende trainings, others indicated that they learned from NGOs. This finding supports the overall secular increase in fertilizer use in project and control villages.

> *We now treat our fields with natural products such as Nim extract, soap, tobacco, powder, and chili… We did not practice these techniques before because we did not know them. Before Yaajeende, we treated plants with chemicals that left us dizzy after each use and were harmful to our health. Many people now recognize the benefits of the new approach and they are less costly when compared to the chemical treatments (KII, GP)*

> *It is with Yaajeende that we started applying fertilizer in our garden. It is only the organic fertilizers: cow and goat dung. Here we grow okra and more. (FGD, MTM, Kédougou)*

> *This year we were able to buy our fertilizer from one of the Yaajeende stores but last year it was the CNCAS that had given us fertilizer (FGD, Head of Household, Matam)*

Because most households using fertilizer make their own, little mention was made of fertilizer source. Households that purchased fertilizer from CBSP indicated that they have been enabled by Yaajeende's credit and loan programs. Focus group discussions showed that beneficiaries had new financial services to enable access to fertilizer, but that beneficiaries did not link the fertilizer to higher productivity or profits.

> *We told them to bring fertilizer. Fertilizer came in the form of credit and at the end of the rainy season we paid for this credit but it was expensive for us. Thereafter they offered loans, people took this to stock up on fertilizer. These two things have been beneficial for us but the rest was bad for us. (FGD, Kédougou)*

<u>Finally, for the prevalence and use of CBSPs, no meaningful treatment effects can be estimated.</u> CBSPs are only rarely available in communities that have no formal exposure to Yaajeende. They were also entirely absent at baseline, prior to the beginning of the CBSP program. Field observations indicate that CBSPs and CNVs are significantly contributing to improved nutrition in the communities they serve. FGDs and KIIs highlighted the widespread influence of CBSPs in Yaajeende program areas. According to discussions, program beneficiaries largely know how to access CBSP services and feel that they are effectively increasing access to nutrition and agriculture products.

Both the quantitative and qualitative findings confirm that many households consult, purchase agricultural inputs and services, and obtain health services from CBSPs and CNVs in Yaajeende treatment areas. While baseline data was not collected on this indicator, it can be assumed that increased use of the CBSP network is a direct result of Yaajeende programming. FGDs discussed that CBSPs set up groups for pregnant women to discuss child health and breastfeeding and teach households about the importance of adopting the ENAs, including healthy diets for children and adults, community meals, handwashing, and animal health.

> *It is our CNV. He set up different groups for pregnant and lactating women. He taught us the different ways to feed our children with vitamin rich foods. The CNV organizes these lectures every 15th of the month, where we learn about preparing these meals for our children as well as handwashing. (FGD, Matam)*

> *The household in question did not know of carrots. A child under five came, took it and began to eat, he saw that it was good. His mother thought her son would die… After the CNV came and informed her of its nutritional value, she said that it was because she did not know what the carrot was… [The CNV] recognized the importance of communication. (KII, Project Coordinator)*

Nevertheless, some FGDs and KIIs discussed ways that the CBSP and VNC networks could be improved. In Bakel, a few respondents highlighted that CBSPs rarely follow up after trainings, and that follow up should incorporated into CBSP activities. In Kédougou, Yaajeende staff emphasized that CBSPs are overworked and insufficiently compensated, as compared to similar service providers working for other NGOs. This comparison is perhaps unfair because CBSPs earn their living through the market and are not employed by the project or by USAID. Qualitative research documented low wages as a concern and suggestions that Yaajeende reimburse CBSPs for out-of-pocket expenses, including transportation costs and extras for community meals. Yet, this is inconsistent with the Yaajeende model (of utilizing local networks for lasting impact) as it may encourage pervasive "culture of dependence."

> *There is no monitoring… They showed us the work and we did it. After the rain, the millet grew and they had to come and verify quality, but they did not come. (FGD, Head of Household, Bakel)*

> *[Yaajeende] does not follow up! It is those who work in the village [CNVs and CBSP] that have to follow up… they are the ones who have not done their job. (FGD, Head of Household, Bakel)*

> *In our area, there is a lot of gold… However, as a CNV I am forced to work for the community when I could go to Dioura…[Also] there are many other projects in this area. WFP gives bags of grain, oil and other things… Some women choose to go to the WFP because they are doing this and Yaajeende is not. Yaajeende only provides 2,500 CFA for each community meal. We have to buy tea and milk for the small chats. (KII, CNV, Kédougou)*

Behavior change in agricultural practices indicates that Yaajeende is effectively communicating lessons to large producers and heads of households. Quantitative findings demonstrate that the agriculture trainee headcount indicator is significantly higher in Yaajeende treatment villages than control villages, though attribution cannot be confirmed without baseline data. Agriculture trainings are frequent in program areas and cover topics including rice cultivation, bio-restoration of degraded lands, market gardening, deep urea placement, reproduction and multiplication of seeds, composting, tree nursey techniques, and phytosanitary products. Several respondents did indicate, however, that they prefer to practice techniques learned from their parents and grandparents.

> *We learned gardening from our parents and grandparents. (FGD, MTM, Kédougou)*
>
> *I only learned about using organic fertilizer from Yaajeende. Everything else I did as before. (FGD, MTM, Kédougou)*

4.7 Further Discussion of Poverty Findings

The measure of poverty used in the evaluation is a headcount measure of poverty, relative to the World Bank's 2005 $1.25 PPP income per capita. That headcount measure was calibrated to a simple survey battery of ten questions by Mark Schreiner in his monograph, "A simple poverty scorecard for Senegal."[39] The scorecard uses ten questions with simple, observable, and categorical responses to generate a raw score. The algorithm assigns integer point-values to every possible response on the scorecard. The respondent's raw score is the sum of the point values corresponding to the ten answers given. Possible raw scores range from zero (0) to ninety-nine (99) and are aggregated into five-point bins. Each bin on the raw score distribution has a known poverty rate (percent) among households that has been calibrated using reference data from the Senegal Poverty Survey. So, while every household in reality falls above or below the poverty line, the calibrated poverty score is a propensity toward poverty based on the household's responses to a short battery of simple questions. The algorithm published with the scorecard knows the percentage of households in each raw score bin that were poor according to each of a menu of poverty lines, and assigns the corresponding poverty propensity to the respondent household. The YMIE uses the World Bank $1.25 daily income poverty line. It is simple to restate poverty propensities with respect to any of the poverty lines calibrated by the scorecard's author, Mark Schreiner. Thus, each household in the YMIE has a poverty estimate ranging from 0 to 100, reflecting a probability expressed as a percent.

The claim of a 2.5% treatment effect in poverty reduction indicates that the poverty propensity falls by 2.5% more among beneficiaries than the comparison group between baseline and midterm. The claim is robust to both the final poverty estimate (%) and the raw score (integer) that underlies the poverty estimate. The treatment effect is estimated

[39] Mark Schreiner (2009), "A simple poverty scorecard for Senegal." Available at http://www.microfinance.com/#Senegal (Accessed April 1, 2015).

with appropriate survey weights, using a simple two-period DD model with a single comparison group. It is robust to several measures of project intensity, which correspond to the specific combinations of project packages undertaken in a specific project zone. As with all DD methods, this approach is dependent on several key assumptions, including the validity of the parallel trends counterfactual between the treatment and comparison groups, and the validity of the claim that the project activities could have produced the change in the regression.

Proxy consumption measures are a common method for rapid assessment of poverty in household surveys. They rely on short batteries of simple questions about consumption to produce estimates of household income categories. A scorecard does not ask respondents to estimate or to disclose their household income or consumption. Instead, it asks a series of questions that are much less difficult for respondents to answer. The scorecard algorithm estimates the respondent's income based on the responses given. The estimate is calibrated to a national income distribution using a sample of reference data where income and consumption expenses are carefully measured. In market research, household consumption is often divided into lettered brackets, typically five or more. The poverty propensity measure divides the income distribution into just two categories: above and below the poverty line.

The consumption estimator used in the YMIE survey is a scorecard for rapid assessment of income poverty measured through consumption proxies. Consumption measures of poverty differ markedly from income measures of poverty in their construction. Either may be preferred depending on the analyst's priorities and the survey context. Seasonality of income tends to make income less smooth than consumption, particularly in agricultural and pastoral households. The same is true of multi-year variance in income. Consumption measures may have difficulty assigning prices to auto-consumption. Self-employed individuals may also have difficulty distinguishing gross income from net income. Rural households may have difficulty distinguishing sources of income, transfers, and credit in interviews. Consumption measures are stickier than income measures in general, with households only slowly adjusting their consumption behavior after adjusting their expectations of future income.

A number of implementation issues can also favor proxy scorecards. Respondents' ability to recall financial and transactional data declines rapidly with time; meaning that questions about the past 24 hours are markedly more accurate than questions about the previous 7 days, 30 days, season, or year. The paper trail for income and consumption transactions can be difficult to follow, and the respondent's role in the household can affect the details of his or her knowledge about certain transactions on the income or consumption side of the ledger.

National poverty lines typically define poverty by household income, rather than consumption. The headcount measure of poverty gives the fraction of the population whose income falls below the poverty line. The poverty gap indicator gives the average amount by which household income falls short of the poverty line, normalized to the poverty line itself. The Gini coefficient measures the equality of the income distribution, ranging from 0 (perfect income equality) to 1 (one household has all the income). The difference between household income and consumption is net saving and investment during the period, by the identity below. The symbol *Y* denotes income, *C* denotes consumption, *S* denotes net saving, and *I* denotes net investment.

$$Y = C + S + I$$

The calibration of the proxy consumption indicators explicitly uses consumption data to measure income. This is fraught with uncertainty for a number of reasons outlined above. Consumption interviews remain, however, simpler to implement and subject to less intertemporal variance, both within and between years, than income interviews. Hence, the scorecard approach permits rapid assessments of household consumption and minimizes survey fatigue and consequential response errors, such as nonresponse, rounding, and fabrication.

The poverty scorecard used for the MIE was created by Mark Schreiner using the 2005-06 Senegal Poverty Survey (ESPS), conducted by the Government of Senegal, Ministry of Economy and Finance.[40] In the reference dataset, the respondent provided detailed income and poverty information as well as responses to simple questions with observable and categorical responses.

The general methodology of calibrating small-sample poverty estimates to national household survey data is described by Elbers, Lanjouw, and Lanjouw.[41] Alessando Tarozzi and Angus Deaton contributed crucial improvements that correct for unobserved heterogeneity in small samples.[42] Momath Cissé of ANSD (National Statistical Agency of Senegal) has proposed updates to the proxy estimation of household consumption and poverty in Senegal using the 2011 ESPS II, the most current reference microdata, using a new methodology.[43]

The Schreiner algorithm prizes parsimony. It selected the ten questions that collectively provided the most accurate poverty prediction for individual respondents relative to the national poverty line in Senegal.[44] Its objective is to provide a quick and accurate categorization of the household with regard to the poverty line of interest, using no more than ten questions and an algorithm that can be scored in real time with simple arithmetic. Schreiner provides calibration of the poverty raw score for several poverty lines: the national poverty line, multiples of the national poverty line (75%, 125%, 150%, and 200%); the World Bank's famous daily income poverty line and its multiples at $1.25 PPP, $2.50

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[40] Schreiner, "A simple poverty scorecard for Senegal," 3.

[41] Chris Elbers, Jean O. Lanjouw, and Peter Lanjouw, "Micro–level estimation of poverty and inequality," *Econometrica* 71, no. 1 (2003): 355-364.

[42] Alessandro Tarozzi and Angus Deaton, "Using census and survey data to estimate poverty and inequality for areas," *The review of economics and statistics* 91, no. 4 (2009): 773-792.

[43] Momath Cissé, "Analyse de la pauvreté multidimensionnelle au Sénégal: Une approche par la théorie des ensembles flous," *7è conférence africaine sur la Population à Johannesburg*, 2015.

[44] Schreiner, "A simple poverty scorecard for Senegal," 4.

PPP, $3.75 PPP; the USAID extreme poverty line; and the food sufficiency poverty line. The Yaajeende evaluation uses the World Bank $1.25 PPP daily income poverty line.

The components of the scorecard battery are consumer durables and educational attainment. Every response is worth a certain number of points in the raw score, which is then calibrated to poverty prevalence using any of the lines above. The list of questions is as follows.

1. What are the walls of the residence made of? (A. Other; B. Mud bricks or cinder blocks.)
2. What is the main source of energy for lighting? (A. Lantern or kerosene lamp; B. Candle, wood or other; C. Generator, solar, gas lamp, or electricity.)
3. What is the main use of fuel for cooking? (A. Other; B. Gas.)
4. What is the main source of drinking water? (A. Other; B. Indoor faucet.)
5. What is the toilet arrangement of the household? (A. Uncovered latrine, basin, bucket, or none; B. Covered latrine or septic tank; C. Flush to sewer.)
6. Does the household own a refrigerator or freezer? (A. No; B. Yes.)
7. Does the household own a television? (A. No; B. Yes.)
8. Does the household own a fan? (A. No; B. Yes.)
9. Does the household own an electric iron? (A. No; B. Yes.)
10. Does the female head of household or spouse know how to read and write in any language? (A. No female head or spouse; B. No; C. Yes.)

Between raw scores of 10 and 49, the poverty rate goes up whenever the raw score goes down, and vice versa. Equivalently, the binned raw score maps monotonically to the poverty prevalence between the raw score values of 10 and 49. Due to a statistical quirk, the index predicts a slight drop in poverty near the bottom of the raw score distribution. There are also blips at 50 points on the raw score and 70 points on the raw score, where the poverty rate rises slightly with a rise in the raw score. However odd, this is in fact the nature of the correlation between income and poverty, since the calibration is derived from a careful and detailed survey of income, consumption, and poverty. It merits no attempt to correct for this discontinuity merely to favor our own intuition about the consumption behavior of Senegal's poor.

Schreiner's scorecard methodology includes adjustments to estimate variance for intertemporal comparison using simple, independent samples. The precision of the Schreiner estimator at the World Bank $1.25 PPP daily income poverty line, with a bootstrapped sample of n=2000 and α=0.05 confidence level, is 0.021 (2.1%).[45] That precision is partially determined by the training data sample size ($n \approx 16000$). A more careful investigation of the treatment effect could account for both the variance of the proxy estimate and the survey weights, but remains technically cumbersome. YMIE regressions adjust estimator variance to account for clustering, stratification, and selection probability. Since the training data are out of date (circa 2006), as of the survey date (2015), Schreiner's adjustments for intertemporal variance provide only illusory

[45] Schreiner, ``A simple poverty scorecard for Senegal'', 107.

precision and have been omitted. The scoring algorithm and the YMIE key indicator, POVL125, are provided in the key indicator definitions.

The individual components of the poverty scorecard are not necessarily predictive of poverty in their own right. The algorithm as a whole is calibrated to the prediction of poverty; but all of the calibrations are mutually contingent. It does not necessarily follow that the individual questions in the poverty scorecard are the ten best individual predictors of poverty. Nor does it follow that at every point on the raw score distribution, the marginal contribution of each indicator to the likelihood of poverty is everywhere the same. The scorecard is devised with the objective of the greatest accuracy with the shortest possible questionnaire, and calibrated on actual survey data. The distribution of the poverty scorecard's raw score is contingent on all of the component indicators simultaneously.

The individual components of the poverty scorecard are also not targets to be managed by the project on their own merits. There is no reason to suspect that distributing electric irons to project beneficiaries would systematically raise their income or consumption expenditures. The scorecard is to some extent dependent on beneficiaries and the project not knowing the algorithm itself. One can imagine ways to influence beneficiaries' behavior in order to manipulate the appearance of poverty, as measured by the algorithm, without addressing the root causes of poverty. (There is no suggestion whatsoever of any such manipulation in the Yaajeende MIE.) Yet, with that in mind, the evaluation team advises against basing policy conclusions on the sub-indicators in the poverty scorecard. The final poverty estimate and the total raw score are the most useful way to analyze the poverty scorecard. The reasons to study its components individually (such as maternal education, construction materials, consumer durables) are for policy objectives related to those ends, and not particularly with poverty in mind. The scorecard's correlation of maternal education with poverty does not constitute causal evidence that maternal education is responsible for poverty alleviation.[46]

Housing and Consumer Durables

With the above in mind and at the request of the project, we describe the intertemporal change in the poverty sub-indicators among beneficiaries. The tables that follow describe changes from 2011 to 2015 in the beneficiary population. These are the components of the household survey concerning house construction and consumer durables.

Table 27. Relative Frequency of Past Wall Material (2011) by Present Wall Material (2015)

Relative Frequency (%) by Row		Wall Material (2011)		
		Brick	Other	Total
Wall Material (2015)	Brick	94.43	5.57	100.00
	Other	19.05	80.95	100.00

[46] Fortunately, a wide variety of other studies have just that objective.

† **How to interpret this table**: The number in each cell is the percentage *within the row*. The first row shows the percentage of those with brick walls in at midterm, who had brick (in the first column) versus something else (in the second column) at baseline? The second row shows, of all those that *did not have brick walls* at midterm, the percentages of those that had brick walls (first column) versus something else (second column) at baseline.

The construction of housing materials shows slight evidence of poverty reduction. The survey distinguished between two categories: cement or mud (brick) versus all others (other). 19% of respondents with non-brick walls today did have brick in the past. Just 5% of those with brick today had a different material in the past. Because brick walls are more prevalent, the absolute number of respondents changing to brick (117) is greater than those changing to something else (76).

Table 28. Relative Frequency of Past Water Source (2011) by Present Water Source (2015)

Relative Frequency (%) by Row		Water Source (2011)		
		Running water	Other	Total
Water Source (2015)	Running water	65.69	34.31	100.00
	Other	1.05	98.95	100.00

† **How to interpret this table**: See note for Table 28.

Many more people now have running water than did four years ago. Approximately one-third of respondents that now have indoor running water did not in 2011.

Table 29. Relative Frequency of Past Use of Gas Cooking Fuel (2011) by Present Use of Gas Cooking Fuel (2015)

Relative Frequency (%) by Row		Use of Gas Cooking Fuel (2011)		
		No	Yes	Total
Use of Gas Cooking Fuel (2015)	No	99.49	0.51	100.00
	Yes	23.81	76.19	100.00

† **How to interpret this table**: See note for Table 28.

Gas cooking fuel made a minor contribution to the fall in poverty. 23% of respondents that used cooking fuel in 2015 did not do so in the past. There was a net change of 64 respondents from non-gas to gas cooking fuel.

Table 30. Relative Frequency of Past Light Source (2011) by Present Light Source (2015)

Relative Frequency (%) by Row		Light Source (2011)			
		Electric	Kerosene lamp	Candles	Total
Light Source (2015)	Electric	78.03	9.63	12.33	100.00
	Kerosene lamp	3.14	82.6	14.27	100.00
	Candles	0.63	5.43	93.94	100.00

† **How to interpret this table**: See note for Table 28.

Light sources made a small contribution to the estimated poverty score. In every pairing (candles vs. lamps; lamps vs. electric light; candles vs. electric light), the net change of respondents was from an inferior source to a superior source. 22% of respondents with electric light in 2015 did not have it in 2011.

Table 31. Relative Frequency of Past Television Ownership (2011) by Present Television Ownership (2015)

Relative Frequency (%) by Row		Television Ownership (2011)		Total
		No	Yes	
Television Ownership (2015)	No	98.81	1.19	100.00
	Yes	36.58	63.42	100.00

† **How to interpret this table**: See note for Table 28.

Television ownership is a low point-value on the scorecard. Although 38% of television owners had acquired them since 2011, television ownership is among the least important predictors of household poverty.

Table 32. Relative Frequency of Past Fan Ownership (2011) by Present Fan Ownership (2015)

Relative Frequency (%) by Row		Fan Ownership (2011)		Total
		No	Yes	
Fan Ownership (2015)	No	99.49	0.51	100.00
	Yes	35.53	64.47	100.00

† **How to interpret this table**: See note for Table 28.

Fan ownership is a strong predictor of wealth, but rare. In the poverty raw score, fan ownership is the third highest point value. Just 6% of respondents at midterm owned a fan. Of those, more than one third did not have a fan in 2011.

Table 33. Relative Frequency of Past Refrigerator Ownership (2011) by Present Refrigerator Ownership (2015)

Relative Frequency (%) by Row		Refrigerator Ownership (2011)		Total
		No	Yes	
Refrigerator Ownership (2015)	No	99.57	0.43	100.00
	Yes	37.35	62.65	100.00

† **How to interpret this table**: See note for Table 28.

Refrigerators are also rare. Although they provide the single highest point value toward the raw score, just 7% of respondents in 2015 had one. Of those with refrigerators, 37% had acquired them since 2011. The net change in respondents to this question was 52 more respondents with refrigerators in 2015, as compared to 2011.

Table 34. Relative Frequency of Past Iron Ownership (2011) by Present Iron Ownership (2015)

Relative Frequency (%) by Row		Iron Ownership (2011)		
		No	Yes	Total
Iron Ownership (2015)	No	99.96	0.04	100.00
	Yes	0	100	100.00
† **How to interpret this table**: See note for Table 28.				

Electric irons are extremely rare, and made almost no difference in the poverty index.

Table 35. Relative Frequency of Past Generator Ownership (2011) by Present Generator Ownership (2015)

Relative Frequency (%) by Row		Generator Ownership (2011)		
		No	Yes	Total
Generator Ownership (2015)	No	99.8	0.2	100.00
	Yes	41.18	58.82	100.00
† **How to interpret this table**: See note for Table 28.				

Generators are rare, with fewer than 1% of respondents in 2015 reporting generator ownership. Of those, more than 40% were acquired since 2011. Generators provide no independent points in the poverty algorithm, but are noted as a source of electricity for lighting.

Table 36. Relative Frequency of Past Solar Panel Ownership (2011) by Present Solar Panel Ownership (2015)

Relative Frequency (%) by Row		Solar Panel Ownership (2011)		
		No	Yes	Total
Solar Panel Ownership (2015)	No	99.23	0.77	100.00
	Yes	50	50	100.00
† **How to interpret this table**: See note for Table 28.				

Solar panels are rapidly proliferating in Senegal. 11% respondents in 2015 owned solar panels. Of those 50% were acquired since 2011. Solar panels provide no independent points in the poverty algorithm, but are noted as a source of electricity for lighting.

Sanitation

The poverty algorithm also scores the household's toilet arrangements. In the scorecard algorithm, only three categories are distinguished.

- Open defecation, bucket, uncovered pit latrine
- Covered latrine, with or without ventilation, including flush to septic tank
- Flush to sewer

Table 37. Percentage of Responses by Year, Household Toilet Facilities

	None	Latrine	Sewer
2011	85.41	14.59	0
2015	73.36	24.84	1.8

Many more respondents used latrines in 2015 as compared to 2011. The point value of a latrine is only 8, although the point value of sewer use is 19. Sewer use is rare, with fewer than 2% of respondents at midterm.

Maternal Education

The final component of the raw poverty index is maternal literacy. When the mother of the household reads or writes at least one language, the marginal value of literacy is 5 points on the index. Since no data on maternal literacy were collected in 2011, these five points were excluded for all households. The existence of a female head of house or wife of the head of household is worth two points on the raw score. Omission of the points for female head of household literacy tends to bias down the estimate of poverty rates in households with a literate female head of household or a literate wife of the head of household. It also tends to attenuate estimates of difference between richer and poorer areas, by reducing the variance of the raw score.

Table 38. Maternal Literacy in 2015, Sample Proportion

No (2015)	Yes (2015)
91.62	8.38

5. CONCLUSIONS

The USAID Yaajeende MIE shows limited but positive results. The evaluation relies principally on cross-sectional statistical analysis of two large baseline (2011) and midterm (2015) household surveys, together with supporting FGDs, KIIs, and direct field observations. The statistical analysis used DD models to measure the treatment effects of Yaajeende, comparing the treatment group to a comparison group of households that were not located in the same municipalities where the project operated. The statistical models investigated separately whether treatment effects could be shown in villages with (i) any project participation at all; (ii) the core nutrition package of project interventions; (iii) the agriculture package of project interventions; and (iv) "high intensity" projects that combined all packages: nutrition, agriculture, and governance. One element of the FtF theory of change is that the combination of nutrition and agriculture interventions will result in positive impacts on nutrition greater than the sum of individual component interventions. To test this synergy hypothesis, a multivariate model containing treatment effects for nutrition and agriculture as well as an interaction or synergy term was estimated. The DD model controls for baseline or *ex ante* differences between treatment and comparison villages. It measures the secular trend of key indicators observed in comparison villages, which is the best available estimate of the *counterfactual* trend that would have been observed in treatment villages had here been no treatment.

Three basic study questions asked whether the Yaajeende project and its components had positive impacts on nutrition outcomes, household practices closely related to nutrition, and agricultural practices closely linked to household income and poverty. A fourth study question, addressed by the multivariate model, asked whether a nutrition-agriculture synergy effect could be established.

5.1 Nutrition (Study Question 1)

In the key target area of nutrition, treatment effects were generally found to be in the right direction and sometimes consequential in real world terms when compared to sample means, but generally failed to attain statistical significance. Key indicators with substantial impact estimates but unimpressive p-values reflect inconsistent results across villages in the treatment group. In such cases, the treatment effect appears to have been strong in some villages and weak in others. If the effects were not shared by enough of the project villages, then the success of a few would not translate into statistical impact. High variance of the impact estimates characterizes most of the nutritional status indicators.

Some effects are worth noting. Yaajeende had a beneficial treatment effect of about 4.3 percentage points on stunting rates. This is an impressive result, and one which was robust to different measures of project participation albeit is statistically insignificant.

Yaajeende exhibited synergistic benefits with regard to wasting and underweight, even when the project treatment effect was not statistically significant. This shows tentative support for the development hypothesis, which predicts greater benefits from simultaneous nutrition and agriculture interventions than the sum of either alone.

Yaajeende had a beneficial treatment effect on the length of the *soudure* or annual period of reduced food intake. Yet, it would be hard to conclude that a strong and consistent picture of project impacts on nutrition emerges from the statistical analysis.

Using the z-score distributions of child nutritional status, rather than headcount indicators, Yaajeende's treatment effects on nutritional status are more promising. Treatment effect sizes are close to 0.3 on the z-distribution, and some of the estimates are statistically significant. Table 18 shows the results of a simple DD regression using only baseline villages and the broadest possible measure of project exposure (any Yaajeende packages in the village). The treatment effects fall just short of statistical significance for wasting (weight for length), and meet the test for significance in underweight (weight for age) and stunting (length for age). The results vary somewhat with different specifications: whether using the baseline-only or full cross-section sample; and whether testing for treatment effects of any project exposure, the nutrition package, or high-intensity only. The size of these treatment effects in economic terms is both meaningful and significant, showing measurable progress in improving child weight and length for the beneficiary population. Near the mean of the distribution, an effect size of 0.18 corresponds to an improvement from the 50th to the 57th percentile on the standard normal distribution. An effect size of 0.36 corresponds to an increase from the 50th to the 64th. Near the tail of the distribution, the same effect size corresponds to larger change in absolute terms (kg and cm) but smaller change in percentile terms.

Strong trends in some indicators among the comparison group contributed to the weakness of treatment effects in the evaluation. When the comparison group exhibits no change from baseline to midterm, the change observed in the beneficiary group is fully attributed to the project. That was not the case in this evaluation. When secular trends are small and positive, modest positive changes in outcome indicators can be indicative of treatment effects. When the secular trend is large and positive, even marked improvement in the key indicator may be insufficient to show evidence of impact because trends in both treatment and comparison villages are being driven by factors exogenous to the project. In the Yaajeende study, unfavorable secular trends in nutritional status were pervasive due to climatic conditions. Wasting increased in both treatment and comparison groups and the prevalence of fewer than two meals per day rose by 4 percent using a multivariate linear probability model. In such cases, no counterfactual treatment vs. comparison change could be detected.

Exclusive maternal breastfeeding, considered a key indicator for the second household practices study question but directly related to nutrition outcomes, provides another example of the difficulty of establishing project impacts with statistical rigor. The rise in rates of exclusive maternal breastfeeding is large in both treatment and comparison groups. Using statistical models that look for linear differences in differences between treatment and comparison groups—meaning a uniform effect in percentage points—there is no statistically significant treatment effect. On the other hand, using models that search for a uniform rise in the probability of exclusive breastfeeding—meaning a rise in the odds ratio—there are large and statistically significant treatment effects. The high-intensity Yaajeende treatment effect range is a 6.2 times rise in the odds ratio for exclusive breastfeeding.

Other statistical challenges include the non-random selection of project and treatment zones, the assumption that all households in a village benefited from a given project treatment, and the staggering of project start dates in the villages of the project zone. Treatment effect estimates suffered from high variance, indicating that not all beneficiary villages saw, for example, similar declines in their rates of stunting, wasting, and underweight.

Moreover, while statistical results were lackluster, the sense that emerges from the qualitative analysis is that the project has had an impact. FGD participants are of the view that children's nutritional status generally improved due to knowledge imparted by the project. Women's awareness and knowledge of sound nutritional practices have increased, but participants also stated that resource constraints sometimes have stood between knowledge and implementation.

5.2 Healthy Household Practices (Study Question 2)

Results related to the second question were a bit weak. Yaajeende mitigated the decline in food diversity scores between baseline and midterm, by an average of one-half of a point on the 12-point index. Reasons for this may have to do with either the nutrition interventions (focused on food selection and preparation) or the prevalence of horticulture and livestock in project villages.

Yaajeende beneficiaries increased exclusive maternal breastfeeding from less than 1% to 24% prevalence between baseline and midterm, although treatment effects were sensitive to the statistical model fit. As mentioned above, there was a similarly large increase in exclusive breastfeeding among the comparison group. That, coupled with very low prevalence at baseline, clouded the statistical results. The increase among beneficiaries could not be fully attributed to the project. The nonlinear models, which may be a better mathematical model of treatment effects, showed statistically significant results. Yet both the trends among beneficiaries and non-beneficiaries were suspiciously large. They were larger than the treatment effect, larger than differences between beneficiary and comparison groups at baseline, larger than differences between beneficiary and comparison groups at midterm and larger than the prevalence of exclusive maternal breastfeeding at baseline. Baseline prevalence of exclusive maternal breastfeeding was determined by a just a handful of observations, leaving some doubt that the treatment effect observed should be attributed to Yaajeende's work alone.

In the statistical analysis, indicators such as the prevalence of water treatment underwent a very strong secular improvement from 2011-15; so strong that project impacts even appear significantly negative. For many variables, however, qualitative analysis suggest that the project has led to improvements in household practices related to nutrition, sometimes constrained by factors such as the ability to buy soap. Qualitative analysis shows that some household practices related to nutrition have been positively affected by project participation.

5.3 Agricultural Practices and Production (Study Question 3)

Univariate statistical analysis suggests that the project significantly reduced poverty through both its nutrition and agriculture components. The magnitude of the impact, 2.5-2.9 percentage points depending on the model, to be compared with a sample mean of 35.6 percent, is substantial. While there were some significant positive treatment effects on agricultural practices such as seed and fertilizer purchases, again, the strongest evidence for positive project impact comes from the FGDs and, especially, KIIs and direct observation in project villages.

While beneficiaries did not see a rise in income during the evaluation, Yaajeende villages were largely shielded from declining incomes. The size of the beneficial treatment effect (CFA 27 000) was nearly enough to offset the decline among the comparison group between baseline and midterm (CFA 30 000).

Qualitative research documented the efficacy of specific agriculture interventions, such as the rise in yields due to CBSP tractors, the success of household and community gardens, and the uptake of specific arboriculture. FGD participants enthusiastically explained the changes to livestock practices in their villages, such as the use of veterinary care, improved feed and pasture, and insurance. Beneficiaries are using improved seeds, practicing improved animal husbandry, and availing themselves of CBSPs and CNVs with positive impacts on nutrition. The participants in the Yaajeende POG program recognize the value of livestock ownership as a form of saving and risk insurance. Qualitative research corroborated that sometimes it is impossible to obtain seed and fertilizer on local markets. Because farmers plant on a very small scale, it is not profitable to spend very much on seed and fertilizer. Farmers are also exposed to highly variable rainfall. Therefore, large investments in seed and fertilizer are risky. CBSPs have greatly improved access to quality seed and fertilizer.

5.4 Nutrition-led Agriculture (Study Question 4)

Statistical evidence for the synergistic effects of the agriculture and nutrition components of Yaajeende is limited, but suggestive. High intensity villages, meaning those that participated in all facets of the project, experienced a much greater decline in underweight children than did villages that participated in only one or two project components. The size of the synergy between nutrition and agriculture programs in underweight, meaning the difference between high intensity treatment effect and that predicted by the marginal effects of nutrition and agriculture, was 11 percentage points.

Wasting among children aged 6 to 59 months showed a similar, beneficial synergy in high intensity villages. The synergy in wasting was 9 percentage points using the baseline village sample.

The synergy effect of the high-intensity intervention on hygienic kitchen practices was large, indicating that low-intensity villages deteriorated while high-intensity villages remained similar to the comparison group. No evidence of synergy was found on the poverty estimate.

There was found to be a statistically significant synergy effect on child underweight (about 9 percentage points, significant with a p-value of less than 1 percent) and a favorable impact on child wasting falling just short of statistical significance, but substantial as compared to the sample mean.

These results show tentative support for the hypothesis that households benefiting from both project components experience greater improvement, or suffer less in the context of food security deterioration, than those who benefit from neither or from only one. However, they do not necessarily indicate that all high-intensity villages were significantly different from the comparison group. Due to the clustering design of the research, one possible interpretation of the data is that Yaajeende's combined effects were strong in some high-intensity areas, but not all, due to high variance in treatment effect estimates.

To summarize, this impact evaluation has implemented a rigorous counterfactual DD statistical analysis and an accompanying qualitative research design to test for the impacts of the Yaajeende project on nutrition, related household practices, and agricultural practices, along with household agricultural revenue and poverty status. Large variance in treatment estimates has made it difficult to establish statistical significance. However, a number of favorable project impacts have been identified, especially regarding nutrition, agricultural practices, and poverty status. Sometimes simplification, such as substituting nutrition-related z-scores for noisier prevalence rates, amplifies results. It has not been possible, except in a few isolated cases, to identify statistically significant synergy effects between the nutrition and agriculture components of the project.

In contrast to the results of statistical analysis, qualitative research results have consistently suggested that the project has had a positive impact. These results should be taken with a grain of salt in the case of nutrition, where there were strong unfavorable secular trends. In the areas of household and agricultural practices, however, FGDs, KIIs, and field observations suggest that Yaajeende interventions are having a beneficial effect.

6. RECOMMENDATIONS

Overall, it appears that the project is relevant to beneficiary needs, coherent with USAID priority objectives, and is achieving results. It should be continued.

Specific program recommendations follow:

1. Focus resources on locations where the complete Yaajeende intervention can be implemented. While synergies are not evident everywhere, there is important evidence that high-intensity villages do better than low- and mid-intensity villages on key measures of child nutritional status. In plain language, the high-intensity intervention is the complete intervention, with all three nutrition, agriculture, and governance packages. The most productive allocation of resources would be to focus on areas where the complete NLA approach can be implemented. Since the high-intensity intervention also includes the governance package, it is reasonable to assume that communities must be willing to invest a bit of political capital into the project in order to reap the full benefits. Unless a clear and compelling argument can be made to explain partial Yaajeende interventions on a case-by-case basis, Yaajeende should focus on its most effective and complete interventions.

2. Recognize the success of the project in preventing the deterioration of annual food scarcity (*soudure*) and food diversity. While the Yaajeende villages may not have seen gains in these areas, the comparison group deteriorated significantly between the baseline and midterm surveys. Some combination of programs prevented residents of Yaajeende villages from letting dietary diversity deteriorate during a drought. The most likely contributing components of Yaajeende were trainings, mothers' groups, CNVs, CBSPs, livestock programs, and horticulture.

3. Reinvest in livestock programs. Site visits and qualitative research showed that pools of eligible beneficiaries had been completely saturated with the livestock subsidy program, POG. The beneficiaries recognized the nutritional and financial benefits of livestock. They invested appropriately in veterinary care and financial services. The livestock pools were sustainably reinvested through the business model of the program. While early attempts to implement the program apparently suffered from unsustainably high livestock loss rates, the more recent ruminant breeds appear to have been better matched to local conditions.

4. Scale up CBSPs. CBSPs provide crucial market linkages in agriculture inputs and community health resources. In order to see whether the CBSP model is truly sustainable, the project should continue with capacity building, business training, and management of these important community resources. CBSPs aspire to true sustainability, meaning that the markets created will outlast the Yaajeende project's support. To realize this aspiration, the CBSPs must continue to grow.

5. Expand the CWG program to cover more Yaajeende zones. These community organizations, seen through the eyes of the project technical staff, are crucial to the consolidation of technical gains in productivity and nutrition. The CWGs can address political priorities such as infrastructure, partnerships, and land tenure that would remain beyond the reach of individual households. While the project cannot force unwilling villages to participate in the CWGs, there are limits to the productivity of NLA without continued investment in water, electricity, and technical expertise.

6. Continue to explain the importance of exclusive maternal breastfeeding. While breastfeeding is a common practice, some young mothers report that they lack the social standing within their families to refuse water for their infants. Senegal has a culture of profound respect for seniority, so the project must remain steadfast and convince grandparents that infants will be healthy without additional water. This and other ENAs (such as salt iodation and orange foods) require changes to household beliefs about food and child rearing. It will take time; but already big changes are evident. Managers should not worry over the lack of a treatment effect, since the trends among beneficiaries are favorable.

7. Consider reallocating efforts away from indicators with beneficial trends among the comparison group. If the rest of Senegal has seen big improvements in handwashing, in water treatment, and in fertilizer purchases, then perhaps Yaajeende will find opportunities to leverage the efforts of local government, technical services, or charities already at work in these areas.

8. Consider non-farm income, such as remittances, in program monitoring data. The poverty alleviation finding, while promising, was unexpected. It was also not closely tied to investments in agriculture, such as surface area planted, seeds purchased, or fertilizer purchased. It remains to be seen whether the poverty alleviation resulted from other sources of farm income (such as livestock) that the MIE survey did not capture, or non- farm income. It is worth exploring why income benefits were concentrated among beneficiaries and whether or not this additional income was related to Yaajeende programming.

9. Despite the failure to statistically establish nutrition-agriculture synergies in a systematic way, the basic theory of change remains sound. Qualitative research showed that project beneficiary households are simultaneously adopting better nutrition-related and agricultural practices. Yaajeende's theory of change generates important hypotheses outside of the scope of this evaluation. First, it aims to make fundamental changes in essential nutrition actions, child rearing, and hygienic practices in the household. Observing changes to these practices is fraught with difficulty. One-time visits from survey teams, even when the enumerators share the same nationality as the beneficiary population, are less effective at observing these sensitive behaviors than short diary studies and trained observers in the home. Second, the specific links between farm productivity and nutrition—which are supported by qualitative research—are still not tested by the key indicators

in the survey. Respondents document the use of community gardens to supply schools, and the presence of both individual and community gardens. Household gardens and community gardens both suggest nonmarket methods by which mothers and children can increase their dietary diversity. Yaajeende's passing on the gift (POG) livestock subsidy program has both nutritional and financial impacts on beneficiaries. Income from livestock was poorly measured in this evaluation, largely because of the difficulty of disentangling the subsidy from any regular income or capital gains. Mothers in the qualitative research groups cited nutritional constraints in exclusive maternal breastfeeding. This suggests that enhanced farm productivity could lead to nutritional gains, whether in total caloric intake or dietary diversity, that would play an important role in promoting essential nutrition actions. Farm productivity in livestock and agriculture supports nutritional behaviors. Nutrition programs support local demand for agriculture and livestock value chains, including inputs, services, and products. The theory of change predicts that nutritional programs and agriculture programs are mutually reinforcing.

10. Overall, household resource constraints need to be more realistically addressed. In the areas of both nutrition and household practices, results indicate that awareness and knowledge were generated ("They can recite the guidance back to you," was one observation) but simple resource constraints reduced implementation. Households that cannot afford soap cannot implement the hygienic practices that they have learned; women who are not eating enough cannot breastfeed effectively. It is worth engaging local partners, such as the Citizen Working Groups, to explore strategies for additional asset building, income generation, or social safety net. Another, preliminary step, might be to undertake a limited follow-up survey on sources of household monetary income.

11. Further explore synergies between the nutrition and agriculture packages and the health sector. Maternal health and child nutrition outcomes were identified in qualitative research as being closely related to the availability of community health workers and centers.

12. While there has been some attention to risk management, this could be deepened. Qualitative results indicated that adoption of improved seeds and fertilizer was limited by farmers' knowledge that they were prone to adverse weather conditions and that, as small-scale operators, their margin for error was narrow. Conversely, they understood well that animal stock represented a hedge against adverse shocks. It is clear that bad weather conditions contributed to negative secular trends in nutrition over the study period. All in all, the theme of risk needs to be better incorporated into the project using a participatory approach to identify concerns and possible management approaches.

ANNEX I: DETAILED KEY INDICATOR DEFINITIONS

Indicator 1.1 is wasting among children aged 6-59 months. Raw data in the survey report children's height, weight, sex, and age. Software published by the World Health Organization, igrowup, calculates the individual child's z-score on the weight for length curve. The definition of wasting in use by USAID is a z-score below -2. The software igrowup flags observations with z-scores below -5 and above 5 as biologically implausible; again using global reference data and not the sample distribution. The WHO software will also estimate the local prevalence of wasting at the same threshold, using a vector of sample weights and excluding observations with edema.

Indicator 1.2 is stunting among children aged 6-59 months. Raw data in the survey report children's height, weight, sex, and age. Software published by the World Health Organization, igrowup, calculates the individual child's z-score on the length for age curve. The definition of stunting in use by USAID is a z-score below -2. The software igrowup flags observations with z-scores below -5 and above 5 as biologically implausible; again using global reference data and not the sample distribution. The WHO software will also estimate the local prevalence of stunting at the same threshold, using a vector of sample weights and excluding observations with edema.

Indicator 1.3 is underweight among children aged 6-59 months. Raw data in the survey report children's height, weight, sex, and age. Software published by the World Health Organization, igrowup, calculates the individual child's z-score on the weight for age curve. The definition of underweight in use by USAID is a z-score below -2. The software igrowup flags observations with z-scores below -5 and above 5 as biologically implausible; again using global reference data and not the sample distribution. The WHO software will also estimate the local prevalence of underweight at the same threshold, using a vector of sample weights and excluding observations with edema.

Indicator 1.4 is underweight among women aged 15-49. Raw data in the survey report women's height, weight, sex, and age. Underweight is a clinical condition defined by a body mass index (BMI) beneath 18.5. Body mass index is calculated as the ratio of weight (kg) to height squared (m). For example, a woman of 150 cm in height and 54 kg in weight would have a body mass index of 24. The units of BMI (kg/m^2) do not have any intuitive physical meaning, but a higher number indicates heavier weight at any given height. Despite the existence of a mature literature on proposed BMI adjustments to account for sex, age, and body type, this study uses only simple BMI.

Indicator 1.5 is minimum acceptable diet (MAD) for children aged 6-23 months. The specific measure of MAD for non-breastfed children 6-23 months of age who had at least the minimum dietary diversity and the minimum meal frequency during the previous day and the proportion of breastfed children 6-23 months of age who received at least two milk feedings and had at least the minimum dietary diversity and the minimum meal frequency during the previous day. Dietary diversity scores are the number of food groups consumed by the child in the previous 24 hours out of the following list: grains, roots and tubers; legumes and nuts; dairy products; flesh foods; eggs Vitamin-A rich fruits and vegetables; other fruits and vegetables.

The minimum meal frequency criterion is two (2) meals for breastfed children aged 6-8 months; three (3) meals for breastfed children aged 9-23 months; and four (4) meals for non-breastfed children aged 6-23 months.

Indicator 1.6 is the duration of reduced food intake (*soudure*) reported by the household. It is common in rural Senegal for households to reduce food intake for a period of time each year, typically during the rainy season.

Indicator 1.7 is fewer than two family meals prepared in the last 24 hours. It is reported once for the household.

Indicator 2.1 is a binary indicator for at least one reported hygienic behavior in food preparation, such as handwashing and hair covering. It is reported once for the household. This indicator is based on a single survey question with multiple responses permitted.

Indicator 2.2 is a binary indicator for at least one hygienic behavior in food storage, such as cold storage and covered storage. This indicator is based on a single survey question with multiple responses permitted.

Indicator 2.3 is a binary indicator for the treatment of drinking water with any of the following: bleach, filters, and silver filters. This indicator is based on a single survey question with multiple responses permitted.

Indicator 2.4 is a binary indicator for the use of at least one food conservation technique, including fermentation, germination, torrefaction, drying, and fortification. This indicator is based on battery of survey questions.

Indicator 2.5 is a binary indicator for the use of iodized salt, including both purchase and storage, and verified with a field chemical test.

Indicator 2.6 is exclusive breast feeding for children under six (6) months of age, an essential nutrition action (ENA). It is reported for children aged 0-24 months. This indicator is based on a single survey question with multiple responses permitted.

Indicator 2.7 is a rise in household dietary diversity score since 2011. The minimum detectable increase is a single point on a 12-point scale, or an 8% rise. It is calculated as a share of households. This indicator is based on a single survey question with multiple responses permitted. *According to the USAID Performance Monitoring Plan definition sheets, this indicator is only valid for panel data and not pooled cross-sections. This variable specifically refers to household-level differences and not the distribution of village responses between periods.*

Indicator 2.8 is a binary indicator for a handwashing station in common use. It is calculated as a share of households. It is based on a short battery of questions about handwashing, with visual verification of the handwashing station, soap, and water.

Indicator 2.9 is a binary indicator for an improved drinking water source, *viz*., a covered well, a deep water well, or a faucet. This indicator is reported once for the household, based on a single response to a multiple-choice question.

Indicator 2.10 is a binary indicator for an improved cooking water source, *viz*., a covered well, a deep water well, or a faucet. This indicator is reported once for the household, based on a single response to a multiple-choice question.

Indicator 3.1 is the likelihood that a household suffers from poverty. It is based on a simple scorecard approach developed in 2009. The scorecard calibrates the estimated poverty rate based on ten (10) questions with simple qualitative responses. The responses are weighted to provide a raw score that takes values between 0 and 100. The raw score can be calibrated to poverty rates at any of a menu of poverty lines: such as the $1.25 World Bank daily income poverty line, the national Senegalese poverty line, and the USAID extreme poverty line.

Indicator 3.2 is the surface area devoted to agriculture (ha). Field crops are counted once for each season planted. Individual fields but not community fields are counted.

Indicator 3.3 is the surface area devoted to horticulture (ha). Fields are counted once for each season planted. Individual fields but not community fields are counted.

Indicator 3.4 is the surface area devoted to irrigation (ha). Fields are counted once for each season planted. Individual fields but not community fields are counted.

Indicator 3.5 is the surface area devoted to flood plain agriculture (ha). Fields are counted once for each season planted. Individual fields but not community fields are counted.

Indicator 3.6 is the total production from agriculture, in kg. It includes both rainy and dry season plantings, and up to three crops planted by the respondent, with the highest surface areas planted first. The list of crops suggested for responses are as follows, with the respondent permitted to replace these with others at his discretion: rice, sorghum, millet, maize, fonio, manioc, yam, tomato, onion, squash, cabbage, cauliflower, lettuce, sweet potato, okra, beans, potato, gourds, groundnuts, sesame, palm (oil), cashew, hibiscus, papaya, melon, watermelon, tobacco, mango, and citrus.

Indicator 3.7 is the total revenue from agriculture (FCFA). It includes both rainy and dry season plantings, and up to three crops planted by the respondent, with the highest surface areas planted first. The list of crops suggested for responses are as follows, with the respondent permitted to replace these with others at his discretion: rice, sorghum, millet, maize, fonio, manioc, yam, tomato, onion, squash, cabbage, cauliflower, lettuce, sweet potato, okra, beans, potato, gourds, groundnuts, sesame, palm (oil), cashew, hibiscus, papaya, melon, watermelon, tobacco, mango, and citrus.

Indicator 3.8 is a binary variable equal to 1 if the household purchased seed, and 0 otherwise.

Indicator 3.9 is a binary variable equal to 1 if the household purchased fertilizer, and 0 otherwise.

Indicator 3.10 is an index of agriculture technology adoption. It adds one point for each specific technology adopted since 2011. These technologies include erosion control, fertilizer, compost pits, water conservation, rice culture, tractors, irrigation, and threshing. Investments of men and women are counted separately, so the index takes values as high as 17 in practice.

Indicator 3.11 is a binary variable equal to 1 if the household obtains seed from an improved source, viz., non-governmental organization, government technical service, or community based service provider (CBSP); and 0 otherwise.

Indicator 3.12 is a binary variable equal to 1 if the household purchases goods or services from a community based service provider (CBSP), and 0 otherwise.

Indicator 3.13 is a binary variable equal to 1 if the household obtains fertilizer from an improved source, viz., non-governmental organization, government technical service, or community based service provider (CBSP), and 0 otherwise.

Indicator 3.14 is a head count of individuals within the household that have attended agriculture trainings in the last 12 months.

Comments on Indicator 3.1

The most complicated scoring algorithm is the poverty scorecard estimate in indicator 3.1. (See above at “Findings / Study Question 3 / Further Discussion of Poverty Findings.”) The Schreiner (2009) scorecard has a known precision when calibrated to a specific poverty line in Senegal. The scorecard assigns points to a raw score, based on categorical responses to a short battery of questions about home furnishings, infrastructure, and education. Schreiner calibrates poverty prevalence within a bucket of raw scores on the index for each poverty line. The menu of poverty lines so calibrated includes the Senegalese national poverty line, the USAID extreme poverty line, a measure of food sufficiency, and the World Bank's PPP $1.25, $2.50, and $3.75 per capita consumption expenditures. We use the poverty prevalence rates for the World Bank $1.25 PPP daily income line. Poverty prevalence is estimated, rather than measured directly through income or consumption expenditure. The algorithm output is a headcount measure, not a poverty gap. Schreiner also notes that parsimony is a key feature of the scorecard's design. While in principle it should be possible to measure income and poverty with a greater number of questions, longer scorecards would tend to aggravate survey fatigue and interfere with real-time scoring by interviewers. In our case, we did not ask interviewers to grade in real time; but rather sought to follow local best practices, using the most widely known estimator of household expenditures and poverty.

The indicators 3.7, 3.8, 3.10, 3.11, 3.12, 3.15, and 3.16 constitute areas of the impact evaluation where Yaajeende Midterm Impact Evaluation revised its intentions since the Inception Report in April. At the time of the Inception Report, we believed that the mission and the project shared our view on the limited value of survey data for these questions. The survey is also not a first-best measure of household surface area allocated to particular cultivation techniques. It is not a first-best measure of participation rates in agriculture trainings; nor of total production from agriculture and its market value. The elements of the PMP in parentheses (3), (13), and (16) are noted that way to indicate the intent of the midterm impact evaluation to defer to project monitoring and evaluation on these indicators. There are good statistical reasons to prefer the project's monitoring and evaluation data on these topics to the findings of the household survey.

Annex II: Correspondence of Indicators with PMP and Poverty Scorecard Issues

PMP Correspondence

Many of the indicators in the Midterm Impact Evaluation are also indicators in the Performance Management Plan (PMP). The table below gives the correspondence between PMP Indicators from the December 2013 PMP and the Yaajeende Midterm Impact Evaluation (MIE).

Correspondence of Midterm Impact Evaluation Indicators and PMP Indicators.

YMIE	PMP	Indicator Description
1.1	28	Wasting among children aged 6-59 months.
1.2	29	Stunting among children aged 6-59 months.
1.3	30	Underweight among children aged 6-59 months.
1.4	31	Underweight among women aged 15-49 years.
1.5	33	Minimum acceptable diet (MAD) among children aged 6-23 months.
1.6	27	Duration of reduced food intake (months).
1.7	32	Fewer than two meals per day.
2.1	36	Hygienic kitchen behavior, including handwashing and hair covering.
2.2	36	Improved food storage practices, including cold storage and covered storage.
2.3	40	Treated drinking water, using at least one of the following: bleach, filters, and silver filters.
2.4	36	Food conservation technique adoption, including fermentation, germination, torrefaction, drying, or fortification (mélange).
2.5	35	Iodized salt, meaning both purchase and storage.
2.6	none	Exclusive breastfeeding of infants under 6 months of age.
2.7	1	Food diversity since 2011.
2.8	41	Handwashing station in common use.
2.9	40	Drinking from an improved water source, meaning from a covered well, faucet, or deep well.
2.10	40	Cooking with an improved water source, meaning from a covered well, faucet, or deep well.
3.1	(3)	Poverty prevalence.

YMIE	PMP	Indicator Description
3.2	(13)	Surface area cultivated.
3.3	(13)	Surface area for horticulture.
3.4	(13)	Surface area for irrigation.
3.5	(13)	Surface area for flood plain agriculture.
3.6	(3)	Total household production in agriculture.
3.7	(3)	Total household revenue from agriculture.
3.8	6	Prevalence of seed purchases.
3.9	6	Prevalence of fertilizer use.
3.10	6	Adoption of agriculture techniques.
3.11	6	Use of improved seed sources.
3.12	7	Use of community based service providers.
3.13	6	Use of improved fertilizer sources.
3.14	(16)	Participation in agriculture trainings.

Annex III: Summary Statistics, Key Indicators, and Sample Distribution by Treatment Intensity

This appendix details the sample means and sample allocation across the treatment groups. Treatment groups are determined by the Yaajeende project's programming in the *communauté rurale* where the household is located. Possible values of the treatment variable, *Project intensity*, include:

Value	Description
A	Nutrition package only
AB	Nutrition and agriculture packages
ABC	High-intensity Yaajeende intervention
AC	Nutrition and governance packages
BorC	Either agriculture or governance packages
FALSE	Comparison group

Sample allocation by geography and year

The geographic sample distribution is as follows in Tables 1 and 2. Grappe values are masked here for confidentiality.

Table 1: Household Sample Allocation

	Period of study					
	2011		2015		Total	
	No.	%	No.	%	No.	%
Strate						
1	320	24.1	612	24.3	932	24.2
2	490	36.8	986	39.2	1476	38.4
4	520	39.1	916	36.4	1436	37.4
Total	1330	100.0	2514	100.0	3844	100.0
Grappe						
26	40	3.0	82	3.3	122	3.2
27	40	3.0	65	2.6	105	2.7
28	40	3.0	82	3.3	122	3.2
29	40	3.0	116	4.6	156	4.1
30	40	3.0	66	2.6	106	2.8
31	30	2.3	51	2.0	81	2.1
32	30	2.3	38	1.5	68	1.8
33	30	2.3	45	1.8	75	2.0
34	30	2.3	49	1.9	79	2.1
35	30	2.3	43	1.7	73	1.9
36	30	2.3	47	1.9	77	2.0

37	30	2.3	94	3.7	124	3.2
38	30	2.3	103	4.1	133	3.5
39	30	2.3	51	2.0	81	2.1
40	30	2.3	110	4.4	140	3.6
41	30	2.3	49	1.9	79	2.1
42	30	2.3	48	1.9	78	2.0
43	30	2.3	109	4.3	139	3.6
44	30	2.3	46	1.8	76	2.0
45	30	2.3	42	1.7	72	1.9
46	50	3.8	69	2.7	119	3.1
47	60	4.5	77	3.1	137	3.6
48	50	3.8	82	3.3	132	3.4
63	30	2.3	68	2.7	98	2.5
64	30	2.3	75	3.0	105	2.7
65	30	2.3	50	2.0	80	2.1
66	30	2.3	43	1.7	73	1.9
67	30	2.3	51	2.0	81	2.1
68	30	2.3	49	1.9	79	2.1
69	30	2.3	40	1.6	70	1.8
70	30	2.3	30	1.2	60	1.6
71	30	2.3	48	1.9	78	2.0
72	30	2.3	50	2.0	80	2.1
73	30	2.3	50	2.0	80	2.1
74	30	2.3	47	1.9	77	2.0
75	160	12.0	266	10.6	426	11.1
76	0	0.0	18	0.7	18	0.5
77	0	0.0	16	0.6	16	0.4
78	0	0.0	15	0.6	15	0.4
79	0	0.0	19	0.8	19	0.5
80	0	0.0	15	0.6	15	0.4
Total	1330	100.0	2514	100.0	3844	100.0

Table 2: Individual Sample Allocation

	Period of study					
	2011		2015		Total	
	No.	%	No.	%	No.	%
(mean) rgrappe						
26	599	4.4	1323	4.4	1922	4.4
27	683	5.0	1137	3.8	1820	4.2
28	455	3.4	1343	4.5	1798	4.1
29	445	3.3	1858	6.2	2303	5.3
30	568	4.2	1216	4.1	1784	4.1

31	286	2.1	928	3.1	1214	2.8
32	415	3.1	820	2.7	1235	2.8
33	247	1.8	526	1.8	773	1.8
34	281	2.1	652	2.2	933	2.1
35	326	2.4	574	1.9	900	2.1
36	462	3.4	544	1.8	1006	2.3
37	243	1.8	1154	3.8	1397	3.2
38	327	2.4	1686	5.6	2013	4.6
39	286	2.1	540	1.8	826	1.9
40	336	2.5	1302	4.3	1638	3.8
41	334	2.5	593	2.0	927	2.1
42	293	2.2	726	2.4	1019	2.3
43	370	2.7	1431	4.8	1801	4.1
44	383	2.8	695	2.3	1078	2.5
45	392	2.9	577	1.9	969	2.2
46	354	2.6	530	1.8	884	2.0
47	484	3.6	754	2.5	1238	2.8
48	401	3.0	741	2.5	1142	2.6
63	202	1.5	470	1.6	672	1.5
64	218	1.6	612	2.0	830	1.9
65	523	3.9	628	2.1	1151	2.6
66	336	2.5	531	1.8	867	2.0
67	368	2.7	432	1.4	800	1.8
68	252	1.9	403	1.3	655	1.5
69	223	1.6	297	1.0	520	1.2
70	278	2.0	337	1.1	615	1.4
71	205	1.5	397	1.3	602	1.4
72	230	1.7	340	1.1	570	1.3
73	249	1.8	351	1.2	600	1.4
74	201	1.5	339	1.1	540	1.2
75	1311	9.7	2337	7.8	3648	8.4
76	0	0.0	221	0.7	221	0.5
77	0	0.0	92	0.3	92	0.2
78	0	0.0	153	0.5	153	0.4
79	0	0.0	183	0.6	183	0.4
80	0	0.0	204	0.7	204	0.5
Total	13566	100.0	29977	100.0	43543	100.0
Strate						
Bakel	3979	29.3	10024	33.4	14003	32.2
Matam	4991	36.8	11939	39.8	16930	38.9
Kédougou	4596	33.9	8014	26.7	12610	29.0
Total	13566	100.0	29977	100.0	43543	100.0

The tables below, 3 and 4, give the sample allocation by project intensity and year.

Table 3: Household Sample Allocation

Household sample allocation						
	Period of study					
Project intensity	2011		2015		Total	
	No.	%	No.	%	No.	%
A	60	4.5	139	5.5	199	5.2
AB	61	4.6	113	4.5	174	4.5
ABC	408	30.7	857	34.1	1265	32.9
AC	131	9.8	283	11.3	414	10.8
BorC	20	1.5	102	4.1	122	3.2
FALSE	650	48.9	1020	40.6	1670	43.4
Total	1330	100.0	2514	100.0	3844	100.0

Table 4: Household Sample Allocation

Individual sample allocation						
	Period of study					
Project intensity	2011		2015		Total	
	No.	%	No.	%	No.	%
A	546	4.0	1747	5.8	2293	5.3
AB	729	5.4	1473	4.9	2202	5.1
ABC	4719	34.8	11349	37.9	16068	36.9
AC	1533	11.3	3965	13.2	5498	12.6
BorC	206	1.5	1136	3.8	1342	3.1
FALSE	5833	43.0	10307	34.4	16140	37.1
Total	13566	100.0	29977	100.0	43543	100.0

Table 5 characterizes the divergence between *ex ante* (2011) and *ex post* (2015) sample allocation. The variable *cod.zone* describes the breakdown of intended project exposure in 2011. The variable *Project intensity* gives the actual sample project exposure as of 2015. The table reports frequency by municipality, not by household or village. 11% of municipalities in the baseline sample did not ultimately participate in Yaajeende, and were reassigned to the comparison group.

Table 5: Ex Ante vs. Ex Post Project Exposure

Project intensity	cod.zone Zone projet No.	%	Zone contr□le No.	%	Total No.	%
A	6	7.8	0	0.0	6	4.5
AB	6	7.8	0	0.0	6	4.5
ABC	41	53.2	0	0.0	41	30.8
AC	13	16.9	0	0.0	13	9.8
BorC	2	2.6	0	0.0	2	1.5
FALSE	9	11.7	56	100.0	65	48.9
Total	77	100.0	56	100.0	133	100.0

Sample size and summary statistics by period and project intensity

The following tables give the sample size, sample means, and sample standard deviation for all key indicators. Reported means are raw sample means and not population estimates.

	N IND 1-1	Mean IND 1-1	Sd IND 1-1
Period of study			
2011	1,513	0.12	0.33
2015	4,877	0.16	0.36
Total	6,390	0.15	0.36
Project intensity			
A	369	0.22	0.41
AB	277	0.23	0.42
ABC	2,359	0.16	0.36
AC	793	0.15	0.35
BorC	223	0.17	0.38
FALSE	2,369	0.12	0.32
Total	6,390	0.15	0.36

	N IND 1-2	Mean IND 1-2	Sd IND 1-2
Period of study			
2011	1,511	0.25	0.43
2015	4,887	0.20	0.40
Total	6,398	0.21	0.41
Project intensity			
A	370	0.19	0.39
AB	277	0.16	0.37
ABC	2,363	0.16	0.37
AC	794	0.15	0.36
BorC	224	0.29	0.46
FALSE	2,370	0.27	0.44
Total	6,398	0.21	0.41

	N IND 1-3	Mean IND 1-3	Sd IND 1-3
Period of study			
2011	1,511	0.23	0.42
2015	4,882	0.22	0.41
Total	6,393	0.22	0.42
Project intensity			
A	369	0.25	0.43
AB	277	0.26	0.44
ABC	2,362	0.20	0.40
AC	794	0.20	0.40
BorC	224	0.29	0.46
FALSE	2,367	0.23	0.42
Total	6,393	0.22	0.42

	N IND 1-4	Mean IND 1-4	Sd IND 1-4
Period of study			
2011	1,283	0.23	0.42
2015	5,180	0.24	0.43
Total	6,463	0.24	0.43
Project intensity			
A	380	0.30	0.46
AB	367	0.35	0.48
ABC	2,645	0.26	0.44
AC	817	0.26	0.44
BorC	193	0.19	0.39
FALSE	2,061	0.17	0.38
Total	6,463	0.24	0.43

	N IND 1-5	Mean IND 1-5	Sd IND 1-5
Period of study			
2011	472	0.11	0.31
2015	1,156	0.07	0.25
Total	1,628	0.08	0.27
Project intensity			
A	74	0.11	0.31
AB	62	0.10	0.30
ABC	627	0.08	0.27
AC	227	0.09	0.28
BorC	62	0.05	0.22
FALSE	576	0.07	0.26
Total	1,628	0.08	0.27

	N IND 1-6	Mean IND 1-6	Sd IND 1-6
Period of study			
2011	1,330	2.44	1.27
2015	2,514	3.63	2.21
Total	3,844	3.22	2.01
Project intensity			
A	199	3.35	2.80
AB	174	3.61	2.39
ABC	1,265	3.38	2.12
AC	414	3.64	2.13
BorC	122	2.90	2.01
FALSE	1,670	2.96	1.69
Total	3,844	3.22	2.01

	N IND 1-7	Mean IND 1-7	Sd IND 1-7
Period of study			
2011	1,330	0.01	0.12
2015	2,514	0.06	0.24
Total	3,844	0.05	0.21
Project intensity			
A	199	0.06	0.23
AB	174	0.04	0.20
ABC	1,265	0.04	0.21
AC	414	0.04	0.20
BorC	122	0.02	0.16
FALSE	1,670	0.05	0.22
Total	3,844	0.05	0.21

	N IND 2-1	Mean IND 2-1	Sd IND 2-1
Period of study			
2011	1,320	0.85	0.36
2015	2,467	0.86	0.35
Total	3,787	0.85	0.35
Project intensity			
A	192	0.89	0.32
AB	173	0.85	0.36
ABC	1,250	0.88	0.33
AC	413	0.85	0.36
BorC	120	0.79	0.41
FALSE	1,639	0.84	0.37
Total	3,787	0.85	0.35

	N IND 2-2	Mean IND 2-2	Sd IND 2-2
Period of study			
2011	1,313	0.62	0.49
2015	2,450	0.60	0.49
Total	3,763	0.61	0.49
Project intensity			
A	191	0.64	0.48
AB	170	0.68	0.47
ABC	1,243	0.65	0.48
AC	413	0.62	0.49
BorC	116	0.46	0.50
FALSE	1,630	0.57	0.50
Total	3,763	0.61	0.49

	N IND 2-3	Mean IND 2-3	Sd IND 2-3
Period of study			
2011	1,330	0.09	0.28
2015	2,453	0.28	0.45
Total	3,783	0.21	0.41
Project intensity			
A	195	0.18	0.38
AB	174	0.10	0.31
ABC	1,244	0.18	0.39
AC	413	0.22	0.42
BorC	117	0.24	0.43
FALSE	1,640	0.25	0.43
Total	3,783	0.21	0.41

	N IND 2-4	Mean IND 2-4	Sd IND 2-4
Period of study			
2011	1,326	0.85	0.35
2015	2,480	0.65	0.48
Total	3,806	0.72	0.45
Project intensity			
A	196	0.64	0.48
AB	173	0.73	0.45
ABC	1,251	0.72	0.45
AC	413	0.70	0.46
BorC	120	0.58	0.50
FALSE	1,653	0.75	0.43
Total	3,806	0.72	0.45

	N IND 2-5	Mean IND 2-5	Sd IND 2-5
Period of study			
2011	1,260	0.18	0.39
2015	2,378	0.17	0.38
Total	3,638	0.18	0.38
Project intensity			
A	185	0.22	0.41
AB	167	0.23	0.42
ABC	1,199	0.20	0.40
AC	401	0.21	0.41
BorC	119	0.09	0.29
FALSE	1,567	0.14	0.35
Total	3,638	0.18	0.38

	N IND 2-6	Mean IND 2-6	Sd IND 2-6
Period of study			
2011	931	0.02	0.13
2015	2,165	0.24	0.43
Total	3,096	0.17	0.38
Project intensity			
A	144	0.16	0.37
AB	121	0.15	0.36
ABC	1,154	0.20	0.40
AC	413	0.18	0.39
BorC	114	0.15	0.36
FALSE	1,150	0.15	0.36
Total	3,096	0.17	0.38

	N IND 2-7	Mean IND 2-7	Sd IND 2-7
Period of study			
2011	1,328	6.60	1.91
2015	2,483	5.95	2.20
Total	3,811	6.18	2.13
Project intensity			
A	198	7.25	1.85
AB	174	7.66	1.67
ABC	1,250	6.94	2.05
AC	412	6.29	1.98
BorC	121	5.48	1.95
FALSE	1,656	5.34	1.94
Total	3,811	6.18	2.13

	N IND 2-8	Mean IND 2-8	Sd IND 2-8
Period of study			
2011	1,330	0.04	0.18
2015	2,514	0.13	0.33
Total	3,844	0.10	0.29
Project intensity			
A	199	0.09	0.29
AB	174	0.11	0.31
ABC	1,265	0.09	0.29
AC	414	0.08	0.27
BorC	122	0.07	0.26
FALSE	1,670	0.10	0.31
Total	3,844	0.10	0.29

	N IND 2-9	Mean IND 2-9	Sd IND 2-9
Period of study			
2011	1,330	0.70	0.46
2015	2,460	0.78	0.41
Total	3,790	0.76	0.43
Project intensity			
A	195	0.74	0.44
AB	174	0.83	0.38
ABC	1,246	0.84	0.37
AC	413	0.76	0.43
BorC	117	0.89	0.32
FALSE	1,645	0.68	0.47
Total	3,790	0.76	0.43

	N IND 2-10	Mean IND 2-10	Sd IND 2-10
Period of study			
2011	1,330	0.67	0.47
2015	2,460	0.78	0.41
Total	3,790	0.74	0.44
Project intensity			
A	195	0.73	0.44
AB	174	0.83	0.38
ABC	1,246	0.82	0.38
AC	413	0.75	0.43
BorC	117	0.89	0.32
FALSE	1,645	0.66	0.47
Total	3,790	0.74	0.44

	N IND 3-1	Mean IND 3-1	Sd IND 3-1
Period of study			
2011	1,323	36.42	6.88
2015	2,514	35.00	9.18
Total	3,837	35.49	8.49
Project intensity			
A	199	32.38	11.92
AB	174	31.45	10.97
ABC	1,261	32.87	10.75
AC	413	37.20	6.42
BorC	122	37.72	4.32
FALSE	1,668	37.68	4.84
Total	3,837	35.49	8.49

	N IND 3-2	Mean IND 3-2	Sd IND 3-2
Period of study			
2011	1,251	2.07	1.88
2015	2,492	3.40	6.07
Total	3,743	2.95	5.11
Project intensity			
A	187	2.12	3.12
AB	164	1.95	2.25
ABC	1,220	2.43	4.63
AC	407	2.67	2.27
BorC	121	4.60	10.60
FALSE	1,644	3.49	5.62
Total	3,743	2.95	5.11

	N IND 3-3	Mean IND 3-3	Sd IND 3-3
Period of study			
2011	1,330	0.03	0.16
2015	2,514	0.23	2.49
Total	3,844	0.16	2.02
Project intensity			
A	199	0.15	0.49
AB	174	0.21	0.77
ABC	1,265	0.21	1.54
AC	414	0.36	5.41
BorC	122	0.16	0.70
FALSE	1,670	0.07	0.45
Total	3,844	0.16	2.02

	N IND 3-4	Mean IND 3-4	Sd IND 3-4
Period of study			
2011	8	1.93	1.30
2015	2,514	0.05	0.47
Total	2,522	0.06	0.48
Project intensity			
A	139	0.03	0.30
AB	113	0.01	0.07
ABC	865	0.12	0.62
AC	283	0.03	0.48
BorC	102	0.16	1.00
FALSE	1,020	0.01	0.26
Total	2,522	0.06	0.48

	N IND 3-5	Mean IND 3-5	Sd IND 3-5
Period of study			
2011	16	1.19	0.82
2015	2,514	0.12	1.92
Total	2,530	0.12	1.92
Project intensity			
A	139	0.15	0.80
AB	114	0.12	0.53
ABC	867	0.15	0.99
AC	284	0.04	0.32
BorC	102	0.01	0.10
FALSE	1,024	0.13	2.85
Total	2,530	0.12	1.92

	N IND 3-6	Mean IND 3-6	Sd IND 3-6
Period of study			
2011	1,330	1,342.35	1,676.28
2015	2,500	869.73	1,327.37
Total	3,830	1,033.85	1,475.07
Project intensity			
A	199	613.67	962.15
AB	174	485.98	809.66
ABC	1,263	910.86	1,342.27
AC	410	944.74	1,038.07
BorC	122	836.13	1,052.00
FALSE	1,662	1,271.48	1,731.16
Total	3,830	1,033.85	1,475.07

	N IND 3-7	Mean IND 3-7	Sd IND 3-7
Period of study			
2011	1,330	36,152.54	111,648.14
2015	2,512	19,447.06	72,002.90
Total	3,842	25,230.06	88,121.86
Project intensity			
A	199	6,115.95	32,184.24
AB	173	15,648.12	85,508.39
ABC	1,264	17,270.30	67,822.54
AC	414	13,908.17	62,213.85
BorC	122	16,794.26	56,953.67
FALSE	1,670	37,947.99	109,640.73
Total	3,842	25,230.06	88,121.86

	N IND 3-8	Mean IND 3-8	Sd IND 3-8
Period of study			
2011	1,330	0.51	0.50
2015	2,504	0.05	0.22
Total	3,834	0.21	0.41
Project intensity			
A	198	0.21	0.41
AB	174	0.11	0.32
ABC	1,262	0.19	0.39
AC	412	0.21	0.41
BorC	122	0.19	0.39
FALSE	1,666	0.23	0.42
Total	3,834	0.21	0.41

	N IND 3-9	Mean IND 3-9	Sd IND 3-9
Period of study			
2011	1,330	0.07	0.26
2015	2,428	0.24	0.43
Total	3,758	0.18	0.39
Project intensity			
A	190	0.14	0.34
AB	165	0.12	0.32
ABC	1,239	0.17	0.37
AC	412	0.13	0.34
BorC	120	0.23	0.42
FALSE	1,632	0.22	0.41
Total	3,758	0.18	0.39

	N IND 3-10	Mean IND 3-10	Sd IND 3-10
Period of study			
2011	0		
2015	2,259	0.80	2.01
Total	2,259	0.80	2.01
Project intensity			
A	122	0.80	1.97
AB	89	1.00	2.02
ABC	721	0.84	1.93
AC	266	0.75	2.12
BorC	95	0.48	1.41
FALSE	966	0.80	2.08
Total	2,259	0.80	2.01

	N IND 3-11	Mean IND 3-11	Sd IND 3-11
Period of study			
2011	0		
2015	2,259	0.36	0.48
Total	2,259	0.36	0.48
Project intensity			
A	122	0.40	0.49
AB	89	0.38	0.49
ABC	721	0.40	0.49
AC	266	0.41	0.49
BorC	95	0.37	0.48
FALSE	966	0.31	0.46
Total	2,259	0.36	0.48

	N IND 3-12	Mean IND 3-12	Sd IND 3-12
Period of study			
2011	0		
2015	2,261	0.11	0.32
Total	2,261	0.11	0.32
Project intensity			
A	122	0.18	0.39
AB	90	0.19	0.39
ABC	722	0.18	0.38
AC	266	0.11	0.31
BorC	95	0.07	0.26
FALSE	966	0.05	0.22
Total	2,261	0.11	0.32

	N IND 3-13	Mean IND 3-13	Sd IND 3-13
Period of study			
2011	0		
2015	2,261	0.20	0.40
Total	2,261	0.20	0.40
Project intensity			
A	122	0.10	0.30
AB	89	0.07	0.25
ABC	722	0.21	0.41
AC	267	0.16	0.36
BorC	95	0.14	0.35
FALSE	966	0.24	0.43
Total	2,261	0.20	0.40

	N IND 3-14	Mean IND 3-14	Sd IND 3-14
Period of study			
2011	530	0.18	0.69
2015	2,514	0.23	0.92
Total	3,044	0.22	0.88
Project intensity			
A	159	0.15	0.52
AB	136	0.11	0.58
ABC	1,011	0.23	0.90
AC	332	0.27	0.87
BorC	109	0.22	0.82
FALSE	1,297	0.22	0.94
Total	3,044	0.22	0.88

ANNEX IV: KIIS AND FGDS IMPLEMENTED FOR THE MID-TERM IMPACT EVALUATION

What / who	Region	Date	Duration	Language
KII Veterinarian	Kédougou	20 May 2015	01:05:48	Français
FG MTM	Kédougou	21 May 2015	03:09:51	Pulaar
FG Male Head of HH	Kédougou	21 May 2015	01:09:36	Pulaar
KII CBSP/CNV	Kédougou	24 May 2015	00:37:33	Wolof
FG Male Head of HH	Kédougou	22 May 2015	01:14:25	Mandingue
KII CBSP Tractor	Kédougou	22 May 2015	01:51:47	Mandingue
KII CNV	Kédougou	24 May 2015	01:13:01	Mandingue
KII CNV	Kédougou	22 May 2015	00:34:35	Mandingue
FG MTM	Kédougou	22 May 2015	02:19:41	Pulaar
KII Large Producer	Kédougou	22 May 2015	01:16:35	Pulaar
KII CBSP	Kédougou	23 May 2015	02:07:34	Pulaar
KII CWG	Kédougou	23 May 2015	00:30:00	Pulaar
KII Grafting	Kédougou	23 May 2015	00:10:00	Français
KII CNV	Kédougou	23 May 2015	00:52:06	Français
FG MTM	Kédougou	25 May 2015	01:23	Mandingue
KII Large Producer	Kédougou	23 May 2015	01:11:16	Pulaar
KII Emerging Producer	Kédougou	24 May 2015	00:45:23	Français
KII Regional Coordinator	Kédougou	25 May 2015	01:53:58	Français
KII Nutrition Supervisor	Kédougou	26 May 2015	00:48:51	Français
KII Husbandry Supervisor	Kédougou	26 May 2015	01:52:28	Français
KII Governance Supervisor	Kédougou	26 May 2015	02:00:31	Français
KII M&E Supervisor	Kédougou	26 May 2015	00:52:18	Français
KII CWG	Bakel	29 May 2015	01:11:39	Pulaar
KII CBSP/CNV	Bakel	29 May 2015	00:43:30	Pulaar
FG MTM	Bakel	29 May 2015	02:30:39	Pulaar
KII Large Producer	Bakel	30 May 2015	01:20:22	Pulaar
FG Male Head of HH	Bakel	30 May 2015	01:24:46	Pulaar
KII Large Producer	Bakel	31 May 2015	01:47:11	Pulaar
KII CBSP Inputs	Bakel	31 May 2015	01:05:40	Pulaar
FG MTM	Bakel	31 May 2015	02:52:13	Soninké
FG Male Head of HH	Bakel	29 May 2015	01:11:45	Soninké
KII Emerging Breeder	Bakel	29 May 2015	01:10:12	Wolof
KII Large Producer	Bakel	29 May 2015	00:54:52	Soninké
KII CNV	Bakel	29 May 2015	01:19:35	Soninké
KII CBSP compost/nursery	Bakel	30 May 2015	01:27:11	Soninké
KII Large Producer	Bakel	31 May 2015	02:33:48	Bambara
KII CBSP compost/nursery	Bakel	1 June 2015	01:47:05	Pulaar
KII CNV	Bakel	1 June 2015	00:47:45	Pulaar

KII Veterinarian	Bakel	3 June 2015	01:08:33	Français
KII Regional Coordinator	Bakel	2 June 2015	03:17:05	Français
KII Nutrition Supervisor	Bakel	1 June 2015	01:46:20	Français
KII Lead Program Manager	Bakel	1 June 2015	03:10:59	Français
KII Access/BDL Supervisor	Bakel	1 June 2015	02:04:50	Français
KII M&E Supervisor	Bakel	2 June 2015	01:16:42	Français
KII Large Producer	Matam	4 June 2015	01:39:40	Français
KII Veterinarian	Matam	5 June 2015	00:57:42	Français
KII Regional Coordinator	Matam	6 June 2015	01:32:06	Français
KII Food Security Supervisor	Matam	5 June 2015	02:48:34	Français
KII Nutrition Supervisor	Matam	5 June 2015	01:36:33	Français
KII Lead Program Manager	Matam	6 June 2015	03:21:01	Français
KII Husbandry Supervisor	Matam	10 June 2015	01:55:57	Français
FG MTM	Matam	10 June 2015	02:50:20	Pulaar
FG MTM	Matam	6 June 2015	03:27:26	Pulaar
KII Large Producer	Matam	6 June 2015	01:09:59	Pulaar
KII CBSP	Matam	5 June 2015	01:13:43	Wolof
FG Male Head of HH	Matam	7 June 2015	01:01:06	Pulaar
KII CBSP Husbandry	Matam	7 June 2015	02:11:00	Pulaar
KII CNV	Matam	7 June 2015	01:22:33	Pulaar
KII CWG	Matam	8 June 2015	01:23:28	Pulaar
KII CWG Asst Coordinator	Matam	8 June 2015	02:17:39	Pulaar
FG Male Head of HH	Matam	7 June 2015	02:32:24	Pulaar
KII CNV	Matam	8 June 2015	01:02:24	Pulaar
FG MTM	Matam	9 June 2015	03:13:06	Pulaar
KII Emerging Breeder	Matam	9 June 2015	00:49:25	Pulaar
KII CBSP/CNV	Matam	9 June 2015	02:16:56	Pulaar
KII Large Producer	Matam	4 June 2015	01:39:00	Pulaar
KII M&E Director	Dakar	29 June 2015	01:00:00	Français
KII Chief of Party	Dakar	29 June 2015	01:15:00	Français

Annex V: Detailed Statistical Results

This appendix details complete statistical results from the Yaajeende Midterm Impact Evaluation. For each indicator, five models (below) are estimated. All five models are first presented with the baseline villages only, using ordinary least squares (OLS). Next, the same OLS models are presented with the full cohort of all midterm villages, including those not sampled at baseline. Third, if appropriate, nonlinear models are used, specifically logistic models for binary indicators and Poisson models for count and duration indicators. In the following section, selected coefficient plots present the same results graphically.

- Model 1. Treatment effect of Yaajeende project.
- Model 2. Treatment effect of Nutrition package (A).
- Model 3. Treatment effect of Agriculture package (B).
- Model 4. Treatment effect of High-Intensity (ABC) Yaajeende project.
- Model 5. Tests for synergy between Nutrition (A) and Agriculture (B).

For a number of variables no data was available in the baseline survey. As a result, these models are estimated without difference in difference (DD) or treatment effects. Instead, project and comparison groups are compared on the basis of their *ex post* differences, which differs crucially from the counterfactual framework of the other results.

Regression Results

Indicator 1.1

Treatment Effect of Yaajeende on Wasting, Ages 6-59 Months
Linear difference-in-difference regression with survey weights

VARIABLES	(1) Wasting 6-59mo	(2) Wasting 6-59mo	(3) Wasting 6-59mo	(4) Wasting 6-59mo	(5) Wasting 6-59mo
Secular trend	0.025*	0.025*	0.025	0.025	0.027*
	(0.095)	(0.095)	(0.116)	(0.124)	(0.063)
Project (A or B) tr. eff.	-0.006				
	(0.815)				
Project ex ante	0.050*				
	(0.053)				
Nutrition (A) tr. eff.		-0.008			0.020
		(0.761)			(0.631)
Nutrition ex ante		0.052**			0.057*
		(0.043)			(0.092)
Agriculture (B) tr. eff.			-0.015		0.045
			(0.593)		(0.420)
Agriculture ex ante			0.051		-0.012
			(0.117)		(0.779)
Synergy (ABC) tr. eff.				-0.023	-0.091
				(0.456)	(0.107)
High intensity (A and B)				0.053	0.012
				(0.129)	(0.803)
Observations	5,476	5,392	4,631	4,302	5,476
R-squared	0.004	0.004	0.003	0.003	0.007
F-test synergy					2.641

pval in parentheses
*** $p<0.01$, ** $p<0.05$, * $p<0.1$
Baseline villages cross-section sample

Treatment Effect of Yaajeende on Wasting, Ages 6-59 Months
Linear difference-in-difference regression with survey weights

VARIABLES	(1) Wasting 6-59mo	(2) Wasting 6-59mo	(3) Wasting 6-59mo	(4) Wasting 6-59mo	(5) Wasting 6-59mo
Secular trend	0.025	0.025	0.025	0.025	0.026*
	(0.109)	(0.105)	(0.133)	(0.136)	(0.086)
Project (A or B) tr. eff.	-0.010				
	(0.705)				
Project ex ante	0.050*				
	(0.069)				
Nutrition (A) tr. eff.		-0.012			-0.000
		(0.656)			(0.995)
Nutrition ex ante		0.052*			0.057
		(0.054)			(0.109)
Agriculture (B) tr. eff.			-0.015		0.056
			(0.625)		(0.298)
Agriculture ex ante			0.051		-0.012
			(0.127)		(0.791)
Synergy (ABC) tr. eff.				-0.022	-0.079
				(0.505)	(0.160)
High intensity (A and B)				0.053	0.012
				(0.133)	(0.813)
Observations	6,370	6,147	5,208	4,708	6,370
R-squared	0.003	0.003	0.003	0.003	0.005
F-test synergy					1.996

pval in parentheses
*** p<0.01, ** p<0.05, * p<0.1
Full cross-section sample

Treatment Effect of Yaajeende on Wasting, Ages 6-59 Months
Logistic difference-in-difference regression with survey weights

VARIABLES	(1) Wasting 6-59mo	(2) Wasting 6-59mo	(3) Wasting 6-59mo	(4) Wasting 6-59mo	(5) Wasting 6-59mo
Secular trend	1.272*	1.272*	1.272	1.272	1.318*
	(0.095)	(0.095)	(0.116)	(0.123)	(0.059)
Project (A or B) tr. eff.	0.902				
	(0.625)				
Project ex ante	1.568**				
	(0.043)				
Nutrition (A) tr. eff.		0.889			1.041
		(0.577)			(0.899)
Nutrition ex ante		1.601**			1.693*
		(0.035)			(0.065)
Agriculture (B) tr. eff.			0.843		1.367
			(0.474)		(0.462)
Agriculture ex ante			1.579*		0.899
			(0.092)		(0.784)
Synergy (ABC) tr. eff.				0.794	0.539
				(0.367)	(0.142)
High intensity (A and B)				1.610*	1.109
				(0.098)	(0.799)
Observations	5,476	5,392	4,631	4,302	5,476

Results presented as odds ratios
P-values in parentheses
*** $p<0.01$, ** $p<0.05$, * $p<0.10$
Baseline villages cross-section sample

Treatment Effect of Yaajeende on Wasting, Ages 6-59 Months
Logistic difference-in-difference regression with survey weights

VARIABLES	(1) Wasting 6-59mo	(2) Wasting 6-59mo	(3) Wasting 6-59mo	(4) Wasting 6-59mo	(5) Wasting 6-59mo
Secular trend	1.273	1.273	1.273	1.273	1.308*
	(0.111)	(0.107)	(0.135)	(0.138)	(0.081)
Project (A or B) tr. eff.	0.875				
	(0.554)				
Project ex ante	1.568*				
	(0.057)				
Nutrition (A) tr. eff.		0.863			0.913
		(0.508)			(0.780)
Nutrition ex ante		1.601**			1.693*
		(0.044)			(0.080)
Agriculture (B) tr. eff.			0.845		1.495
			(0.509)		(0.352)
Agriculture ex ante			1.579		0.899
			(0.102)		(0.796)
Synergy (ABC) tr. eff.				0.802	0.571
				(0.412)	(0.199)
High intensity (A and B)				1.610	1.109
				(0.104)	(0.810)
Observations	6,370	6,147	5,208	4,708	6,370

Results presented as odds ratios
P-values in parentheses
*** $p<0.01$, ** $p<0.05$, * $p<0.10$
Full cross-section sample

Indicator 1.2

Treatment Effect of Yaajeende on Stunting, Ages 6-59 Months
Linear difference-in-difference regression with survey weights

VARIABLES	(1) Stunting 6-59mo	(2) Stunting 6-59mo	(3) Stunting 6-59mo	(4) Stunting 6-59mo	(5) Stunting 6-59mo
Secular trend	-0.025	-0.025	-0.025	-0.025	-0.027
	(0.535)	(0.535)	(0.559)	(0.567)	(0.499)
Project (A or B) tr. eff.	-0.043				
	(0.367)				
Project ex ante	-0.092***				
	(0.009)				
Nutrition (A) tr. eff.		-0.043			-0.038
		(0.373)			(0.364)
Nutrition ex ante		-0.094***			-0.100***
		(0.008)			(0.004)
Agriculture (B) tr. eff.			-0.044		-0.019
			(0.418)		(0.594)
Agriculture ex ante			-0.090**		0.008
			(0.019)		(0.855)
Synergy (ABC) tr. eff.				-0.043	0.016
				(0.403)	(0.697)
High intensity (A and B)				-0.092**	-0.000
				(0.011)	(0.997)
Observations	5,483	5,398	4,637	4,307	5,483
R-squared	0.023	0.024	0.023	0.024	0.023
F-test synergy					0.152

pval in parentheses
*** $p<0.01$, ** $p<0.05$, * $p<0.1$
Baseline villages cross-section sample

Treatment Effect of Yaajeende on Stunting, Ages 6-59 Months
Linear difference-in-difference regression with survey weights

VARIABLES	(1) Stunting 6-59mo	(2) Stunting 6-59mo	(3) Stunting 6-59mo	(4) Stunting 6-59mo	(5) Stunting 6-59mo
Secular trend	-0.027	-0.027	-0.027	-0.027	-0.027
	(0.537)	(0.532)	(0.562)	(0.566)	(0.518)
Project (A or B) tr. eff.	-0.041				
	(0.412)				
Project ex ante	-0.092**				
	(0.014)				
Nutrition (A) tr. eff.		-0.042			-0.033
		(0.396)			(0.480)
Nutrition ex ante		-0.094**			-0.100***
		(0.012)			(0.007)
Agriculture (B) tr. eff.			-0.043		-0.016
			(0.444)		(0.702)
Agriculture ex ante			-0.090**		0.008
			(0.028)		(0.864)
Synergy (ABC) tr. eff.				-0.045	0.004
				(0.401)	(0.923)
High intensity (A and B)				-0.092**	-0.000
				(0.016)	(0.997)
Observations	6,380	6,156	5,216	4,715	6,380
R-squared	0.022	0.024	0.023	0.025	0.024
F-test synergy					0.00936

pval in parentheses
*** $p<0.01$, ** $p<0.05$, * $p<0.1$
Full cross-section sample

Treatment Effect of Yaajeende on Stunting, Ages 6-59 Months
Logistic difference-in-difference regression with survey weights

VARIABLES	(1) Stunting 6-59mo	(2) Stunting 6-59mo	(3) Stunting 6-59mo	(4) Stunting 6-59mo	(5) Stunting 6-59mo
Secular trend	0.887	0.887	0.887	0.887	0.882
	(0.533)	(0.533)	(0.557)	(0.565)	(0.502)
Project (A or B) tr. eff.	0.720				
	(0.195)				
Project ex ante	0.627***				
	(0.008)				
Nutrition (A) tr. eff.		0.719			0.731
		(0.198)			(0.139)
Nutrition ex ante		0.620***			0.599***
		(0.007)			(0.004)
Agriculture (B) tr. eff.			0.722		0.887
			(0.262)		(0.531)
Agriculture ex ante			0.634**		1.043
			(0.017)		(0.854)
Synergy (ABC) tr. eff.				0.723	1.121
				(0.235)	(0.650)
High intensity (A and B)				0.626***	1.001
				(0.008)	(0.996)
Observations	5,483	5,398	4,637	4,307	5,483

Results presented as odds ratios
P-values in parentheses
*** $p<0.01$, ** $p<0.05$, * $p<0.10$
Baseline villages cross-section sample

Treatment Effect of Yaajeende on Stunting, Ages 6-59 Months
Logistic difference-in-difference regression with survey weights

VARIABLES	(1) Stunting 6-59mo	(2) Stunting 6-59mo	(3) Stunting 6-59mo	(4) Stunting 6-59mo	(5) Stunting 6-59mo
Secular trend	0.882	0.882	0.882	0.882	0.881
	(0.535)	(0.530)	(0.560)	(0.563)	(0.520)
Project (A or B) tr. eff.	0.729				
	(0.228)				
Project ex ante	0.627**				
	(0.012)				
Nutrition (A) tr. eff.		0.720			0.762
		(0.210)			(0.270)
Nutrition ex ante		0.620***			0.599***
		(0.010)			(0.007)
Agriculture (B) tr. eff.			0.721		0.911
			(0.280)		(0.677)
Agriculture ex ante			0.634**		1.043
			(0.025)		(0.864)
Synergy (ABC) tr. eff.				0.709	1.023
				(0.226)	(0.934)
High intensity (A and B)				0.626**	1.001
				(0.012)	(0.997)
Observations	6,380	6,156	5,216	4,715	6,380

Results presented as odds ratios
P-values in parentheses
*** p<0.01, ** p<0.05, * p<0.10
Full cross-section sample

Indicator 1.3

Treatment Effect of Yaajeende on Underweight, Ages 6-59 Months
Linear difference-in-difference regression with survey weights

VARIABLES	(1) Underweight 6-59mo	(2) Underweight 6-59mo	(3) Underweight 6-59mo	(4) Underweight 6-59mo	(5) Underweight 6-59mo
Secular trend	-0.036	-0.036	-0.036	-0.036	-0.037
	(0.242)	(0.242)	(0.271)	(0.281)	(0.211)
Project (A or B) tr. eff.	0.007				
	(0.875)				
Project ex ante	-0.032				
	(0.434)				
Nutrition (A) tr. eff.		0.006			0.039
		(0.880)			(0.437)
Nutrition ex ante		-0.032			-0.033
		(0.438)			(0.488)
Agriculture (B) tr. eff.			-0.001		0.065
			(0.980)		(0.191)
Agriculture ex ante			-0.032		-0.026
			(0.516)		(0.548)
Synergy (ABC) tr. eff.				-0.011	-0.113**
				(0.825)	(0.024)
High intensity (A and B)				-0.029	0.030
				(0.579)	(0.562)
Observations	5,480	5,395	4,634	4,304	5,480
R-squared	0.002	0.002	0.003	0.004	0.004
F-test synergy					5.290

pval in parentheses
*** $p<0.01$, ** $p<0.05$, * $p<0.1$
Baseline villages cross-section sample

Treatment Effect of Yaajeende on Underweight, Ages 6-59 Months
Linear difference-in-difference regression with survey weights

VARIABLES	(1) Underweight 6-59mo	(2) Underweight 6-59mo	(3) Underweight 6-59mo	(4) Underweight 6-59mo	(5) Underweight 6-59mo
Secular trend	-0.031	-0.031	-0.031	-0.031	-0.033
	(0.331)	(0.326)	(0.362)	(0.366)	(0.290)
Project (A or B) tr. eff.	0.005				
	(0.919)				
Project ex ante	-0.032				
	(0.463)				
Nutrition (A) tr. eff.		0.004			0.034
		(0.928)			(0.519)
Nutrition ex ante		-0.032			-0.033
		(0.462)			(0.513)
Agriculture (B) tr. eff.			-0.004		0.061
			(0.935)		(0.242)
Agriculture ex ante			-0.032		-0.026
			(0.538)		(0.573)
Synergy (ABC) tr. eff.				-0.013	-0.107**
				(0.795)	(0.047)
High intensity (A and B)				-0.029	0.030
				(0.595)	(0.586)
Observations	6,375	6,151	5,212	4,711	6,375
R-squared	0.002	0.002	0.003	0.004	0.004
F-test synergy					4.016

pval in parentheses
*** $p<0.01$, ** $p<0.05$, * $p<0.1$
Full cross-section sample

Treatment Effect of Yaajeende on Underweight, Ages 6-59 Months
Logistic difference-in-difference regression with survey weights

	(1)	(2)	(3)	(4)	(5)
VARIABLES	Underweight 6-59mo	Underweight 6-59mo	Underweight 6-59mo	Underweight 6-59mo	Underweight 6-59mo
Secular trend	0.825	0.825	0.825	0.825	0.818
	(0.233)	(0.233)	(0.263)	(0.272)	(0.202)
Project (A or B) tr. eff.	1.022				
	(0.925)				
Project ex ante	0.842				
	(0.439)				
Nutrition (A) tr. eff.		1.020			1.234
		(0.930)			(0.445)
Nutrition ex ante		0.842			0.838
		(0.444)			(0.497)
Agriculture (B) tr. eff.			0.974		1.430
			(0.914)		(0.199)
Agriculture ex ante			0.844		0.860
			(0.523)		(0.548)
Synergy (ABC) tr. eff.				0.917	0.525**
				(0.739)	(0.021)
High intensity (A and B)				0.854	1.187
				(0.587)	(0.561)
Observations	5,480	5,395	4,634	4,304	5,480

Results presented as odds ratios
P-values in parentheses
*** $p<0.01$, ** $p<0.05$, * $p<0.10$
Baseline villages cross-section sample

Treatment Effect of Yaajeende on Underweight, Ages 6-59 Months
Logistic difference-in-difference regression with survey weights

VARIABLES	(1) Underweight 6-59mo	(2) Underweight 6-59mo	(3) Underweight 6-59mo	(4) Underweight 6-59mo	(5) Underweight 6-59mo
Secular trend	0.845	0.845	0.845	0.845	0.835
	(0.323)	(0.318)	(0.354)	(0.358)	(0.281)
Project (A or B) tr. eff.	1.011				
	(0.964)				
Project ex ante	0.842				
	(0.468)				
Nutrition (A) tr. eff.		1.008			1.205
		(0.975)			(0.528)
Nutrition ex ante		0.842			0.838
		(0.468)			(0.522)
Agriculture (B) tr. eff.			0.959		1.402
			(0.875)		(0.250)
Agriculture ex ante			0.844		0.860
			(0.545)		(0.572)
Synergy (ABC) tr. eff.				0.904	0.541**
				(0.718)	(0.043)
High intensity (A and B)				0.854	1.187
				(0.602)	(0.585)
Observations	6,375	6,151	5,212	4,711	6,375

Results presented as odds ratios
P-values in parentheses
*** $p<0.01$, ** $p<0.05$, * $p<0.10$
Full cross-section sample

Indicator 1.4

Treatment Effect of Yaajeende on Underweight, Female Ages 15-49
Linear difference-in-difference regression with survey weights

VARIABLES	(1) Underweight Fem 15-49	(2) Underweight Fem 15-49	(3) Underweight Fem 15-49	(4) Underweight Fem 15-49	(5) Underweight Fem 15-49
Secular trend	-0.004	-0.004	-0.004	-0.004	-0.004
	(0.837)	(0.837)	(0.846)	(0.849)	(0.826)
Project (A or B) tr. eff.	-0.031				
	(0.428)				
Project ex ante	0.134***				
	(0.001)				
Nutrition (A) tr. eff.		-0.031			-0.011
		(0.433)			(0.820)
Nutrition ex ante		0.136***			0.136***
		(0.001)			(0.008)
Agriculture (B) tr. eff.			-0.036		-0.033
			(0.419)		(0.633)
Agriculture ex ante			0.136***		0.067
			(0.009)		(0.346)
Synergy (ABC) tr. eff.				-0.036	0.008
				(0.498)	(0.917)
High intensity (A and B)				0.132**	-0.068
				(0.029)	(0.401)
Observations	5,451	5,395	4,590	4,213	5,451
R-squared	0.014	0.015	0.016	0.015	0.017
F-test synergy					0.0109

pval in parentheses
*** $p<0.01$, ** $p<0.05$, * $p<0.1$
Baseline villages cross-section sample

Treatment Effect of Yaajeende on Underweight, Female Ages 15-49
Linear difference-in-difference regression with survey weights

VARIABLES	(1) Underweight Fem 15-49	(2) Underweight Fem 15-49	(3) Underweight Fem 15-49	(4) Underweight Fem 15-49	(5) Underweight Fem 15-49
Secular trend	0.005	0.005	0.005	0.005	0.004
	(0.806)	(0.804)	(0.818)	(0.819)	(0.833)
Project (A or B) tr. eff.	-0.040				
	(0.329)				
Project ex ante	0.134***				
	(0.003)				
Nutrition (A) tr. eff.		-0.040			-0.022
		(0.334)			(0.662)
Nutrition ex ante		0.136***			0.136**
		(0.002)			(0.011)
Agriculture (B) tr. eff.			-0.046		-0.033
			(0.340)		(0.647)
Agriculture ex ante			0.136**		0.067
			(0.012)		(0.373)
Synergy (ABC) tr. eff.				-0.044	0.012
				(0.432)	(0.886)
High intensity (A and B)				0.132**	-0.068
				(0.034)	(0.430)
Observations	6,475	6,282	5,278	4,718	6,475
R-squared	0.012	0.012	0.013	0.013	0.014
F-test synergy					0.0208

pval in parentheses
*** $p<0.01$, ** $p<0.05$, * $p<0.1$
Full cross-section sample

Treatment Effect of Yaajeende on Underweight, Female Aages 15-49
Logistic difference-in-difference regression with survey weights

	(1)	(2)	(3)	(4)	(5)
	Underweight	Underweight	Underweight	Underweight	Underweight
VARIABLES	Fem 15-49	Fem 15-49	Fem 15-49	Fem 15-49	Fem 15-49
Secular trend	0.973	0.973	0.973	0.973	0.969
	(0.836)	(0.836)	(0.845)	(0.848)	(0.809)
Project (A or B) tr. eff.	0.865				
	(0.499)				
Project ex ante	2.167***				
	(0.001)				
Nutrition (A) tr. eff.		0.866			0.961
		(0.504)			(0.877)
Nutrition ex ante		2.187***			2.184***
		(0.001)			(0.005)
Agriculture (B) tr. eff.			0.844		0.860
			(0.477)		(0.645)
Agriculture ex ante			2.185***		1.381
			(0.006)		(0.329)
Synergy (ABC) tr. eff.				0.841	1.021
				(0.537)	(0.953)
High intensity (A and B)				2.140**	0.723
				(0.019)	(0.383)
Observations	5,451	5,395	4,590	4,213	5,451

Results presented as odds ratios
P-values in parentheses
*** p<0.01, ** p<0.05, * p<0.10
Baseline villages cross-section sample

Treatment Effect of Yaajeende on Underweight, Female Aages 15-49
Logistic difference-in-difference regression with survey weights

	(1)	(2)	(3)	(4)	(5)
	Underweight	Underweight	Underweight	Underweight	Underweight
VARIABLES	Fem 15-49	Fem 15-49	Fem 15-49	Fem 15-49	Fem 15-49
Secular trend	1.039	1.039	1.039	1.039	1.032
	(0.808)	(0.805)	(0.819)	(0.821)	(0.838)
Project (A or B) tr. eff.	0.809				
	(0.359)				
Project ex ante	2.167***				
	(0.003)				
Nutrition (A) tr. eff.		0.812			0.891
		(0.364)			(0.664)
Nutrition ex ante		2.187***			2.184***
		(0.002)			(0.007)
Agriculture (B) tr. eff.			0.788		0.863
			(0.362)		(0.668)
Agriculture ex ante			2.185***		1.381
			(0.009)		(0.356)
Synergy (ABC) tr. eff.				0.791	1.035
				(0.437)	(0.927)
High intensity (A and B)				2.140**	0.723
				(0.023)	(0.411)
Observations	6,475	6,282	5,278	4,718	6,475

Results presented as odds ratios
P-values in parentheses
*** $p<0.01$, ** $p<0.05$, * $p<0.10$
Full cross-section sample

Indicator 1.5

Treatment Effect of Yaajeende on Minimum Acceptable Diet, Ages 6-23 Months
Linear difference-in-difference regression with survey weights

VARIABLES	(1) MAD 6-23mo	(2) MAD 6-23mo	(3) MAD 6-23mo	(4) MAD 6-23mo	(5) MAD 6-23mo
Secular trend	-0.069**	-0.069**	-0.069*	-0.069*	-0.077**
	(0.049)	(0.049)	(0.065)	(0.070)	(0.025)
Project (A or B) tr. eff.	-0.008				
	(0.885)				
Project ex ante	0.001				
	(0.981)				
Nutrition (A) tr. eff.		-0.006			0.039
		(0.912)			(0.555)
Nutrition ex ante		0.000			-0.034
		(1.000)			(0.583)
Agriculture (B) tr. eff.			-0.014		0.091
			(0.762)		(0.210)
Agriculture ex ante			0.006		-0.036
			(0.910)		(0.562)
Synergy (ABC) tr. eff.				-0.026	-0.148**
				(0.582)	(0.041)
High intensity (A and B)				0.012	0.077
				(0.807)	(0.323)
Observations	1,404	1,385	1,184	1,106	1,404
R-squared	0.016	0.015	0.017	0.021	0.019
F-test synergy					4.285

pval in parentheses
*** $p<0.01$, ** $p<0.05$, * $p<0.1$
Baseline villages cross-section sample

Treatment Effect of Yaajeende on Minimum Acceptable Diet, Ages 6-23 Months
Linear difference-in-difference regression with survey weights

	(1)	(2)	(3)	(4)	(5)
VARIABLES	MAD 6-23mo	MAD 6-23mo	MAD 6-23mo	MAD 6-23mo	MAD 6-23mo
Secular trend	-0.071*	-0.071*	-0.071*	-0.071*	-0.079**
	(0.059)	(0.056)	(0.077)	(0.079)	(0.030)
Project (A or B) tr. eff.	-0.000				
	(0.996)				
Project ex ante	0.001				
	(0.983)				
Nutrition (A) tr. eff.		0.002			0.056
		(0.978)			(0.407)
Nutrition ex ante		0.000			-0.034
		(1.000)			(0.607)
Agriculture (B) tr. eff.			-0.009		0.068
			(0.852)		(0.339)
Agriculture ex ante			0.006		-0.036
			(0.918)		(0.587)
Synergy (ABC) tr. eff.				-0.020	-0.135*
				(0.691)	(0.083)
High intensity (A and B)				0.012	0.077
				(0.823)	(0.357)
Observations	1,624	1,562	1,323	1,199	1,624
R-squared	0.014	0.013	0.016	0.020	0.017
F-test synergy					3.061

pval in parentheses
*** $p<0.01$, ** $p<0.05$, * $p<0.1$
Full cross-section sample

Treatment Effect of Yaajeende on Minimum Acceptable Diet, Ages 6-23 Months
Logistic difference-in-difference regression with survey weights

VARIABLES	(1) MAD 6-23mo	(2) MAD 6-23mo	(3) MAD 6-23mo	(4) MAD 6-23mo	(5) MAD 6-23mo
Secular trend	0.449***	0.449***	0.449**	0.449**	0.413***
	(0.007)	(0.007)	(0.012)	(0.014)	(0.002)
Project (A or B) tr. eff.	0.880				
	(0.804)				
Project ex ante	1.012				
	(0.981)				
Nutrition (A) tr. eff.		0.897			1.501
		(0.835)			(0.591)
Nutrition ex ante		1.000			0.716
		(1.000)			(0.601)
Agriculture (B) tr. eff.			0.824		2.951
			(0.672)		(0.227)
Agriculture ex ante			1.049		0.660
			(0.911)		(0.590)
Synergy (ABC) tr. eff.				0.708	0.174**
				(0.473)	(0.027)
High intensity (A and B)				1.108	2.224
				(0.810)	(0.343)
Observations	1,404	1,385	1,184	1,106	1,404

Results presented as odds ratios
P-values in parentheses
*** $p<0.01$, ** $p<0.05$, * $p<0.10$
Baseline villages cross-section sample

Treatment Effect of Yaajeende on Minimum Acceptable Diet, Ages 6-23 Months
Logistic difference-in-difference regression with survey weights

	(1)	(2)	(3)	(4)	(5)
VARIABLES	MAD 6-23mo	MAD 6-23mo	MAD 6-23mo	MAD 6-23mo	MAD 6-23mo
Secular trend	0.436***	0.436***	0.436**	0.436**	0.398***
	(0.009)	(0.008)	(0.015)	(0.016)	(0.003)
Project (A or B) tr. eff.	1.006				
	(0.991)				
Project ex ante	1.012				
	(0.983)				
Nutrition (A) tr. eff.		1.028			1.914
		(0.960)			(0.365)
Nutrition ex ante		1.000			0.716
		(1.000)			(0.625)
Agriculture (B) tr. eff.			0.893		2.242
			(0.813)		(0.349)
Agriculture ex ante			1.049		0.660
			(0.918)		(0.614)
Synergy (ABC) tr. eff.				0.785	0.201*
				(0.622)	(0.059)
High intensity (A and B)				1.108	2.224
				(0.826)	(0.375)
Observations	1,624	1,562	1,323	1,199	1,624

Results presented as odds ratios
P-values in parentheses
*** $p<0.01$, ** $p<0.05$, * $p<0.10$
Full cross-section sample

Indicator 1.6

Treatment Effect of Yaajeende on Duration of Reduced Food Intake (months)
Linear difference-in-difference regression with survey weights

VARIABLES	(1) Duration mo	(2) Duration mo	(3) Duration mo	(4) Duration mo	(5) Duration mo
Secular trend	1.170***	1.170***	1.170***	1.170***	1.149***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Project (A or B) tr. eff.	-0.175				
	(0.418)				
Project ex ante	0.474***				
	(0.001)				
Nutrition (A) tr. eff.		-0.149			0.474**
		(0.493)			(0.035)
Nutrition ex ante		0.495***			0.329**
		(0.000)			(0.027)
Agriculture (B) tr. eff.			-0.349*		-0.614*
			(0.087)		(0.054)
Agriculture ex ante			0.534***		-0.064
			(0.000)		(0.848)
Synergy (ABC) tr. eff.				-0.357*	-0.196
				(0.073)	(0.560)
High intensity (A and B)				0.581***	0.331
				(0.000)	(0.372)
Observations	3,394	3,342	2,908	2,699	3,394
R-squared	0.075	0.079	0.068	0.072	0.086
F-test synergy					0.342

pval in parentheses
*** $p<0.01$, ** $p<0.05$, * $p<0.1$
Baseline villages cross-section sample

Treatment Effect of Yaajeende on Duration of Reduced Food Intake, Months
Linear difference-in-difference regression with survey weights

	(1)	(2)	(3)	(4)	(5)
	Duration	Duration	Duration	Duration	Duration
VARIABLES	mo	mo	mo	mo	mo
Secular trend	1.141***	1.141***	1.141***	1.141***	1.144***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Project (A or B) tr. eff.	-0.112				
	(0.608)				
Project ex ante	0.474***				
	(0.002)				
Nutrition (A) tr. eff.		-0.102			0.390*
		(0.641)			(0.090)
Nutrition ex ante		0.495***			0.329**
		(0.001)			(0.041)
Agriculture (B) tr. eff.			-0.286		-0.288
			(0.166)		(0.455)
Agriculture ex ante			0.534***		-0.064
			(0.001)		(0.858)
Synergy (ABC) tr. eff.				-0.311	-0.417
				(0.119)	(0.293)
High intensity (A and B)				0.581***	0.331
				(0.000)	(0.403)
Observations	3,824	3,702	3,211	2,915	3,824
R-squared	0.075	0.078	0.068	0.071	0.083
F-test synergy					1.115

pval in parentheses
*** $p<0.01$, ** $p<0.05$, * $p<0.1$
Full cross-section sample

Treatment Effect of Yaajeende on Duration of Reduced Food Intake (months)
Poisson difference-in-difference regression with survey weights

	(1)	(2)	(3)	(4)	(5)
	Duration	Duration	Duration	Duration	Duration
VARIABLES	mo	mo	mo	mo	mo
Secular trend	0.427***	0.427***	0.427***	0.427***	0.421***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Project (A or B) tr. eff.	-0.110				
	(0.132)				
Project ex ante	0.195***				
	(0.001)				
Nutrition (A) tr. eff.		-0.105			0.079
		(0.151)			(0.256)
Nutrition ex ante		0.203***			0.141**
		(0.001)			(0.026)
Agriculture (B) tr. eff.			-0.164**		-0.164
			(0.021)		(0.102)
Agriculture ex ante			0.217***		-0.027
			(0.000)		(0.850)
Synergy (ABC) tr. eff.				-0.170**	-0.080
				(0.013)	(0.452)
High intensity (A and B)				0.234***	0.127
				(0.000)	(0.408)
Observations	3,394	3,342	2,908	2,699	3,394

pval in parentheses
*** $p<0.01$, ** $p<0.05$, * $p<0.1$
Baseline villages cross-section sample

Treatment Effect of Yaajeende on Duration of Reduced Food Intake (months)
Poisson difference-in-difference regression with survey weights

VARIABLES	(1) Duration mo	(2) Duration mo	(3) Duration mo	(4) Duration mo	(5) Duration mo
Secular trend	0.418***	0.418***	0.418***	0.418***	0.421***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Project (A or B) tr. eff.	-0.092				
	(0.221)				
Project ex ante	0.195***				
	(0.002)				
Nutrition (A) tr. eff.		-0.092			0.057
		(0.222)			(0.444)
Nutrition ex ante		0.203***			0.141**
		(0.001)			(0.039)
Agriculture (B) tr. eff.			-0.146**		-0.071
			(0.047)		(0.551)
Agriculture ex ante			0.217***		-0.027
			(0.001)		(0.860)
Synergy (ABC) tr. eff.				-0.157**	-0.145
				(0.026)	(0.247)
High intensity (A and B)				0.234***	0.127
				(0.000)	(0.438)
Observations	3,824	3,702	3,211	2,915	3,824

pval in parentheses
*** $p<0.01$, ** $p<0.05$, * $p<0.1$
Full cross-section sample

Indicator 1.7

Treatment Effect of Yaajeende on Fewer Than Two Meals, Prevalence
Linear difference-in-difference regression with survey weights

	(1)	(2)	(3)	(4)	(5)
VARIABLES	Under 2 Meals	Under 2 Meals	Under 2 Meals	Under 2 Meals	Under 2 Meals
Secular trend	0.055***	0.055***	0.055***	0.055***	0.053***
	(0.002)	(0.002)	(0.004)	(0.005)	(0.003)
Project (A or B) tr. eff.	-0.005				
	(0.805)				
Project ex ante	-0.012				
	(0.161)				
Nutrition (A) tr. eff.		-0.003			0.007
		(0.865)			(0.805)
Nutrition ex ante		-0.013			-0.003
		(0.158)			(0.761)
Agriculture (B) tr. eff.			-0.006		-0.012
			(0.766)		(0.669)
Agriculture ex ante			-0.016*		-0.015*
			(0.099)		(0.084)
Synergy (ABC) tr. eff.				-0.006	0.002
				(0.788)	(0.942)
High intensity (A and B)				-0.015	0.003
				(0.118)	(0.657)
Observations	3,394	3,342	2,908	2,699	3,394
R-squared	0.016	0.017	0.017	0.017	0.017
F-test synergy					0.00530

pval in parentheses
*** $p<0.01$, ** $p<0.05$, * $p<0.1$
Baseline villages cross-section sample

Treatment Effect of Yaajeende on Fewer Than Two Meals, Prevalence
Linear difference-in-difference regression with survey weights

	(1)	(2)	(3)	(4)	(5)
VARIABLES	Under 2 Meals	Under 2 Meals	Under 2 Meals	Under 2 Meals	Under 2 Meals
Secular trend	0.053***	0.053***	0.053***	0.053***	0.051***
	(0.005)	(0.005)	(0.009)	(0.010)	(0.007)
Project (A or B) tr. eff.	-0.003				
	(0.882)				
Project ex ante	-0.012				
	(0.188)				
Nutrition (A) tr. eff.		-0.001			0.007
		(0.954)			(0.785)
Nutrition ex ante		-0.013			-0.003
		(0.178)			(0.776)
Agriculture (B) tr. eff.			-0.004		-0.014
			(0.844)		(0.575)
Agriculture ex ante			-0.016		-0.015
			(0.121)		(0.105)
Synergy (ABC) tr. eff.				-0.003	0.007
				(0.886)	(0.807)
High intensity (A and B)				-0.015	0.003
				(0.137)	(0.675)
Observations	3,824	3,702	3,211	2,915	3,824
R-squared	0.015	0.015	0.016	0.016	0.015
F-test synergy					0.0597

pval in parentheses
*** $p<0.01$, ** $p<0.05$, * $p<0.1$
Full cross-section sample

Treatment Effect of Yaajeende on Fewer Than Two Meals, Prevalence
Logit difference-in-difference regression with survey weights

	(1)	(2)	(3)	(4)	(5)
VARIABLES	Under 2 Meals	Under 2 Meals	Under 2 Meals	Under 2 Meals	Under 2 Meals
Secular trend	3.838***	3.838***	3.838**	3.838**	3.663***
	(0.008)	(0.008)	(0.013)	(0.015)	(0.010)
Project (A or B) tr. eff.	1.870				
	(0.355)				
Project ex ante	0.405				
	(0.122)				
Nutrition (A) tr. eff.		1.952			1.271
		(0.330)			(0.756)
Nutrition ex ante		0.398			0.822
		(0.122)			(0.767)
Agriculture (B) tr. eff.			2.711		3.096
			(0.243)		(0.379)
Agriculture ex ante			0.258*		0.203
			(0.098)		(0.166)
Synergy (ABC) tr. eff.				2.641	0.703
				(0.285)	(0.804)
High intensity (A and B)				0.269	1.576
				(0.134)	(0.720)
Observations	3,394	3,342	2,908	2,699	3,394

Results presented as odds ratios
P-values in parentheses
*** p<0.01, ** p<0.05, * p<0.10
Baseline villages cross-section sample

Treatment Effect of Yaajeende on Fewer Than Two Meals, Prevalence
Logit difference-in-difference regression with survey weights

	(1)	(2)	(3)	(4)	(5)
VARIABLES	Under 2 Meals	Under 2 Meals	Under 2 Meals	Under 2 Meals	Under 2 Meals
Secular trend	3.731**	3.731**	3.731**	3.731**	3.536**
	(0.015)	(0.014)	(0.023)	(0.024)	(0.018)
Project (A or B) tr. eff.	1.920				
	(0.364)				
Project ex ante	0.405				
	(0.145)				
Nutrition (A) tr. eff.		2.017			1.279
		(0.330)			(0.761)
Nutrition ex ante		0.398			0.822
		(0.139)			(0.781)
Agriculture (B) tr. eff.			2.781		2.896
			(0.265)		(0.434)
Agriculture ex ante			0.258		0.203
			(0.117)		(0.194)
Synergy (ABC) tr. eff.				2.743	0.781
				(0.297)	(0.870)
High intensity (A and B)				0.269	1.576
				(0.152)	(0.735)
Observations	3,824	3,702	3,211	2,915	3,824

Results presented as odds ratios
P-values in parentheses
*** p<0.01, ** p<0.05, * p<0.10
Full cross-section sample

Indicator 2.1

Treatment Effect of Yaajeende on Kitchen Hygiene, Prevalence
Linear difference-in-difference regression with survey weights

VARIABLES	(1) Hygiene	(2) Hygiene	(3) Hygiene	(4) Hygiene	(5) Hygiene
Secular trend	0.044	0.044	0.044	0.044	0.044
	(0.135)	(0.135)	(0.160)	(0.168)	(0.133)
Project (A or B) tr. eff.	-0.057				
	(0.149)				
Project ex ante	0.077**				
	(0.031)				
Nutrition (A) tr. eff.		-0.053			-0.031
		(0.183)			(0.503)
Nutrition ex ante		0.078**			0.065*
		(0.029)			(0.081)
Agriculture (B) tr. eff.			-0.064		-0.206**
			(0.121)		(0.034)
Agriculture ex ante			0.083**		0.070**
			(0.017)		(0.039)
Synergy (ABC) tr. eff.				-0.042	0.195*
				(0.271)	(0.064)
High intensity (A and B)				0.078**	-0.054
				(0.031)	(0.174)
Observations	3,350	3,299	2,866	2,658	3,350
R-squared	0.005	0.006	0.006	0.008	0.013
F-test synergy					3.508

pval in parentheses
*** p<0.01, ** p<0.05, * p<0.1
Baseline villages cross-section sample

Treatment Effect of Yaajeende on Kitchen Hygiene, Prevalence
Linear difference-in-difference regression with survey weights

VARIABLES	(1) Hygiene	(2) Hygiene	(3) Hygiene	(4) Hygiene	(5) Hygiene
Secular trend	0.046	0.046	0.046	0.046	0.046
	(0.143)	(0.138)	(0.169)	(0.173)	(0.141)
Project (A or B) tr. eff.	-0.070*				
	(0.095)				
Project ex ante	0.077**				
	(0.044)				
Nutrition (A) tr. eff.		-0.065			-0.046
		(0.117)			(0.329)
Nutrition ex ante		0.078**			0.065
		(0.040)			(0.102)
Agriculture (B) tr. eff.			-0.077*		-0.189**
			(0.074)		(0.032)
Agriculture ex ante			0.083**		0.070*
			(0.028)		(0.055)
Synergy (ABC) tr. eff.				-0.057	0.180*
				(0.165)	(0.076)
High intensity (A and B)				0.078**	-0.054
				(0.044)	(0.204)
Observations	3,767	3,647	3,162	2,869	3,767
R-squared	0.004	0.005	0.005	0.006	0.010
F-test synergy					3.200

pval in parentheses
*** p<0.01, ** p<0.05, * p<0.1
Full cross-section sample

Treatment Effect of Yaajeende on Kitchen Hygiene, Prevalence
Logistic difference-in-difference regression with survey weights

VARIABLES	(1) Hygiene	(2) Hygiene	(3) Hygiene	(4) Hygiene	(5) Hygiene
Secular trend	1.389	1.389	1.389	1.389	1.392*
	(0.108)	(0.108)	(0.131)	(0.138)	(0.100)
Project (A or B) tr. eff.	0.637				
	(0.170)				
Project ex ante	1.877**				
	(0.028)				
Nutrition (A) tr. eff.		0.660			0.788
		(0.220)			(0.554)
Nutrition ex ante		1.904**			1.693*
		(0.028)			(0.089)
Agriculture (B) tr. eff.			0.591		0.182**
			(0.122)		(0.014)
Agriculture ex ante			1.997***		2.169
			(0.009)		(0.113)
Synergy (ABC) tr. eff.				0.738	5.150**
				(0.330)	(0.044)
High intensity (A and B)				1.906**	0.528
				(0.021)	(0.246)
Observations	3,350	3,299	2,866	2,658	3,350

Results presented as odds ratios
P-values in parentheses
*** p<0.01, ** p<0.05, * p<0.10
Baseline villages cross-section sample

Treatment Effect of Yaajeende on Kitchen Hygiene, Prevalence
Logistic difference-in-difference regression with survey weights

VARIABLES	(1) Hygiene	(2) Hygiene	(3) Hygiene	(4) Hygiene	(5) Hygiene
Secular trend	1.411	1.411	1.411	1.411	1.413
	(0.113)	(0.109)	(0.137)	(0.141)	(0.108)
Project (A or B) tr. eff.	0.567				
	(0.100)				
Project ex ante	1.877**				
	(0.041)				
Nutrition (A) tr. eff.		0.588			0.688
		(0.130)			(0.350)
Nutrition ex ante		1.904**			1.693
		(0.038)			(0.112)
Agriculture (B) tr. eff.			0.526*		0.207**
			(0.064)		(0.019)
Agriculture ex ante			1.997**		2.169
			(0.018)		(0.139)
Synergy (ABC) tr. eff.				0.639	4.497*
				(0.173)	(0.065)
High intensity (A and B)				1.906**	0.528
				(0.034)	(0.277)
Observations	3,767	3,647	3,162	2,869	3,767

Results presented as odds ratios
P-values in parentheses
*** p<0.01, ** p<0.05, * p<0.10
Full cross-section sample

Indicator 2.2

Treatment Effect of Yaajeende on Food Storage, Prevalence
Linear difference-in-difference regression with survey weights

	(1)	(2)	(3)	(4)	(5)
VARIABLES	Storage	Storage	Storage	Storage	Storage
Secular trend	-0.004	-0.004	-0.004	-0.004	-0.001
	(0.936)	(0.936)	(0.940)	(0.941)	(0.984)
Project (A or B) tr. eff.	0.028				
	(0.602)				
Project ex ante	0.080*				
	(0.076)				
Nutrition (A) tr. eff.		0.025			-0.004
		(0.643)			(0.964)
Nutrition ex ante		0.091**			0.131*
		(0.047)			(0.054)
Agriculture (B) tr. eff.			0.035		0.095
			(0.529)		(0.338)
Agriculture ex ante			0.075		-0.127
			(0.105)		(0.260)
Synergy (ABC) tr. eff.				0.027	-0.067
				(0.631)	(0.510)
High intensity (A and B)				0.089**	0.096
				(0.046)	(0.425)
Observations	3,332	3,281	2,848	2,643	3,332
R-squared	0.009	0.011	0.010	0.012	0.015
F-test synergy					0.437

pval in parentheses
*** $p<0.01$, ** $p<0.05$, * $p<0.1$
Baseline villages cross-section sample

Treatment Effect of Yaajeende on Food Storage, Prevalence
Linear difference-in-difference regression with survey weights

VARIABLES	(1) Storage	(2) Storage	(3) Storage	(4) Storage	(5) Storage
Secular trend	-0.013	-0.013	-0.013	-0.013	-0.010
	(0.795)	(0.793)	(0.808)	(0.809)	(0.839)
Project (A or B) tr. eff.	0.031				
	(0.584)				
Project ex ante	0.080*				
	(0.094)				
Nutrition (A) tr. eff.		0.029			-0.010
		(0.614)			(0.907)
Nutrition ex ante		0.091*			0.131*
		(0.058)			(0.070)
Agriculture (B) tr. eff.			0.040		0.113
			(0.502)		(0.292)
Agriculture ex ante			0.075		-0.127
			(0.131)		(0.291)
Synergy (ABC) tr. eff.				0.034	-0.073
				(0.578)	(0.510)
High intensity (A and B)				0.089*	0.096
				(0.063)	(0.454)
Observations	3,743	3,627	3,139	2,853	3,743
R-squared	0.010	0.011	0.011	0.013	0.015
F-test synergy					0.436

pval in parentheses
*** $p<0.01$, ** $p<0.05$, * $p<0.1$
Full cross-section sample

Treatment Effect of Yaajeende on Food Storage, Prevalence
Logistic difference-in-difference regression with survey weights

VARIABLES	(1) Storage	(2) Storage	(3) Storage	(4) Storage	(5) Storage
Secular trend	0.986	0.986	0.986	0.986	0.996
	(0.936)	(0.936)	(0.940)	(0.941)	(0.984)
Project (A or B) tr. eff.	1.124				
	(0.588)				
Project ex ante	1.386*				
	(0.076)				
Nutrition (A) tr. eff.		1.111			0.985
		(0.629)			(0.963)
Nutrition ex ante		1.451**			1.723*
		(0.047)			(0.062)
Agriculture (B) tr. eff.			1.158		1.476
			(0.512)		(0.344)
Agriculture ex ante			1.356		0.591
			(0.104)		(0.259)
Synergy (ABC) tr. eff.				1.122	0.764
				(0.616)	(0.519)
High intensity (A and B)				1.442**	1.475
				(0.044)	(0.426)
Observations	3,332	3,281	2,848	2,643	3,332

Results presented as odds ratios
P-values in parentheses
*** $p<0.01$, ** $p<0.05$, * $p<0.10$
Baseline villages cross-section sample

Treatment Effect of Yaajeende on Food Storage, Prevalence
Logistic difference-in-difference regression with survey weights

VARIABLES	(1) Storage	(2) Storage	(3) Storage	(4) Storage	(5) Storage
Secular trend	0.950	0.950	0.950	0.950	0.961
	(0.795)	(0.793)	(0.808)	(0.809)	(0.839)
Project (A or B) tr. eff.	1.139				
	(0.576)				
Project ex ante	1.386*				
	(0.094)				
Nutrition (A) tr. eff.		1.127			0.956
		(0.606)			(0.899)
Nutrition ex ante		1.451*			1.723*
		(0.058)			(0.080)
Agriculture (B) tr. eff.			1.183		1.594
			(0.490)		(0.293)
Agriculture ex ante			1.356		0.591
			(0.130)		(0.291)
Synergy (ABC) tr. eff.				1.152	0.747
				(0.567)	(0.518)
High intensity (A and B)				1.442*	1.475
				(0.061)	(0.456)
Observations	3,743	3,627	3,139	2,853	3,743

Results presented as odds ratios
P-values in parentheses
*** $p<0.01$, ** $p<0.05$, * $p<0.10$
Full cross-section sample

Indicator 2.3

Treatment Effect of Yaajeende on Treated Water, Prevalence
Linear difference-in-difference regression with survey weights

VARIABLES	(1) Treatment	(2) Treatment	(3) Treatment	(4) Treatment	(5) Treatment
Secular trend	0.269***	0.269***	0.269***	0.269***	0.271***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Project (A or B) tr. eff.	-0.077*				
	(0.071)				
Project ex ante	-0.000				
	(0.984)				
Nutrition (A) tr. eff.		-0.080*			-0.069
		(0.062)			(0.233)
Nutrition ex ante		0.001			0.008
		(0.953)			(0.788)
Agriculture (B) tr. eff.			-0.083*		-0.021
			(0.083)		(0.669)
Agriculture ex ante			-0.003		-0.081***
			(0.882)		(0.000)
Synergy (ABC) tr. eff.				-0.084*	0.003
				(0.091)	(0.957)
High intensity (A and B)				0.006	0.079***
				(0.789)	(0.000)
Observations	3,343	3,295	2,858	2,653	3,343
R-squared	0.075	0.074	0.078	0.076	0.078
F-test synergy					0.00294

pval in parentheses
*** $p<0.01$, ** $p<0.05$, * $p<0.1$
Baseline villages cross-section sample

Treatment Effect of Yaajeende on Treated Water, Prevalence
Linear difference-in-difference regression with survey weights

VARIABLES	(1) Treatment	(2) Treatment	(3) Treatment	(4) Treatment	(5) Treatment
Secular trend	0.265***	0.265***	0.265***	0.265***	0.266***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Project (A or B) tr. eff.	-0.077*				
	(0.084)				
Project ex ante	-0.000				
	(0.985)				
Nutrition (A) tr. eff.		-0.080*			-0.094*
		(0.073)			(0.095)
Nutrition ex ante		0.001			0.008
		(0.955)			(0.800)
Agriculture (B) tr. eff.			-0.074		-0.001
			(0.135)		(0.990)
Agriculture ex ante			-0.003		-0.081***
			(0.889)		(0.000)
Synergy (ABC) tr. eff.				-0.075	0.017
				(0.141)	(0.741)
High intensity (A and B)				0.006	0.079***
				(0.798)	(0.001)
Observations	3,763	3,646	3,155	2,864	3,763
R-squared	0.069	0.068	0.074	0.072	0.071
F-test synergy					0.110

pval in parentheses
*** p<0.01, ** p<0.05, * p<0.1
Full cross-section sample

Treatment Effect of Yaajeende on Treated Water, Prevalence
Logistic difference-in-difference regression with survey weights

VARIABLES	(1) Treatment	(2) Treatment	(3) Treatment	(4) Treatment	(5) Treatment
Secular trend	6.460***	6.460***	6.460***	6.460***	6.551***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Project (A or B) tr. eff.	0.696				
	(0.277)				
Project ex ante	0.994				
	(0.984)				
Nutrition (A) tr. eff.		0.675			0.667
		(0.239)			(0.375)
Nutrition ex ante		1.018			1.124
		(0.953)			(0.784)
Agriculture (B) tr. eff.			0.694		1521021.536***
			(0.302)		(0.000)
Agriculture ex ante			0.954		0.000***
			(0.881)		(0.000)
Synergy (ABC) tr. eff.				0.634	0.000***
				(0.204)	(0.000)
High intensity (A and B)				1.089	2560067.979***
				(0.791)	(0.000)
Observations	3,343	3,295	2,858	2,653	3,343

Results presented as odds ratios
P-values in parentheses
*** $p<0.01$, ** $p<0.05$, * $p<0.10$
Baseline villages cross-section sample

Treatment Effect of Yaajeende on Treated Water, Prevalence
Logistic difference-in-difference regression with survey weights

	(1)	(2)	(3)	(4)	(5)
VARIABLES	Treatment	Treatment	Treatment	Treatment	Treatment
Secular trend	6.350***	6.350***	6.350***	6.350***	6.418***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Project (A or B) tr. eff.	0.694				
	(0.302)				
Project ex ante	0.994				
	(0.985)				
Nutrition (A) tr. eff.		0.674			0.584
		(0.261)			(0.267)
Nutrition ex ante		1.018			1.124
		(0.955)			(0.796)
Agriculture (B) tr. eff.			0.726		800,226.794***
			(0.389)		(0.000)
Agriculture ex ante			0.954		0.000***
			(0.888)		(0.000)
Synergy (ABC) tr. eff.				0.663	0.000***
				(0.270)	(0.000)
High intensity (A and B)				1.089	1209267.268***
				(0.800)	(0.000)
Observations	3,763	3,646	3,155	2,864	3,763

Results presented as odds ratios
P-values in parentheses
*** $p<0.01$, ** $p<0.05$, * $p<0.10$
Full cross-section sample

Indicator 2.4

Treatment Effect of Yaajeende on Food Conservation Techniques, Prevalence
Linear difference-in-difference regression with survey weights

VARIABLES	(1) Any techniques	(2) Any techniques	(3) Any techniques	(4) Any techniques	(5) Any techniques
Secular trend	-0.145***	-0.145***	-0.145***	-0.145***	-0.147***
	(0.000)	(0.000)	(0.000)	(0.001)	(0.000)
Project (A or B) tr. eff.	-0.082				
	(0.154)				
Project ex ante	0.004				
	(0.887)				
Nutrition (A) tr. eff.		-0.084			-0.099
		(0.149)			(0.230)
Nutrition ex ante		0.002			-0.047
		(0.953)			(0.417)
Agriculture (B) tr. eff.			-0.075		0.049
			(0.236)		(0.725)
Agriculture ex ante			0.018		0.046
			(0.512)		(0.448)
Synergy (ABC) tr. eff.				-0.081	-0.029
				(0.202)	(0.861)
High intensity (A and B)				0.018	0.017
				(0.509)	(0.757)
Observations	3,365	3,314	2,881	2,673	3,365
R-squared	0.053	0.054	0.049	0.050	0.058
F-test synergy					0.0307

pval in parentheses
*** $p<0.01$, ** $p<0.05$, * $p<0.1$
Baseline villages cross-section sample

Treatment Effect of Yaajeende on Food Conservation Techniques, Prevalence
Linear difference-in-difference regression with survey weights

	(1)	(2)	(3)	(4)	(5)
VARIABLES	Any techniques	Any techniques	Any techniques	Any techniques	Any techniques
Secular trend	-0.143***	-0.143***	-0.143***	-0.143***	-0.149***
	(0.000)	(0.000)	(0.001)	(0.001)	(0.000)
Project (A or B) tr. eff.	-0.084				
	(0.150)				
Project ex ante	0.004				
	(0.893)				
Nutrition (A) tr. eff.		-0.084			-0.096
		(0.150)			(0.259)
Nutrition ex ante		0.002			-0.047
		(0.955)			(0.446)
Agriculture (B) tr. eff.			-0.070		0.008
			(0.261)		(0.950)
Agriculture ex ante			0.018		0.046
			(0.538)		(0.475)
Synergy (ABC) tr. eff.				-0.073	0.021
				(0.244)	(0.896)
High intensity (A and B)				0.018	0.017
				(0.529)	(0.772)
Observations	3,786	3,666	3,177	2,884	3,786
R-squared	0.052	0.052	0.046	0.046	0.057
F-test synergy					0.0171

pval in parentheses
*** $p<0.01$, ** $p<0.05$, * $p<0.1$
Full cross-section sample

Treatment Effect of Yaajeende on Food Conservation Techniques, Prevalence
Logistic difference-in-difference regression with survey weights

	(1)	(2)	(3)	(4)	(5)
VARIABLES	Any techniques	Any techniques	Any techniques	Any techniques	Any techniques
Secular trend	0.397***	0.397***	0.397***	0.397***	0.389***
	(0.000)	(0.000)	(0.001)	(0.001)	(0.000)
Project (A or B) tr. eff.	0.672				
	(0.274)				
Project ex ante	1.039				
	(0.887)				
Nutrition (A) tr. eff.		0.674			0.753
		(0.280)			(0.566)
Nutrition ex ante		1.016			0.687
		(0.953)			(0.381)
Agriculture (B) tr. eff.			0.649		1.051
			(0.250)		(0.954)
Agriculture ex ante			1.177		1.471
			(0.502)		(0.469)
Synergy (ABC) tr. eff.				0.629	0.810
				(0.217)	(0.825)
High intensity (A and B)				1.183	1.142
				(0.499)	(0.797)
Observations	3,365	3,314	2,881	2,673	3,365

Results presented as odds ratios
P-values in parentheses
*** $p<0.01$, ** $p<0.05$, * $p<0.10$
Baseline villages cross-section sample

Treatment Effect of Yaajeende on Food Conservation Techniques, Prevalence
Logistic difference-in-difference regression with survey weights

	(1)	(2)	(3)	(4)	(5)
VARIABLES	Any techniques	Any techniques	Any techniques	Any techniques	Any techniques
Secular trend	0.401***	0.401***	0.401***	0.401***	0.385***
	(0.001)	(0.001)	(0.002)	(0.002)	(0.000)
Project (A or B) tr. eff.	0.665				
	(0.280)				
Project ex ante	1.039				
	(0.893)				
Nutrition (A) tr. eff.		0.673			0.766
		(0.291)			(0.607)
Nutrition ex ante		1.016			0.687
		(0.955)			(0.411)
Agriculture (B) tr. eff.			0.661		0.872
			(0.282)		(0.869)
Agriculture ex ante			1.177		1.471
			(0.527)		(0.496)
Synergy (ABC) tr. eff.				0.652	1.017
				(0.261)	(0.986)
High intensity (A and B)				1.183	1.142
				(0.518)	(0.809)
Observations	3,786	3,666	3,177	2,884	3,786

Results presented as odds ratios
P-values in parentheses
*** $p<0.01$, ** $p<0.05$, * $p<0.10$
Full cross-section sample

Indicator 2.5

Treatment Effect of Yaajeende on Salt Iodation and Storage, Prevalence
Linear difference-in-difference regression with survey weights

VARIABLES	(1) Iodation	(2) Iodation	(3) Iodation	(4) Iodation	(5) Iodation
Secular trend	-0.001	-0.001	-0.001	-0.001	0.003
	(0.968)	(0.968)	(0.970)	(0.971)	(0.926)
Project (A or B) tr. eff.	-0.020				
	(0.653)				
Project ex ante	0.063*				
	(0.050)				
Nutrition (A) tr. eff.		-0.021			0.046
		(0.650)			(0.419)
Nutrition ex ante		0.068**			0.064
		(0.038)			(0.126)
Agriculture (B) tr. eff.			-0.045		-0.111
			(0.325)		(0.110)
Agriculture ex ante			0.071**		0.042
			(0.030)		(0.545)
Synergy (ABC) tr. eff.				-0.042	0.019
				(0.401)	(0.790)
High intensity (A and B)				0.069**	-0.030
				(0.046)	(0.677)
Observations	3,211	3,160	2,744	2,542	3,211
R-squared	0.005	0.006	0.006	0.005	0.010
F-test synergy					0.0716

pval in parentheses
*** p<0.01, ** p<0.05, * p<0.1
Baseline villages cross-section sample

Treatment Effect of Yaajeende on Salt Iodation and Storage, Prevalence
Linear difference-in-difference regression with survey weights

	(1)	(2)	(3)	(4)	(5)
VARIABLES	Iodation	Iodation	Iodation	Iodation	Iodation
Secular trend	-0.002	-0.002	-0.002	-0.002	0.002
	(0.963)	(0.963)	(0.966)	(0.966)	(0.949)
Project (A or B) tr. eff.	-0.016				
	(0.734)				
Project ex ante	0.063*				
	(0.067)				
Nutrition (A) tr. eff.		-0.016			0.026
		(0.741)			(0.681)
Nutrition ex ante		0.068**			0.064
		(0.049)			(0.153)
Agriculture (B) tr. eff.			-0.035		-0.093
			(0.469)		(0.205)
Agriculture ex ante			0.071**		0.042
			(0.041)		(0.572)
Synergy (ABC) tr. eff.				-0.029	0.035
				(0.576)	(0.641)
High intensity (A and B)				0.069*	-0.030
				(0.057)	(0.695)
Observations	3,620	3,501	3,034	2,748	3,620
R-squared	0.005	0.006	0.005	0.005	0.009
F-test synergy					0.219

pval in parentheses
*** p<0.01, ** p<0.05, * p<0.1
Full cross-section sample

Treatment Effect of Yaajeende on Salt Iodation and Storage, Prevalence
Logistic difference-in-difference regression with survey weights

VARIABLES	(1) Iodation	(2) Iodation	(3) Iodation	(4) Iodation	(5) Iodation
Secular trend	0.989	0.989	0.989	0.989	1.016
	(0.968)	(0.968)	(0.970)	(0.971)	(0.955)
Project (A or B) tr. eff.	0.878				
	(0.707)				
Project ex ante	1.576*				
	(0.055)				
Nutrition (A) tr. eff.		0.878			1.336
		(0.707)			(0.469)
Nutrition ex ante		1.623**			1.592
		(0.042)			(0.113)
Agriculture (B) tr. eff.			0.741		0.471*
			(0.402)		(0.078)
Agriculture ex ante			1.648**		1.308
			(0.037)		(0.516)
Synergy (ABC) tr. eff.				0.759	1.175
				(0.469)	(0.710)
High intensity (A and B)				1.632*	0.829
				(0.053)	(0.650)
Observations	3,211	3,160	2,744	2,542	3,211

Results presented as odds ratios
P-values in parentheses
*** p<0.01, ** p<0.05, * p<0.10
Baseline villages cross-section sample

Treatment Effect of Yaajeende on Salt Iodation and Storage, Prevalence
Logistic difference-in-difference regression with survey weights

VARIABLES	(1) Iodation	(2) Iodation	(3) Iodation	(4) Iodation	(5) Iodation
Secular trend	0.986	0.986	0.986	0.986	1.009
	(0.963)	(0.963)	(0.966)	(0.966)	(0.975)
Project (A or B) tr. eff.	0.905				
	(0.781)				
Project ex ante	1.576*				
	(0.072)				
Nutrition (A) tr. eff.		0.909			1.189
		(0.789)			(0.691)
Nutrition ex ante		1.623*			1.592
		(0.053)			(0.139)
Agriculture (B) tr. eff.			0.800		0.522
			(0.548)		(0.156)
Agriculture ex ante			1.648*		1.308
			(0.051)		(0.545)
Synergy (ABC) tr. eff.				0.834	1.312
				(0.641)	(0.548)
High intensity (A and B)				1.632*	0.829
				(0.065)	(0.669)
Observations	3,620	3,501	3,034	2,748	3,620

Results presented as odds ratios
P-values in parentheses
*** $p<0.01$, ** $p<0.05$, * $p<0.10$
Full cross-section sample

Indicator 2.6

Treatment Effect of Yaajeende on Exclusive Maternal Breastfeeding
Linear difference-in-difference regression with survey weights

VARIABLES	(1) Exclusive	(2) Exclusive	(3) Exclusive	(4) Exclusive	(5) Exclusive
Secular trend	0.210***	0.210***	0.210***	0.210***	0.213***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Project (A or B) tr. eff.	0.024				
	(0.440)				
Project ex ante	-0.021				
	(0.171)				
Nutrition (A) tr. eff.		0.024			0.017
		(0.443)			(0.637)
Nutrition ex ante		-0.021			-0.011
		(0.166)			(0.550)
Agriculture (B) tr. eff.			0.024		-0.052
			(0.470)		(0.277)
Agriculture ex ante			-0.024		-0.016
			(0.128)		(0.173)
Synergy (ABC) tr. eff.				0.029	0.062
				(0.402)	(0.249)
High intensity (A and B)				-0.024	0.002
				(0.137)	(0.756)
Observations	2,727	2,684	2,302	2,148	2,727
R-squared	0.085	0.085	0.084	0.084	0.086
F-test synergy					1.345

pval in parentheses
*** $p<0.01$, ** $p<0.05$, * $p<0.1$
Baseline villages cross-section sample

Treatment Effect of Yaajeende on Exclusive Maternal Breastfeeding
Linear difference-in-difference regression with survey weights

VARIABLES	(1) Exclusive	(2) Exclusive	(3) Exclusive	(4) Exclusive	(5) Exclusive
Secular trend	0.205***	0.205***	0.205***	0.205***	0.205***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Project (A or B) tr. eff.	0.020				
	(0.522)				
Project ex ante	-0.021				
	(0.198)				
Nutrition (A) tr. eff.		0.022			0.005
		(0.481)			(0.903)
Nutrition ex ante		-0.021			-0.011
		(0.188)			(0.574)
Agriculture (B) tr. eff.			0.025		-0.055
			(0.457)		(0.227)
Agriculture ex ante			-0.024		-0.016
			(0.153)		(0.199)
Synergy (ABC) tr. eff.				0.032	0.083
				(0.355)	(0.111)
High intensity (A and B)				-0.024	0.002
				(0.159)	(0.771)
Observations	3,123	3,009	2,566	2,331	3,123
R-squared	0.076	0.077	0.078	0.079	0.078
F-test synergy					2.573

pval in parentheses
*** $p<0.01$, ** $p<0.05$, * $p<0.1$
Full cross-section sample

Treatment Effect of Yaajeende on Exclusive Maternal Breastfeeding
Logistic difference-in-difference regression with survey weights

VARIABLES	(1) Exclusive	(2) Exclusive	(3) Exclusive	(4) Exclusive	(5) Exclusive
Secular trend	10.425***	10.425***	10.425***	10.425***	10.343***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Project (A or B) tr. eff.	3.619*				
	(0.071)				
Project ex ante	0.281*				
	(0.075)				
Nutrition (A) tr. eff.		3.734*			1.686
		(0.073)			(0.544)
Nutrition ex ante		0.272*			0.613
		(0.075)			(0.560)
Agriculture (B) tr. eff.			5.987**		2.851
			(0.024)		(0.373)
Agriculture ex ante			0.167**		0.232
			(0.027)		(0.218)
Synergy (ABC) tr. eff.				6.159**	1.291
				(0.039)	(0.844)
High intensity (A and B)				0.167**	1.141
				(0.044)	(0.921)
Observations	2,727	2,684	2,302	2,148	2,727

Results presented as odds ratios
P-values in parentheses
*** $p<0.01$, ** $p<0.05$, * $p<0.10$
Baseline villages cross-section sample

Treatment Effect of Yaajeende on Exclusive Maternal Breastfeeding
Logistic difference-in-difference regression with survey weights

VARIABLES	(1) Exclusive	(2) Exclusive	(3) Exclusive	(4) Exclusive	(5) Exclusive
Secular trend	10.171***	10.171***	10.171***	10.171***	9.950***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Project (A or B) tr. eff.	3.546*				
	(0.094)				
Project ex ante	0.281*				
	(0.092)				
Nutrition (A) tr. eff.		3.702*			1.577
		(0.088)			(0.616)
Nutrition ex ante		0.272*			0.613
		(0.089)			(0.583)
Agriculture (B) tr. eff.			6.028**		2.718
			(0.034)		(0.428)
Agriculture ex ante			0.167**		0.232
			(0.038)		(0.247)
Synergy (ABC) tr. eff.				6.271**	1.495
				(0.048)	(0.775)
High intensity (A and B)				0.167*	1.141
				(0.057)	(0.926)
Observations	3,123	3,009	2,566	2,331	3,123

Results presented as odds ratios
P-values in parentheses
*** $p<0.01$, ** $p<0.05$, * $p<0.10$
Full cross-section sample

Indicator 2.7

Treatment Effect of Yaajeende on Food Diversity, Raw Score
Linear difference-in-difference regression with survey weights

VARIABLES	(1) Diversity index	(2) Diversity index	(3) Diversity index	(4) Diversity index	(5) Diversity index
Secular trend	-1.072***	-1.072***	-1.072***	-1.072***	-1.116***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Project (A or B) tr. eff.	0.469**				
	(0.026)				
Project ex ante	1.265***				
	(0.000)				
Nutrition (A) tr. eff.		0.529**			0.824**
		(0.012)			(0.035)
Nutrition ex ante		1.267***			0.835**
		(0.000)			(0.018)
Agriculture (B) tr. eff.			0.408*		-0.847
			(0.064)		(0.150)
Agriculture ex ante			1.402***		1.257***
			(0.000)		(0.001)
Synergy (ABC) tr. eff.				0.500**	0.567
				(0.017)	(0.339)
High intensity (A and B)				1.339***	-0.749**
				(0.000)	(0.040)
Observations	3,367	3,315	2,883	2,674	3,367
R-squared	0.153	0.158	0.173	0.172	0.171
F-test synergy					0.923

pval in parentheses
*** p<0.01, ** p<0.05, * p<0.1
Baseline villages cross-section sample

Treatment Effect of Yaajeende on Food Diversity, Raw Score
Linear difference-in-difference regression with survey weights

VARIABLES	(1) Diversity index	(2) Diversity index	(3) Diversity index	(4) Diversity index	(5) Diversity index
Secular trend	-1.081***	-1.081***	-1.081***	-1.081***	-1.147***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Project (A or B) tr. eff.	0.398*				
	(0.095)				
Project ex ante	1.265***				
	(0.000)				
Nutrition (A) tr. eff.		0.478**			0.652
		(0.044)			(0.186)
Nutrition ex ante		1.267***			0.835**
		(0.000)			(0.027)
Agriculture (B) tr. eff.			0.397*		-0.839
			(0.097)		(0.198)
Agriculture ex ante			1.402***		1.257***
			(0.000)		(0.002)
Synergy (ABC) tr. eff.				0.531**	0.784
				(0.017)	(0.194)
High intensity (A and B)				1.339***	-0.749*
				(0.000)	(0.058)
Observations	3,791	3,670	3,181	2,886	3,791
R-squared	0.140	0.147	0.169	0.173	0.164
F-test synergy					1.705

pval in parentheses
*** $p<0.01$, ** $p<0.05$, * $p<0.1$
Full cross-section sample

Treatment Effect of Yaajeende on Food Diversity, Raw Score
Poisson difference-in-difference regression with survey weights

VARIABLES	(1) Diversity index	(2) Diversity index	(3) Diversity index	(4) Diversity index	(5) Diversity index
Secular trend	-0.196***	-0.196***	-0.196***	-0.196***	-0.205***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Project (A or B) tr. eff.	0.110***				
	(0.004)				
Project ex ante	0.191***				
	(0.000)				
Nutrition (A) tr. eff.		0.119***			0.162***
		(0.002)			(0.009)
Nutrition ex ante		0.191***			0.128**
		(0.000)			(0.014)
Agriculture (B) tr. eff.			0.102**		-0.109
			(0.012)		(0.214)
Agriculture ex ante			0.209***		0.174***
			(0.000)		(0.001)
Synergy (ABC) tr. eff.				0.115***	0.071
				(0.004)	(0.407)
High intensity (A and B)				0.201***	-0.101**
				(0.000)	(0.031)
Observations	3,367	3,315	2,883	2,674	3,367

pval in parentheses
*** $p<0.01$, ** $p<0.05$, * $p<0.1$
Baseline villages cross-section sample

Treatment Effect of Yaajeende on Food Diversity, Raw Score
Poisson difference-in-difference regression with survey weights

VARIABLES	(1) Diversity index	(2) Diversity index	(3) Diversity index	(4) Diversity index	(5) Diversity index
Secular trend	-0.198***	-0.198***	-0.198***	-0.198***	-0.211***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Project (A or B) tr. eff.	0.099**				
	(0.018)				
Project ex ante	0.191***				
	(0.000)				
Nutrition (A) tr. eff.		0.112***			0.137*
		(0.008)			(0.081)
Nutrition ex ante		0.191***			0.128**
		(0.000)			(0.021)
Agriculture (B) tr. eff.			0.101**		-0.104
			(0.019)		(0.306)
Agriculture ex ante			0.209***		0.174***
			(0.000)		(0.002)
Synergy (ABC) tr. eff.				0.120***	0.101
				(0.004)	(0.261)
High intensity (A and B)				0.201***	-0.101**
				(0.000)	(0.047)
Observations	3,791	3,670	3,181	2,886	3,791

pval in parentheses
*** $p<0.01$, ** $p<0.05$, * $p<0.1$
Full cross-section sample

Indicator 2.8

Treatment Effect of Yaajeende on Verified Handwashing Station, Prevalence
Linear difference-in-difference regression with survey weights

VARIABLES	(1) Handwashing	(2) Handwashing	(3) Handwashing	(4) Handwashing	(5) Handwashing
Secular trend	0.144***	0.144***	0.144***	0.144***	0.140***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Project (A or B) tr. eff.	-0.120***				
	(0.001)				
Project ex ante	0.041**				
	(0.016)				
Nutrition (A) tr. eff.		-0.119***			-0.065
		(0.001)			(0.129)
Nutrition ex ante		0.042**			0.018
		(0.015)			(0.291)
Agriculture (B) tr. eff.			-0.131***		-0.017
			(0.001)		(0.807)
Agriculture ex ante			0.049**		0.014
			(0.025)		(0.543)
Synergy (ABC) tr. eff.				-0.139***	-0.052
				(0.001)	(0.475)
High intensity (A and B)				0.051**	0.020
				(0.041)	(0.519)
Observations	3,394	3,342	2,908	2,699	3,394
R-squared	0.029	0.029	0.032	0.034	0.029
F-test synergy					0.515

pval in parentheses
*** $p<0.01$, ** $p<0.05$, * $p<0.1$
Baseline villages cross-section sample

Treatment Effect of Yaajeende on Handwashing Station, Prevalence
Linear difference-in-difference regression with survey weights

	(1)	(2)	(3)	(4)	(5)
VARIABLES	Handwashing	Handwashing	Handwashing	Handwashing	Handwashing
Secular trend	0.140***	0.140***	0.140***	0.140***	0.137***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Project (A or B) tr. eff.	-0.109***				
	(0.003)				
Project ex ante	0.041**				
	(0.024)				
Nutrition (A) tr. eff.		-0.111***			-0.073*
		(0.002)			(0.092)
Nutrition ex ante		0.042**			0.018
		(0.022)			(0.321)
Agriculture (B) tr. eff.			-0.117***		0.007
			(0.005)		(0.917)
Agriculture ex ante			0.049**		0.014
			(0.037)		(0.567)
Synergy (ABC) tr. eff.				-0.127***	-0.058
				(0.003)	(0.422)
High intensity (A and B)				0.051*	0.020
				(0.054)	(0.547)
Observations	3,824	3,702	3,211	2,915	3,824
R-squared	0.025	0.025	0.027	0.029	0.027
F-test synergy					0.649

pval in parentheses
*** $p<0.01$, ** $p<0.05$, * $p<0.1$
Full cross-section sample

Treatment Effect of Yaajeende on Handwashing Station, Prevalence
Logistic difference-in-difference regression with survey weights

VARIABLES	(1) Handwashing	(2) Handwashing	(3) Handwashing	(4) Handwashing	(5) Handwashing
Secular trend	14.479***	14.479***	14.479***	14.479***	14.708***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Project (A or B) tr. eff.	0.104***				
	(0.001)				
Project ex ante	4.382**				
	(0.014)				
Nutrition (A) tr. eff.		0.104***			0.262
		(0.001)			(0.124)
Nutrition ex ante		4.484**			2.480
		(0.013)			(0.225)
Agriculture (B) tr. eff.			0.085***		0.601
			(0.001)		(0.570)
Agriculture ex ante			5.081**		1.616
			(0.014)		(0.525)
Synergy (ABC) tr. eff.				0.075***	0.468
				(0.001)	(0.354)
High intensity (A and B)				5.331**	1.411
				(0.016)	(0.596)
Observations	3,394	3,342	2,908	2,699	3,394

Results presented as odds ratios
P-values in parentheses
*** p<0.01, ** p<0.05, * p<0.10
Baseline villages cross-section sample

Treatment Effect of Yaajeende on Verified Handwashing Station, Prevalence
Logistic difference-in-difference regression with survey weights

	(1)	(2)	(3)	(4)	(5)
VARIABLES	Handwashing	Handwashing	Handwashing	Handwashing	Handwashing
Secular trend	14.040***	14.040***	14.040***	14.040***	14.401***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Project (A or B) tr. eff.	0.117***				
	(0.004)				
Project ex ante	4.382**				
	(0.021)				
Nutrition (A) tr. eff.		0.113***			0.240
		(0.003)			(0.122)
Nutrition ex ante		4.484**			2.480
		(0.018)			(0.255)
Agriculture (B) tr. eff.			0.100***		0.754
			(0.004)		(0.750)
Agriculture ex ante			5.081**		1.616
			(0.021)		(0.550)
Synergy (ABC) tr. eff.				0.087***	0.467
				(0.003)	(0.335)
High intensity (A and B)				5.331**	1.411
				(0.022)	(0.620)
Observations	3,824	3,702	3,211	2,915	3,824

Results presented as odds ratios
P-values in parentheses
*** $p<0.01$, ** $p<0.05$, * $p<0.10$
Full cross-section sample

Indicator 2.9

Treatment Effect of Yaajeende on Improved Drinking Water Source, Prevalence
Linear difference-in-difference regression with survey weights

VARIABLES	(1) Dr. water	(2) Dr. water	(3) Dr. water	(4) Dr. water	(5) Dr. water
Secular trend	0.055	0.055	0.055	0.055	0.054
	(0.209)	(0.210)	(0.238)	(0.247)	(0.207)
Project (A or B) tr. eff.	-0.025				
	(0.636)				
Project ex ante	0.105				
	(0.173)				
Nutrition (A) tr. eff.		-0.025			-0.015
		(0.650)			(0.839)
Nutrition ex ante		0.099			0.053
		(0.202)			(0.536)
Agriculture (B) tr. eff.			-0.028		-0.045
			(0.619)		(0.359)
Agriculture ex ante			0.111		0.113
			(0.149)		(0.514)
Synergy (ABC) tr. eff.				-0.024	0.037
				(0.684)	(0.390)
High intensity (A and B)				0.104	-0.070
				(0.164)	(0.700)
Observations	3,350	3,302	2,865	2,660	3,350
R-squared	0.011	0.010	0.013	0.012	0.010
F-test synergy					0.745

pval in parentheses
*** p<0.01, ** p<0.05, * p<0.1
Baseline villages cross-section sample

Treatment Effect of Yaajeende on Improved Drinking Water Source, Prevalence
Linear difference-in-difference regression with survey weights

VARIABLES	(1) Dr. water	(2) Dr. water	(3) Dr. water	(4) Dr. water	(5) Dr. water
Secular trend	0.063	0.063	0.063	0.063	0.062
	(0.183)	(0.178)	(0.212)	(0.216)	(0.174)
Project (A or B) tr. eff.	-0.020				
	(0.728)				
Project ex ante	0.105				
	(0.202)				
Nutrition (A) tr. eff.		-0.018			-0.011
		(0.746)			(0.883)
Nutrition ex ante		0.099			0.053
		(0.227)			(0.560)
Agriculture (B) tr. eff.			-0.020		-0.047
			(0.734)		(0.429)
Agriculture ex ante			0.111		0.113
			(0.181)		(0.540)
Synergy (ABC) tr. eff.				-0.015	0.044
				(0.807)	(0.394)
High intensity (A and B)				0.104	-0.070
				(0.194)	(0.717)
Observations	3,770	3,653	3,162	2,871	3,770
R-squared	0.013	0.012	0.015	0.015	0.012
F-test synergy					0.731

pval in parentheses
*** $p<0.01$, ** $p<0.05$, * $p<0.1$
Full cross-section sample

Treatment Effect of Yaajeende on Improved Drinking Water Source, Prevalence
Logistic difference-in-difference regression with survey weights

VARIABLES	(1) Dr. water	(2) Dr. water	(3) Dr. water	(4) Dr. water	(5) Dr. water
Secular trend	1.278	1.278	1.278	1.278	1.277
	(0.214)	(0.214)	(0.243)	(0.252)	(0.213)
Project (A or B) tr. eff.	0.917				
	(0.738)				
Project ex ante	1.631				
	(0.180)				
Nutrition (A) tr. eff.		0.919			0.948
		(0.746)			(0.879)
Nutrition ex ante		1.584			1.278
		(0.209)			(0.542)
Agriculture (B) tr. eff.			0.907		0.803
			(0.717)		(0.350)
Agriculture ex ante			1.685		1.804
			(0.152)		(0.570)
Synergy (ABC) tr. eff.				0.923	1.214
				(0.783)	(0.401)
High intensity (A and B)				1.628	0.680
				(0.162)	(0.725)
Observations	3,350	3,302	2,865	2,660	3,350

Results presented as odds ratios
P-values in parentheses
*** $p<0.01$, ** $p<0.05$, * $p<0.10$
Baseline villages cross-section sample

Treatment Effect of Yaajeende on Improved Drinking Water Source, Prevalence
Logistic difference-in-difference regression with survey weights

VARIABLES	(1) Dr. water	(2) Dr. water	(3) Dr. water	(4) Dr. water	(5) Dr. water
Secular trend	1.325	1.325	1.325	1.325	1.328
	(0.188)	(0.183)	(0.217)	(0.221)	(0.181)
Project (A or B) tr. eff.	0.954				
	(0.864)				
Project ex ante	1.631				
	(0.210)				
Nutrition (A) tr. eff.		0.958			0.969
		(0.876)			(0.933)
Nutrition ex ante		1.584			1.278
		(0.234)			(0.566)
Agriculture (B) tr. eff.			0.957		0.800
			(0.878)		(0.454)
Agriculture ex ante			1.685		1.804
			(0.185)		(0.594)
Synergy (ABC) tr. eff.				0.982	1.265
				(0.953)	(0.415)
High intensity (A and B)				1.628	0.680
				(0.193)	(0.741)
Observations	3,770	3,653	3,162	2,871	3,770

Results presented as odds ratios
P-values in parentheses
*** $p<0.01$, ** $p<0.05$, * $p<0.10$
Full cross-section sample

Indicator 2.10

Treatment Effect of Yaajeende on Improved Cooking Water Source, Prevalence
Linear difference-in-difference regression with survey weights

VARIABLES	(1) Co. water	(2) Co. water	(3) Co. water	(4) Co. water	(5) Co. water
Secular trend	0.066*	0.066*	0.066	0.066	0.067*
	(0.089)	(0.089)	(0.110)	(0.117)	(0.079)
Project (A or B) tr. eff.	-0.018				
	(0.716)				
Project ex ante	0.109				
	(0.140)				
Nutrition (A) tr. eff.		-0.019			-0.010
		(0.710)			(0.888)
Nutrition ex ante		0.105			0.060
		(0.160)			(0.469)
Agriculture (B) tr. eff.			-0.022		-0.025
			(0.673)		(0.618)
Agriculture ex ante			0.117		0.110
			(0.127)		(0.502)
Synergy (ABC) tr. eff.				-0.021	0.014
				(0.707)	(0.764)
High intensity (A and B)				0.111	-0.067
				(0.133)	(0.701)
Observations	3,350	3,302	2,865	2,660	3,350
R-squared	0.014	0.013	0.016	0.015	0.013
F-test synergy					0.0906

pval in parentheses
*** p<0.01, ** p<0.05, * p<0.1
Baseline villages cross-section sample

Treatment Effect of Yaajeende on Improved Cooking Water Source, Prevalence
Linear difference-in-difference regression with survey weights

VARIABLES	(1) Co. water	(2) Co. water	(3) Co. water	(4) Co. water	(5) Co. water
Secular trend	0.074*	0.074*	0.074*	0.074	0.076*
	(0.078)	(0.075)	(0.099)	(0.102)	(0.066)
Project (A or B) tr. eff.	-0.016				
	(0.767)				
Project ex ante	0.109				
	(0.167)				
Nutrition (A) tr. eff.		-0.016			-0.017
		(0.761)			(0.823)
Nutrition ex ante		0.105			0.060
		(0.183)			(0.496)
Agriculture (B) tr. eff.			-0.014		-0.018
			(0.794)		(0.756)
Agriculture ex ante			0.117		0.110
			(0.160)		(0.529)
Synergy (ABC) tr. eff.				-0.012	0.023
				(0.835)	(0.663)
High intensity (A and B)				0.111	-0.067
				(0.165)	(0.718)
Observations	3,770	3,653	3,162	2,871	3,770
R-squared	0.016	0.015	0.019	0.018	0.016
F-test synergy					0.191

pval in parentheses
*** $p<0.01$, ** $p<0.05$, * $p<0.1$
Full cross-section sample

Treatment Effect of Yaajeende on Improved Cooking Water Source, Prevalence
Logistic difference-in-difference regression with survey weights

VARIABLES	(1) Co. water	(2) Co. water	(3) Co. water	(4) Co. water	(5) Co. water
Secular trend	1.334*	1.334*	1.334	1.334	1.343*
	(0.095)	(0.095)	(0.117)	(0.124)	(0.086)
Project (A or B) tr. eff.	0.963				
	(0.878)				
Project ex ante	1.635				
	(0.143)				
Nutrition (A) tr. eff.		0.958			0.979
		(0.859)			(0.951)
Nutrition ex ante		1.600			1.308
		(0.164)			(0.475)
Agriculture (B) tr. eff.			0.948		0.930
			(0.831)		(0.792)
Agriculture ex ante			1.697		1.724
			(0.129)		(0.551)
Synergy (ABC) tr. eff.				0.951	1.037
				(0.852)	(0.901)
High intensity (A and B)				1.648	0.710
				(0.130)	(0.723)
Observations	3,350	3,302	2,865	2,660	3,350

Results presented as odds ratios
P-values in parentheses
*** $p<0.01$, ** $p<0.05$, * $p<0.10$
Baseline villages cross-section sample

Treatment Effect of Yaajeende on Improved Cooking Water Source, Prevalence
Logistic difference-in-difference regression with survey weights

VARIABLES	(1) Co. water	(2) Co. water	(3) Co. water	(4) Co. water	(5) Co. water
Secular trend	1.384*	1.384*	1.384	1.384	1.397*
	(0.084)	(0.081)	(0.105)	(0.109)	(0.074)
Project (A or B) tr. eff.	0.986				
	(0.955)				
Project ex ante	1.635				
	(0.171)				
Nutrition (A) tr. eff.		0.980			0.947
		(0.937)			(0.885)
Nutrition ex ante		1.600			1.308
		(0.187)			(0.502)
Agriculture (B) tr. eff.			1.002		0.970
			(0.995)		(0.904)
Agriculture ex ante			1.697		1.724
			(0.163)		(0.576)
Synergy (ABC) tr. eff.				1.011	1.090
				(0.969)	(0.765)
High intensity (A and B)				1.648	0.710
				(0.163)	(0.739)
Observations	3,770	3,653	3,162	2,871	3,770

Results presented as odds ratios
P-values in parentheses
*** $p<0.01$, ** $p<0.05$, * $p<0.10$
Full cross-section sample

Indicator 3.1

Treatment Effect of Yaajeende on Poverty
Linear difference-in-difference regression with survey weights

VARIABLES	(1) Poverty	(2) Poverty	(3) Poverty	(4) Poverty	(5) Poverty
Secular trend	0.430	0.430	0.430	0.430	0.444
	(0.168)	(0.168)	(0.195)	(0.204)	(0.148)
Project (A or B) tr. eff.	-2.527***				
	(0.001)				
Project ex ante	-2.563***				
	(0.000)				
Nutrition (A) tr. eff.		-2.570***			-1.525**
		(0.001)			(0.042)
Nutrition ex ante		-2.611***			-1.208
		(0.000)			(0.140)
Agriculture (B) tr. eff.			-2.844***		-1.208
			(0.005)		(0.277)
Agriculture ex ante			-3.016***		-1.374
			(0.001)		(0.317)
Synergy (ABC) tr. eff.				-2.917**	-0.197
				(0.011)	(0.885)
High intensity (A and B)				-3.116***	-0.569
				(0.000)	(0.755)
Observations	3,387	3,335	2,902	2,693	3,387
R-squared	0.055	0.057	0.075	0.079	0.069
F-test synergy					0.0211

pval in parentheses
*** $p<0.01$, ** $p<0.05$, * $p<0.1$
Baseline villages cross-section sample

Treatment Effect of Yaajeende on Poverty
Linear difference-in-difference regression with survey weights

	(1)	(2)	(3)	(4)	(5)
VARIABLES	Poverty	Poverty	Poverty	Poverty	Poverty
Secular trend	0.407	0.407	0.407	0.407	0.461
	(0.217)	(0.211)	(0.246)	(0.250)	(0.158)
Project (A or B) tr. eff.	-2.293***				
	(0.003)				
Project ex ante	-2.563***				
	(0.001)				
Nutrition (A) tr. eff.		-2.382***			-1.478**
		(0.003)			(0.048)
Nutrition ex ante		-2.611***			-1.208
		(0.001)			(0.168)
Agriculture (B) tr. eff.			-2.697***		-0.991
			(0.007)		(0.291)
Agriculture ex ante			-3.016***		-1.374
			(0.001)		(0.352)
Synergy (ABC) tr. eff.				-2.839**	-0.424
				(0.011)	(0.745)
High intensity (A and B)				-3.116***	-0.569
				(0.001)	(0.770)
Observations	3,817	3,695	3,205	2,909	3,817
R-squared	0.050	0.053	0.072	0.077	0.066
F-test synergy					0.107

pval in parentheses
*** $p<0.01$, ** $p<0.05$, * $p<0.1$
Full cross-section sample

Treatment Effect of Yaajeende on Poverty
Logistic difference-in-difference regression with survey weights

VARIABLES	(1) Poverty	(2) Poverty	(3) Poverty	(4) Poverty	(5) Poverty
Secular trend	1.018	1.018	1.018	1.018	1.019
	(0.168)	(0.168)	(0.195)	(0.204)	(0.146)
Project (A or B) tr. eff.	0.894***				
	(0.001)				
Project ex ante	0.895***				
	(0.000)				
Nutrition (A) tr. eff.		0.892***			0.936**
		(0.001)			(0.045)
Nutrition ex ante		0.893***			0.949
		(0.000)			(0.142)
Agriculture (B) tr. eff.			0.881***		0.947
			(0.005)		(0.281)
Agriculture ex ante			0.877***		0.942
			(0.001)		(0.320)
Synergy (ABC) tr. eff.				0.878**	0.989
				(0.012)	(0.864)
High intensity (A and B)				0.873***	0.975
				(0.000)	(0.752)
Observations	3,387	3,335	2,902	2,693	3,387

Results presented as odds ratios
P-values in parentheses
*** $p<0.01$, ** $p<0.05$, * $p<0.10$
Baseline villages cross-section sample

Treatment Effect of Yaajeende on Poverty
Logistic difference-in-difference regression with survey weights

VARIABLES	(1) Poverty	(2) Poverty	(3) Poverty	(4) Poverty	(5) Poverty
Secular trend	1.017	1.017	1.017	1.017	1.020
	(0.217)	(0.211)	(0.246)	(0.250)	(0.157)
Project (A or B) tr. eff.	0.904***				
	(0.004)				
Project ex ante	0.895***				
	(0.001)				
Nutrition (A) tr. eff.		0.900***			0.938*
		(0.003)			(0.051)
Nutrition ex ante		0.893***			0.949
		(0.001)			(0.170)
Agriculture (B) tr. eff.			0.887***		0.957
			(0.007)		(0.291)
Agriculture ex ante			0.877***		0.942
			(0.002)		(0.355)
Synergy (ABC) tr. eff.				0.881**	0.979
				(0.012)	(0.720)
High intensity (A and B)				0.873***	0.975
				(0.001)	(0.768)
Observations	3,817	3,695	3,205	2,909	3,817

Results presented as odds ratios
P-values in parentheses
*** $p<0.01$, ** $p<0.05$, * $p<0.10$
Full cross-section sample

Indicator 3.2

Treatment Effect of Yaajeende on Surface Area Planted
Linear difference-in-difference regression with survey weights

VARIABLES	(1) Agriculture ha	(2) Agriculture ha	(3) Agriculture ha	(4) Agriculture ha	(5) Agriculture ha
Secular trend	1.780***	1.780***	1.780**	1.780**	1.759***
	(0.009)	(0.009)	(0.015)	(0.017)	(0.009)
Project (A or B) tr. eff.	-0.648				
	(0.365)				
Project ex ante	-0.711***				
	(0.000)				
Nutrition (A) tr. eff.		-0.652			-0.822
		(0.364)			(0.231)
Nutrition ex ante		-0.732***			-0.524**
		(0.000)			(0.012)
Agriculture (B) tr. eff.			-0.570		0.079
			(0.446)		(0.861)
Agriculture ex ante			-0.789***		-0.327*
			(0.000)		(0.094)
Synergy (ABC) tr. eff.				-0.573	0.192
				(0.456)	(0.700)
High intensity (A and B)				-0.802***	0.031
				(0.000)	(0.891)
Observations	3,298	3,246	2,831	2,632	3,298
R-squared	0.032	0.033	0.032	0.032	0.033
F-test synergy					0.149

pval in parentheses
*** p<0.01, ** p<0.05, * p<0.1
Baseline villages cross-section sample

Treatment Effect of Yaajeende on Surface Area Planted
Linear difference-in-difference regression with survey weights

VARIABLES	(1) Agriculture ha	(2) Agriculture ha	(3) Agriculture ha	(4) Agriculture ha	(5) Agriculture ha
Secular trend	1.863***	1.863***	1.863**	1.863**	1.830***
	(0.009)	(0.008)	(0.014)	(0.015)	(0.008)
Project (A or B) tr. eff.	-0.759				
	(0.306)				
Project ex ante	-0.711***				
	(0.000)				
Nutrition (A) tr. eff.		-0.765			-0.799
		(0.298)			(0.252)
Nutrition ex ante		-0.732***			-0.524**
		(0.000)			(0.019)
Agriculture (B) tr. eff.			-0.717		-0.135
			(0.359)		(0.781)
Agriculture ex ante			-0.789***		-0.327
			(0.000)		(0.117)
Synergy (ABC) tr. eff.				-0.733	0.233
				(0.356)	(0.656)
High intensity (A and B)				-0.802***	0.031
				(0.000)	(0.897)
Observations	3,723	3,602	3,129	2,844	3,723
R-squared	0.033	0.034	0.033	0.034	0.034
F-test synergy					0.200

pval in parentheses
*** $p<0.01$, ** $p<0.05$, * $p<0.1$
Full cross-section sample

Indicator 3.3

Treatment Effect of Yaajeende on Surface Area for Horticulture
Linear difference-in-difference regression with survey weights

VARIABLES	(1) Horticulture ha	(2) Horticulture ha	(3) Horticulture ha	(4) Horticulture ha	(5) Horticulture ha
Secular trend	0.034**	0.034**	0.034**	0.034**	0.032**
	(0.031)	(0.031)	(0.042)	(0.047)	(0.044)
Project (A or B) tr. eff.	0.122***				
	(0.002)				
Project ex ante	0.002				
	(0.829)				
Nutrition (A) tr. eff.		0.124***			0.108**
		(0.002)			(0.049)
Nutrition ex ante		0.003			-0.005
		(0.811)			(0.723)
Agriculture (B) tr. eff.			0.128***		0.077
			(0.008)		(0.368)
Agriculture ex ante			0.005		-0.004
			(0.711)		(0.793)
Synergy (ABC) tr. eff.				0.125**	-0.057
				(0.018)	(0.568)
High intensity (A and B)				0.006	0.015
				(0.640)	(0.370)
Observations	3,394	3,342	2,908	2,699	3,394
R-squared	0.015	0.015	0.015	0.014	0.016
F-test synergy					0.328

pval in parentheses
*** p<0.01, ** p<0.05, * p<0.1
Baseline villages cross-section sample

Treatment Effect of Yaajeende on Surface Area for Horticulture
Linear difference-in-difference regression with survey weights

	(1)	(2)	(3)	(4)	(5)
	Horticulture	Horticulture	Horticulture	Horticulture	Horticulture
VARIABLES	ha	ha	ha	ha	ha
Secular trend	0.042**	0.042**	0.042**	0.042**	0.060**
	(0.023)	(0.021)	(0.033)	(0.035)	(0.037)
Project (A or B) tr. eff.	0.272				
	(0.107)				
Project ex ante	0.002				
	(0.840)				
Nutrition (A) tr. eff.		0.281			0.626
		(0.103)			(0.245)
Nutrition ex ante		0.003			-0.005
		(0.821)			(0.741)
Agriculture (B) tr. eff.			0.129***		-0.278
			(0.006)		(0.463)
Agriculture ex ante			0.005		-0.004
			(0.730)		(0.806)
Synergy (ABC) tr. eff.				0.128**	-0.237
				(0.012)	(0.295)
High intensity (A and B)				0.006	0.015
				(0.660)	(0.404)
Observations	3,824	3,702	3,211	2,915	3,824
R-squared	0.003	0.003	0.016	0.016	0.006
F-test synergy					1.107

pval in parentheses
*** $p<0.01$, ** $p<0.05$, * $p<0.1$
Full cross-section sample

Indicator 3.4

Treatment Effect of Yaajeende on Surface Area for Irrigation
Linear difference-in-difference regression with survey weights

VARIABLES	(1) Irrigation ha	(2) Irrigation ha	(3) Irrigation ha	(4) Irrigation ha	(5) Irrigation ha
Project ex ante	0.077**				
	(0.014)				
Nutrition ex ante		0.079**			0.012
		(0.013)			(0.616)
Agriculture ex ante			0.095**		-0.020
			(0.010)		(0.284)
High intensity (A and B)				0.109***	0.116***
				(0.003)	(0.006)
Observations	2,102	2,070	1,807	1,679	2,102
R-squared	0.005	0.006	0.009	0.011	0.011
F-test synergy					7.864

pval in parentheses
*** $p<0.01$, ** $p<0.05$, * $p<0.1$
Baseline villages cross-section sample

Treatment Effect of Yaajeende on Surface Area for Irrigation
Linear difference-in-difference regression with survey weights

VARIABLES	(1) Irrigation ha	(2) Irrigation ha	(3) Irrigation ha	(4) Irrigation ha	(5) Irrigation ha
Project ex ante	0.066**				
	(0.021)				
Nutrition ex ante		0.068**			0.007
		(0.019)			(0.722)
Agriculture ex ante			0.086**		-0.008
			(0.015)		(0.596)
High intensity (A and B)				0.098***	0.098**
				(0.005)	(0.018)
Observations	2,532	2,430	2,110	1,895	2,532
R-squared	0.004	0.004	0.007	0.009	0.009
F-test synergy					5.789

pval in parentheses
*** p<0.01, ** p<0.05, * p<0.1
Full cross-section sample

Indicator 3.5

Treatment Effect of Yaajeende on Surface Area for Decrue
Linear difference-in-difference regression with survey weights

VARIABLES	(1) Decrue ha	(2) Decrue ha	(3) Decrue ha	(4) Decrue ha	(5) Decrue ha
Project ex ante	-0.012				
	(0.917)				
Nutrition ex ante		-0.009			-0.025
		(0.936)			(0.826)
Agriculture ex ante			-0.005		-0.067
			(0.965)		(0.273)
High intensity (A and B)				0.006	0.100*
				(0.964)	(0.087)
Observations	2,110	2,078	1,814	1,685	2,110
R-squared	0.000	0.000	0.000	0.000	0.000
F-test synergy					2.988

pval in parentheses
*** $p<0.01$, ** $p<0.05$, * $p<0.1$
Baseline villages cross-section sample

Treatment Effect of Yaajeende on Surface Area for Decrue
Linear difference-in-difference regression with survey weights

VARIABLES	(1) Decrue ha	(2) Decrue ha	(3) Decrue ha	(4) Decrue ha	(5) Decrue ha
Project ex ante	-0.016				
	(0.888)				
Nutrition ex ante		-0.013			-0.021
		(0.911)			(0.848)
Agriculture ex ante			-0.011		-0.070
			(0.927)		(0.243)
High intensity (A and B)				-0.001	0.094
				(0.993)	(0.143)
Observations	2,540	2,438	2,117	1,901	2,540
R-squared	0.000	0.000	0.000	0.000	0.000
F-test synergy					2.176

pval in parentheses
*** $p<0.01$, ** $p<0.05$, * $p<0.1$
Full cross-section sample

Indicator 3.6

Treatment Effect of Yaajeende on Agriculture Production
Linear difference-in-difference regression with survey weights

VARIABLES	(1) Production kg	(2) Production kg	(3) Production kg	(4) Production kg	(5) Production kg
Secular trend	-464.074***	-464.074***	-464.074***	-464.074***	-451.951***
	(0.004)	(0.004)	(0.007)	(0.008)	(0.004)
Project (A or B) tr. eff.	129.916				
	(0.447)				
Project ex ante	-436.031***				
	(0.007)				
Nutrition (A) tr. eff.		127.383			241.142
		(0.457)			(0.167)
Nutrition ex ante		-438.577***			-629.191***
		(0.007)			(0.000)
Agriculture (B) tr. eff.			81.839		-102.208
			(0.661)		(0.441)
Agriculture ex ante			-371.918**		-203.737
			(0.041)		(0.129)
Synergy (ABC) tr. eff.				81.106	-69.951
				(0.678)	(0.617)
High intensity (A and B)				-331.768*	505.395***
				(0.072)	(0.006)
Observations	3,380	3,328	2,898	2,689	3,380
R-squared	0.029	0.029	0.027	0.024	0.034
F-test synergy					0.252

pval in parentheses
*** p<0.01, ** p<0.05, * p<0.1
Baseline villages cross-section sample

Treatment Effect of Yaajeende on Agriculture Production
Linear difference-in-difference regression with survey weights

VARIABLES	(1) Production kg	(2) Production kg	(3) Production kg	(4) Production kg	(5) Production kg
Secular trend	-433.696**	-433.696**	-433.696**	-433.696**	-425.404**
	(0.012)	(0.011)	(0.019)	(0.020)	(0.012)
Project (A or B) tr. eff.	101.451				
	(0.584)				
Project ex ante	-436.031**				
	(0.012)				
Nutrition (A) tr. eff.		105.085			306.625
		(0.567)			(0.121)
Nutrition ex ante		-438.577**			-629.191***
		(0.011)			(0.000)
Agriculture (B) tr. eff.			28.887		-229.482
			(0.886)		(0.146)
Agriculture ex ante			-371.918*		-203.737
			(0.055)		(0.154)
Synergy (ABC) tr. eff.				28.804	-56.632
				(0.890)	(0.728)
High intensity (A and B)				-331.768*	505.395***
				(0.089)	(0.010)
Observations	3,810	3,688	3,201	2,905	3,810
R-squared	0.029	0.029	0.029	0.026	0.034
F-test synergy					0.122

pval in parentheses
*** $p<0.01$, ** $p<0.05$, * $p<0.1$
Full cross-section sample

Indicator 3.7

Treatment Effect of Yaajeende on Agriculture Revenue
Linear difference-in-difference regression with survey weights

	(1)	(2)	(3)	(4)	(5)
	Revenue	Revenue	Revenue	Revenue	Revenue
VARIABLES	FCFA	FCFA	FCFA	FCFA	FCFA
Secular trend	-30,050.084***	-30,050.084***	-30,050.084***	-30,050.084**	-29,280.488***
	(0.005)	(0.006)	(0.009)	(0.011)	(0.006)
Project (A or B) tr. eff.	27,440.918**				
	(0.034)				
Project ex ante	-37,877.574***				
	(0.002)				
Nutrition (A) tr. eff.		27,569.224**			28,133.139**
		(0.035)			(0.017)
Nutrition ex ante		-38,028.271***			-44,688.164***
		(0.002)			(0.000)
Agriculture (B) tr. eff.			26,397.362**		21.419
			(0.044)		(0.999)
Agriculture ex ante			-34,530.300**		1,308.502
			(0.011)		(0.942)
Synergy (ABC) tr. eff.				26,950.362**	-1,973.792
				(0.034)	(0.897)
High intensity (A and B)				-34,663.509***	9,884.734
				(0.008)	(0.576)
Observations	3,392	3,340	2,906	2,698	3,392
R-squared	0.018	0.018	0.015	0.016	0.018
F-test synergy					0.0167

pval in parentheses
*** $p<0.01$, ** $p<0.05$, * $p<0.1$
Baseline villages cross-section sample

Treatment Effect of Yaajeende on Agriculture Revenue
Linear difference-in-difference regression with survey weights

VARIABLES	(1) Revenue FCFA	(2) Revenue FCFA	(3) Revenue FCFA	(4) Revenue FCFA	(5) Revenue FCFA
Secular trend	-30,410.877***	-30,410.877***	-30,410.877**	-30,410.877**	-30,082.319***
	(0.008)	(0.007)	(0.013)	(0.014)	(0.007)
Project (A or B) tr. eff.	26,219.301*				
	(0.051)				
Project ex ante	-37,877.574***				
	(0.003)				
Nutrition (A) tr. eff.		26,560.685**			29,182.501**
		(0.047)			(0.020)
Nutrition ex ante		-38,028.271***			-44,688.164***
		(0.003)			(0.001)
Agriculture (B) tr. eff.			25,117.061*		-4,551.285
			(0.070)		(0.770)
Agriculture ex ante			-34,530.300**		1,308.502
			(0.016)		(0.945)
Synergy (ABC) tr. eff.				25,852.099*	892.326
				(0.051)	(0.958)
High intensity (A and B)				-34,663.509**	9,884.734
				(0.011)	(0.601)
Observations	3,822	3,700	3,209	2,914	3,822
R-squared	0.019	0.019	0.017	0.017	0.020
F-test synergy					0.00277

pval in parentheses
*** $p<0.01$, ** $p<0.05$, * $p<0.1$
Full cross-section sample

Indicator 3.8

Treatment Effect of Yaajeende on Seed Purchase, Prevalence
Linear difference-in-difference regression with survey weights

	(1)	(2)	(3)	(4)	(5)
VARIABLES	Seed purchase	Seed purchase	Seed purchase	Seed purchase	Seed purchase
Secular trend	-0.502***	-0.502***	-0.502***	-0.502***	-0.520***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Project (A or B) tr. eff.	0.092**				
	(0.015)				
Project ex ante	-0.048				
	(0.199)				
Nutrition (A) tr. eff.		0.102***			0.065
		(0.007)			(0.322)
Nutrition ex ante		-0.058			-0.035
		(0.120)			(0.608)
Agriculture (B) tr. eff.			0.118***		0.098
			(0.004)		(0.521)
Agriculture ex ante			-0.073*		-0.120
			(0.073)		(0.470)
Synergy (ABC) tr. eff.				0.117***	-0.028
				(0.003)	(0.848)
High intensity (A and B)				-0.065*	0.070
				(0.096)	(0.665)
Observations	3,385	3,333	2,901	2,692	3,385
R-squared	0.261	0.257	0.257	0.259	0.265
F-test synergy					0.0370

pval in parentheses
*** $p<0.01$, ** $p<0.05$, * $p<0.1$
Baseline villages cross-section sample

Treatment Effect of Yaajeende on Seed Purchase, Prevalence
Linear difference-in-difference regression with survey weights

	(1)	(2)	(3)	(4)	(5)
VARIABLES	Seed purchase	Seed purchase	Seed purchase	Seed purchase	Seed purchase
Secular trend	-0.503***	-0.503***	-0.503***	-0.503***	-0.521***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Project (A or B) tr. eff.	0.085**				
	(0.034)				
Project ex ante	-0.048				
	(0.233)				
Nutrition (A) tr. eff.		0.096**			0.060
		(0.016)			(0.398)
Nutrition ex ante		-0.058			-0.035
		(0.143)			(0.634)
Agriculture (B) tr. eff.			0.112**		0.102
			(0.012)		(0.541)
Agriculture ex ante			-0.073*		-0.120
			(0.099)		(0.497)
Synergy (ABC) tr. eff.				0.111***	-0.033
				(0.008)	(0.835)
High intensity (A and B)				-0.065	0.070
				(0.124)	(0.686)
Observations	3,814	3,692	3,204	2,908	3,814
R-squared	0.269	0.264	0.264	0.265	0.273
F-test synergy					0.0435

pval in parentheses
*** $p<0.01$, ** $p<0.05$, * $p<0.1$
Full cross-section sample

Treatment Effect of Yaajeende on Seed Purchase, Prevalence
Logistic difference-in-difference regression with survey weights

VARIABLES	(1) Seed purchase	(2) Seed purchase	(3) Seed purchase	(4) Seed purchase	(5) Seed purchase
Secular trend	0.034***	0.034***	0.034***	0.034***	0.033***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Project (A or B) tr. eff.	2.712***				
	(0.008)				
Project ex ante	0.826				
	(0.200)				
Nutrition (A) tr. eff.		2.833***			2.085*
		(0.006)			(0.094)
Nutrition ex ante		0.792			0.868
		(0.121)			(0.607)
Agriculture (B) tr. eff.			3.071***		1.025
			(0.005)		(0.963)
Agriculture ex ante			0.748*		0.616
			(0.074)		(0.477)
Synergy (ABC) tr. eff.				3.212***	1.544
				(0.004)	(0.411)
High intensity (A and B)				0.769*	1.329
				(0.097)	(0.669)
Observations	3,385	3,333	2,901	2,692	3,385

Results presented as odds ratios
P-values in parentheses
*** $p<0.01$, ** $p<0.05$, * $p<0.10$
Baseline villages cross-section sample

Treatment Effect of Yaajeende on Seed Purchase, Prevalence
Logistic difference-in-difference regression with survey weights

	(1)	(2)	(3)	(4)	(5)
VARIABLES	Seed purchase	Seed purchase	Seed purchase	Seed purchase	Seed purchase
Secular trend	0.033***	0.033***	0.033***	0.033***	0.032***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Project (A or B) tr. eff.	2.505**				
	(0.020)				
Project ex ante	0.826				
	(0.233)				
Nutrition (A) tr. eff.		2.642**			1.964
		(0.013)			(0.135)
Nutrition ex ante		0.792			0.868
		(0.144)			(0.633)
Agriculture (B) tr. eff.			2.855**		1.054
			(0.012)		(0.927)
Agriculture ex ante			0.748		0.616
			(0.100)		(0.505)
Synergy (ABC) tr. eff.				2.995***	1.497
				(0.009)	(0.490)
High intensity (A and B)				0.769	1.329
				(0.125)	(0.690)
Observations	3,814	3,692	3,204	2,908	3,814

Results presented as odds ratios
P-values in parentheses
*** $p<0.01$, ** $p<0.05$, * $p<0.10$
Full cross-section sample

Indicator 3.9

Treatment Effect of Yaajeende on Fertiilizer Purchase, Prevalence
Linear difference-in-difference regression with survey weights

	(1)	(2)	(3)	(4)	(5)
VARIABLES	Fert. purchase	Fert. purchase	Fert. purchase	Fert. purchase	Fert. purchase
Secular trend	0.173***	0.173***	0.173***	0.173***	0.180***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Project (A or B) tr. eff.	0.013				
	(0.765)				
Project ex ante	-0.082**				
	(0.011)				
Nutrition (A) tr. eff.		0.006			-0.067*
		(0.898)			(0.070)
Nutrition ex ante		-0.085***			-0.095***
		(0.008)			(0.003)
Agriculture (B) tr. eff.			0.030		0.125*
			(0.583)		(0.088)
Agriculture ex ante			-0.080**		-0.002
			(0.025)		(0.932)
Synergy (ABC) tr. eff.				0.023	-0.042
				(0.605)	(0.669)
High intensity (A and B)				-0.081**	0.014
				(0.030)	(0.621)
Observations	3,320	3,270	2,838	2,640	3,320
R-squared	0.064	0.065	0.064	0.063	0.075
F-test synergy					0.184

pval in parentheses
*** p<0.01, ** p<0.05, * p<0.1
Baseline villages cross-section sample

Treatment Effect of Yaajeende on Fertiilizer Purchase, Prevalence
Linear difference-in-difference regression with survey weights

	(1)	(2)	(3)	(4)	(5)
VARIABLES	Fert. purchase	Fert. purchase	Fert. purchase	Fert. purchase	Fert. purchase
Secular trend	0.169***	0.169***	0.169***	0.169***	0.174***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Project (A or B) tr. eff.	0.037				
	(0.415)				
Project ex ante	-0.082**				
	(0.016)				
Nutrition (A) tr. eff.		0.032			-0.019
		(0.486)			(0.758)
Nutrition ex ante		-0.085**			-0.095***
		(0.012)			(0.005)
Agriculture (B) tr. eff.			0.052		0.067
			(0.353)		(0.392)
Agriculture ex ante			-0.080**		-0.002
			(0.035)		(0.936)
Synergy (ABC) tr. eff.				0.049	-0.004
				(0.318)	(0.965)
High intensity (A and B)				-0.081**	0.014
				(0.039)	(0.640)
Observations	3,738	3,618	3,136	2,851	3,738
R-squared	0.062	0.062	0.063	0.062	0.068
F-test synergy					0.00191

pval in parentheses
*** p<0.01, ** p<0.05, * p<0.1
Full cross-section sample

Treatment Effect of Yaajeende on Fertiilizer Purchase, Prevalence
Logistic difference-in-difference regression with survey weights

VARIABLES	(1) Fert. purchase	(2) Fert. purchase	(3) Fert. purchase	(4) Fert. purchase	(5) Fert. purchase
Secular trend	3.141***	3.141***	3.141***	3.141***	3.193***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Project (A or B) tr. eff.	2.718*				
	(0.066)				
Project ex ante	0.255**				
	(0.010)				
Nutrition (A) tr. eff.		2.834*			2.407
		(0.079)			(0.204)
Nutrition ex ante		0.230**			0.159**
		(0.010)			(0.017)
Agriculture (B) tr. eff.			2.854		2.123*
			(0.120)		(0.056)
Agriculture ex ante			0.271**		0.948
			(0.040)		(0.934)
Synergy (ABC) tr. eff.				2.820	0.543
				(0.151)	(0.484)
High intensity (A and B)				0.262*	1.700
				(0.062)	(0.571)
Observations	3,320	3,270	2,838	2,640	3,320

Results presented as odds ratios
P-values in parentheses
*** $p<0.01$, ** $p<0.05$, * $p<0.10$
Baseline villages cross-section sample

Treatment Effect of Yaajeende on Fertiilizer Purchase, Prevalence
Logistic difference-in-difference regression with survey weights

VARIABLES	(1) Fert. purchase	(2) Fert. purchase	(3) Fert. purchase	(4) Fert. purchase	(5) Fert. purchase
Secular trend	3.073***	3.073***	3.073***	3.073***	3.111***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Project (A or B) tr. eff.	3.106**				
	(0.046)				
Project ex ante	0.255**				
	(0.015)				
Nutrition (A) tr. eff.		3.294*			3.336
		(0.052)			(0.142)
Nutrition ex ante		0.230**			0.159**
		(0.014)			(0.029)
Agriculture (B) tr. eff.			3.207*		1.494
			(0.096)		(0.386)
Agriculture ex ante			0.271*		0.948
			(0.051)		(0.938)
Synergy (ABC) tr. eff.				3.247	0.643
				(0.119)	(0.623)
High intensity (A and B)				0.262*	1.700
				(0.074)	(0.595)
Observations	3,738	3,618	3,136	2,851	3,738

Results presented as odds ratios
P-values in parentheses
*** p<0.01, ** p<0.05, * p<0.10
Full cross-section sample

Indicator 3.10

Treatment Effect of Yaajeende on Agriculture Investment, Index
Linear difference-in-difference regression with survey weights

	(1)	(2)	(3)	(4)	(5)
VARIABLES	Agr techniques Index	Agr techniques Index	Agr techniques Index	Agr techniques Index	Agr techniques Index
Project ex ante	0.172				
	(0.207)				
Nutrition ex ante		0.183			0.246
		(0.167)			(0.196)
Agriculture ex ante			0.160		-0.006
			(0.297)		(0.978)
High intensity (A and B)				0.160	-0.069
				(0.269)	(0.776)
Observations	1,914	1,882	1,640	1,530	1,914
R-squared	0.002	0.002	0.002	0.002	0.002
F-test synergy					0.0811

pval in parentheses
*** $p<0.01$, ** $p<0.05$, * $p<0.1$
Baseline villages cross-section sample

Treatment Effect of Yaajeende on Agriculture Investment, Index
Linear difference-in-difference regression with survey weights

	(1)	(2)	(3)	(4)	(5)
VARIABLES	Agr techniques Index	Agr techniques Index	Agr techniques Index	Agr techniques Index	Agr techniques Index
Project ex ante	0.212				
	(0.148)				
Nutrition ex ante		0.221			0.189
		(0.122)			(0.277)
Agriculture ex ante			0.228		0.081
			(0.159)		(0.741)
High intensity (A and B)				0.234	-0.029
				(0.137)	(0.912)
Observations	2,269	2,174	1,881	1,697	2,269
R-squared	0.002	0.003	0.003	0.003	0.003
F-test synergy					0.0122

pval in parentheses
*** $p<0.01$, ** $p<0.05$, * $p<0.1$
Full cross-section sample

Indicator 3.11

Treatment Effect of Yaajeende on Improved Seed Source, Prevalence
Linear difference-in-difference regression with survey weights

	(1)	(2)	(3)	(4)	(5)
VARIABLES	Seed source	Seed source	Seed source	Seed source	Seed source
Project ex ante	0.101***				
	(0.002)				
Nutrition ex ante		0.103***			0.080**
		(0.003)			(0.046)
Agriculture ex ante			0.109***		0.045
			(0.003)		(0.322)
High intensity (A and B)				0.110***	-0.014
				(0.006)	(0.793)
Observations	1,914	1,882	1,640	1,530	1,914
R-squared	0.011	0.011	0.013	0.013	0.012
F-test synergy					0.0690

pval in parentheses
*** $p<0.01$, ** $p<0.05$, * $p<0.1$
Baseline villages cross-section sample

Treatment Effect of Yaajeende on Improved Seed Source, Prevalence
Linear difference-in-difference regression with survey weights

	(1)	(2)	(3)	(4)	(5)
VARIABLES	Seed source	Seed source	Seed source	Seed source	Seed source
Project ex ante	0.114***				
	(0.001)				
Nutrition ex ante		0.115***			0.086**
		(0.001)			(0.019)
Agriculture ex ante			0.123***		0.059
			(0.002)		(0.156)
High intensity (A and B)				0.124***	-0.023
				(0.004)	(0.678)
Observations	2,269	2,174	1,881	1,697	2,269
R-squared	0.013	0.013	0.016	0.017	0.014
F-test synergy					0.174

pval in parentheses
*** $p<0.01$, ** $p<0.05$, * $p<0.1$
Full cross-section sample

Indicator 3.12

Treatment Effect of Yaajeende on Use of CBSP / APS, Prevalence
Linear difference-in-difference regression with survey weights

	(1)	(2)	(3)	(4)	(5)
VARIABLES	CSBP use	CSBP use	CSBP use	CSBP use	CSBP use
Project ex ante	0.123***				
	(0.000)				
Nutrition ex ante		0.126***			0.079***
		(0.000)			(0.003)
Agriculture ex ante			0.140***		0.067
			(0.000)		(0.323)
High intensity (A and B)				0.143***	0.001
				(0.000)	(0.995)
Observations	1,916	1,884	1,642	1,531	1,916
R-squared	0.034	0.036	0.046	0.050	0.043
F-test synergy					4.37e-05

pval in parentheses
*** $p<0.01$, ** $p<0.05$, * $p<0.1$
Baseline villages cross-section sample

Treatment Effect of Yaajeende on Use of CBSP / APS, Prevalence
Linear difference-in-difference regression with survey weights

VARIABLES	(1) CSBP use	(2) CSBP use	(3) CSBP use	(4) CSBP use	(5) CSBP use
Project ex ante	0.126***				
	(0.000)				
Nutrition ex ante		0.131***			0.077***
		(0.000)			(0.002)
Agriculture ex ante			0.149***		0.060
			(0.000)		(0.322)
High intensity (A and B)				0.155***	0.023
				(0.000)	(0.772)
Observations	2,271	2,176	1,883	1,698	2,271
R-squared	0.033	0.036	0.049	0.054	0.046
F-test synergy					0.0845

pval in parentheses
*** $p<0.01$, ** $p<0.05$, * $p<0.1$
Full cross-section sample

Indicator 3.13

Treatment Effect of Yaajeende on Improved Fertilizer Source, Prevalence
Linear difference-in-difference regression with survey weights

	(1)	(2)	(3)	(4)	(5)
VARIABLES	Fert. source	Fert. source	Fert. source	Fert. source	Fert. source
Project ex ante	-0.020				
	(0.673)				
Nutrition ex ante		-0.025			-0.101**
		(0.607)			(0.019)
Agriculture ex ante			-0.001		0.021
			(0.984)		(0.737)
High intensity (A and B)				0.005	0.079
				(0.911)	(0.360)
Observations	1,915	1,883	1,640	1,530	1,915
R-squared	0.001	0.001	0.000	0.000	0.009
F-test synergy					0.845

pval in parentheses
*** $p<0.01$, ** $p<0.05$, * $p<0.1$
Baseline villages cross-section sample

Treatment Effect of Yaajeende on Improved Fertilizer Source, Prevalence
Linear difference-in-difference regression with survey weights

	(1)	(2)	(3)	(4)	(5)
VARIABLES	Fert. source	Fert. source	Fert. source	Fert. source	Fert. source
Project ex ante	0.003				
	(0.952)				
Nutrition ex ante		-0.000			-0.066
		(0.996)			(0.243)
Agriculture ex ante			0.022		-0.007
			(0.719)		(0.921)
High intensity (A and B)				0.031	0.098
				(0.504)	(0.279)
Observations	2,271	2,176	1,882	1,698	2,271
R-squared	0.000	0.000	0.001	0.001	0.007
F-test synergy					1.183

pval in parentheses
*** $p<0.01$, ** $p<0.05$, * $p<0.1$
Full cross-section sample

Indicator 3.14

Treatment Effect of Yaajeende on Agriculture Trainees, Head Count
Linear difference-in-difference regression with survey weights

	(1)	(2)	(3)	(4)	(5)
VARIABLES	Trainees	Trainees	Trainees	Trainees	Trainees
Project ex ante	0.004				
	(0.919)				
Nutrition ex ante		0.009			-0.003
		(0.833)			(0.961)
Agriculture ex ante			0.008		-0.156***
			(0.838)		(0.005)
High intensity (A and B)				0.030	0.190***
				(0.469)	(0.001)
Observations	2,615	2,576	2,251	2,093	2,615
R-squared	0.000	0.000	0.000	0.000	0.002
F-test synergy					11.16

pval in parentheses
*** $p<0.01$, ** $p<0.05$, * $p<0.1$
Baseline villages cross-section sample

Treatment Effect of Yaajeende on Agriculture Trainees, Head Count
Linear difference-in-difference regression with survey weights

	(1)	(2)	(3)	(4)	(5)
VARIABLES	Trainees	Trainees	Trainees	Trainees	Trainees
Project ex ante	0.040				
	(0.447)				
Nutrition ex ante		0.036			-0.035
		(0.483)			(0.594)
Agriculture ex ante			0.055		-0.030
			(0.228)		(0.828)
High intensity (A and B)				0.068	0.123
				(0.146)	(0.359)
Observations	3,045	2,936	2,554	2,309	3,045
R-squared	0.000	0.000	0.001	0.001	0.002
F-test synergy					0.848

pval in parentheses
*** $p<0.01$, ** $p<0.05$, * $p<0.1$
Full cross-section sample

Z-Scores Weight-for-Length, Length-for-Age, and Weight-for-Age

Treatment Effect of Yaajeende on Z-scores
Weight for length; Length for age; Weight for age
Linear difference-in-difference regression with survey weights

	(1)	(2)	(3)
VARIABLES	Z weight for length	Z length	Z weight
Secular Trend	-0.250***	-0.364**	-0.347***
	(0.00233)	(0.0380)	(0.000112)
Project ex ante	-0.380***	-0.146	-0.311***
	(3.35e-05)	(0.413)	(0.00900)
Treatment effect	0.153	0.412**	0.339***
	(0.134)	(0.0384)	(0.00354)
Observations	5,045	5,086	5,080
R-squared	0.014	0.003	0.004

P-values in parentheses
*** $p<0.01$, ** $p<0.05$, * $p<0.10$
Baseline villages cross-section sample

Coefficient Plots

Two coefficient plots per key indicator are presented here. The regressions are the same as are detailed in the preceding section.

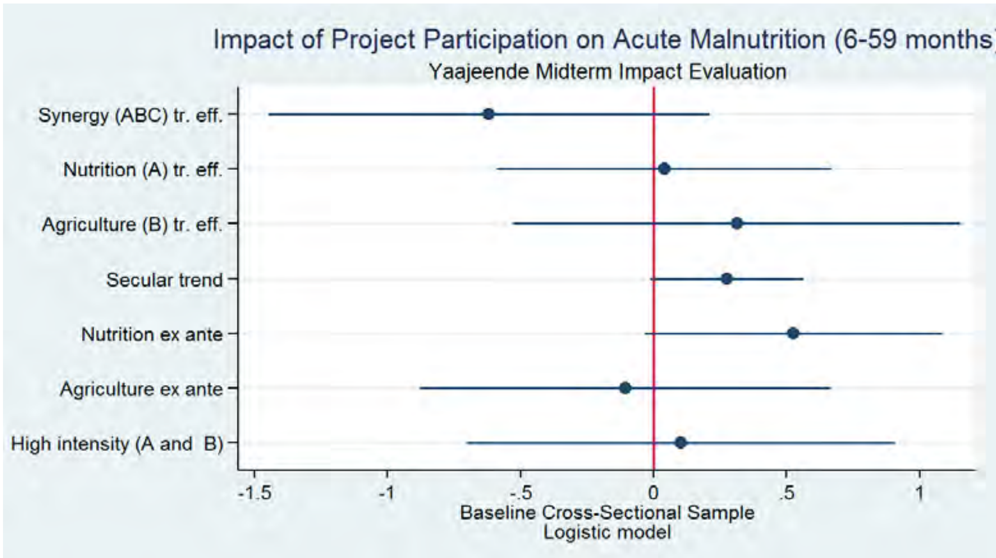

Figure 1: Coefficient Plot of Indicator 1-1, Baseline Sample

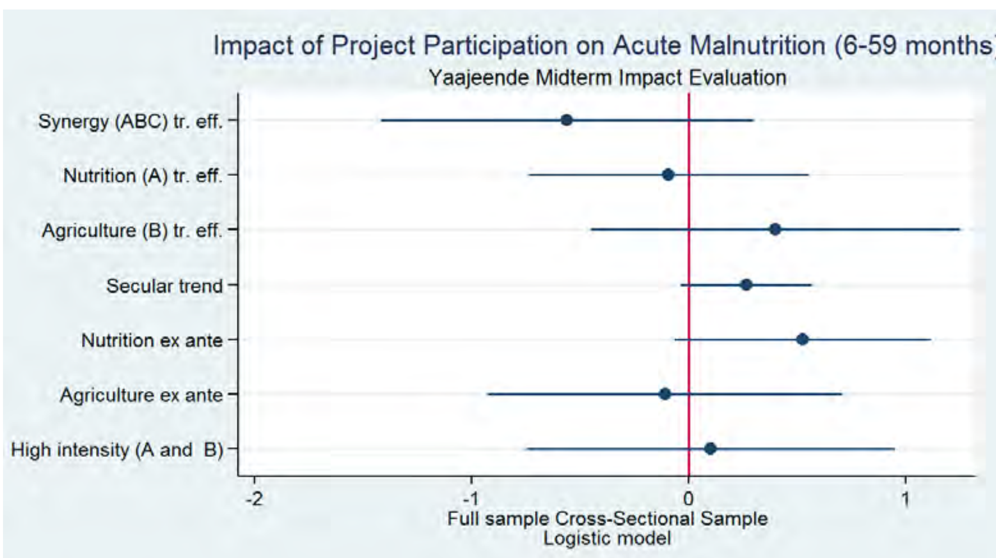

Figure 2: Coefficient Plot of Indicator 1-1, Full Cross-Section Sample

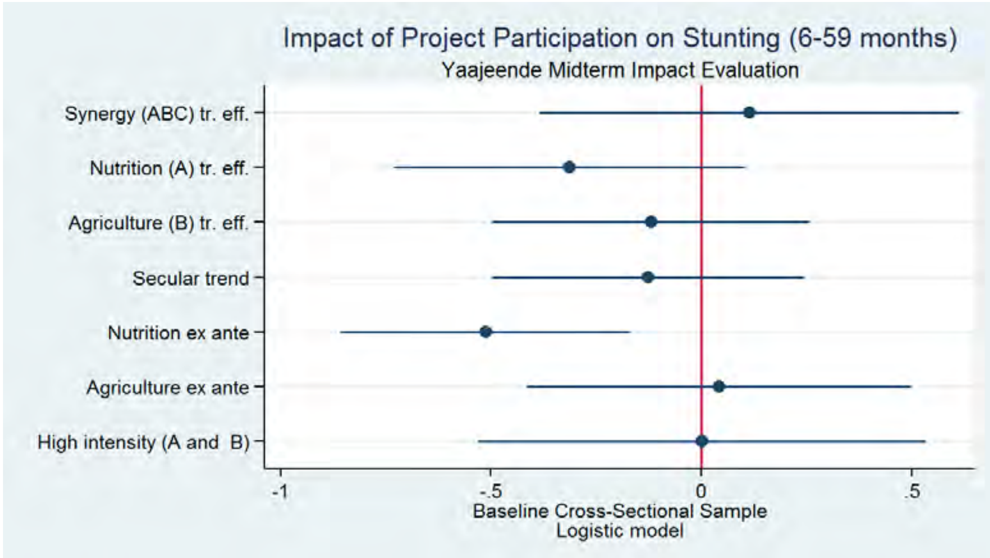

Figure 3: Coefficient Plot of Indicator 1-2, Baseline Sample

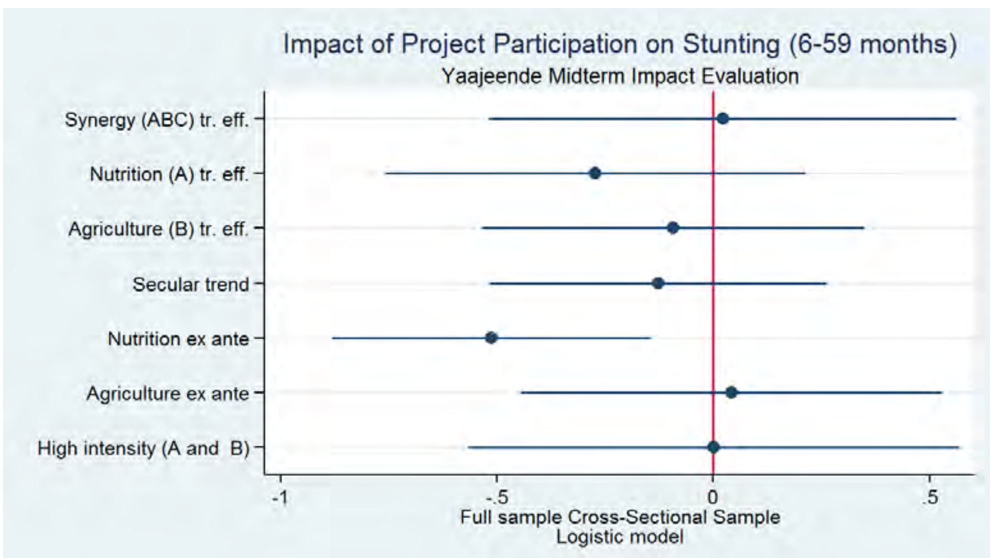

Figure 4: Coefficient Plot of Indicator 1-2, Full Cross-Section Sample

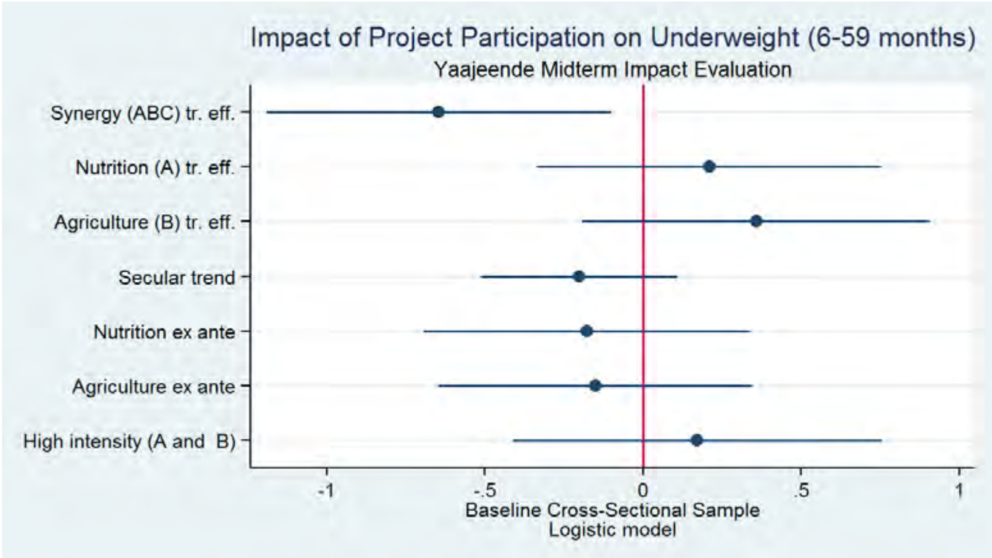

Figure 5: Coefficient Plot of Indicator 1-3, Baseline Sample

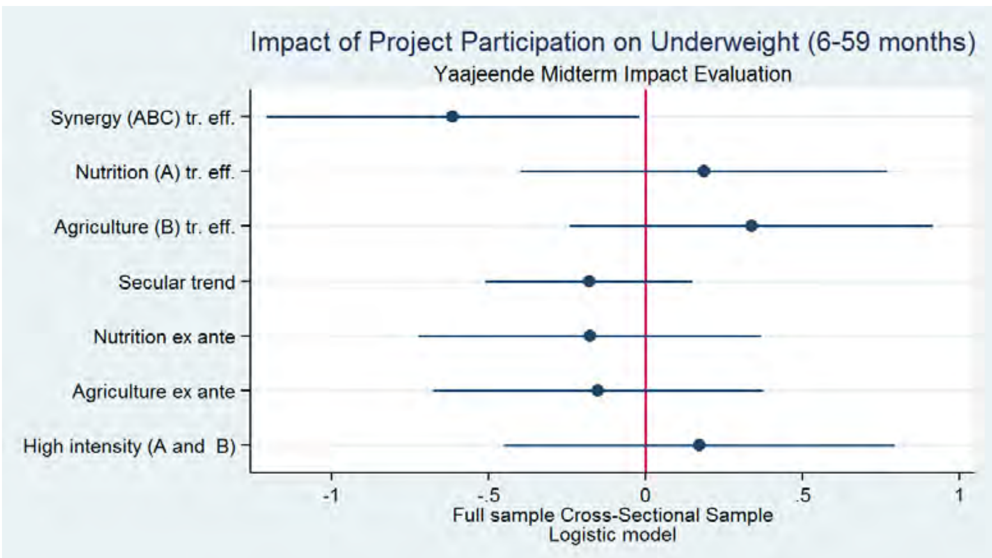

Figure 6: Coefficient Plot of Indicator 1-3, Full Cross-Section Sample

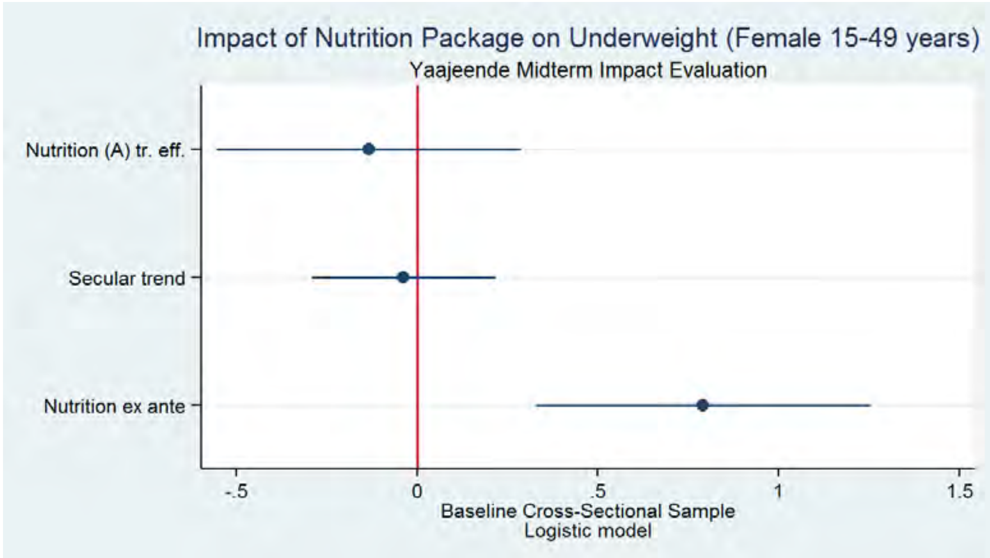

Figure 7: Coefficient Plot of Indicator 1-4, Baseline Sample

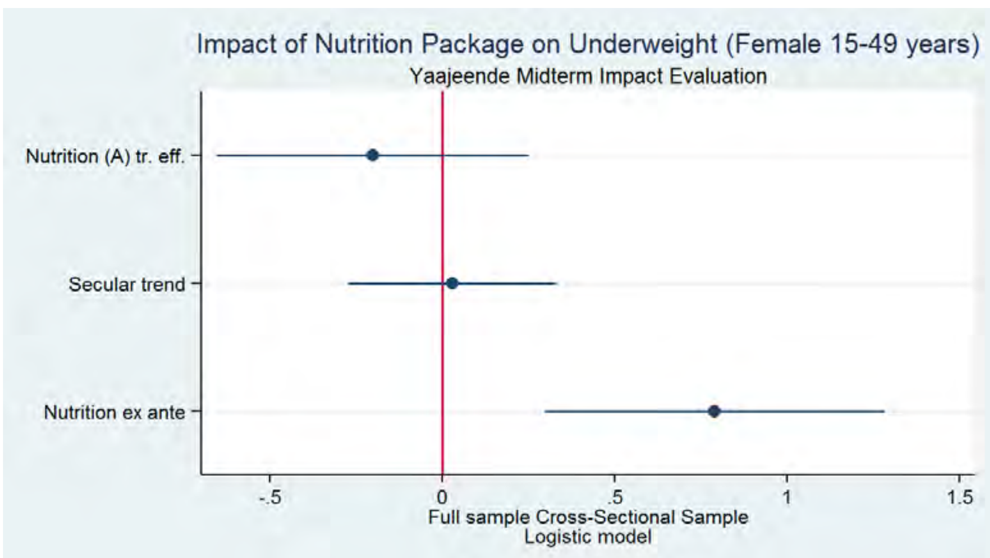

Figure 8: Coefficient Plot of Indicator 1-4, Full Cross-Section Sample

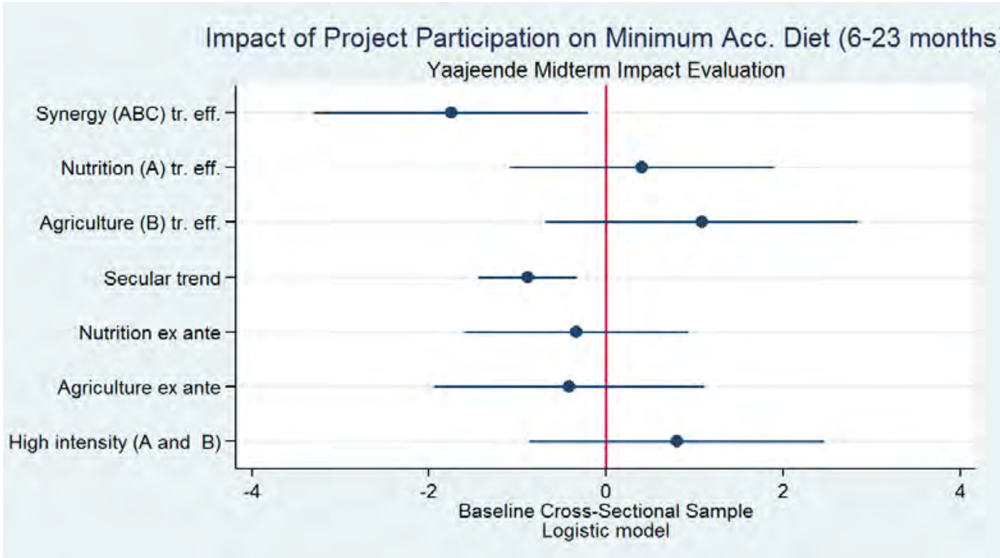

Figure 9: Coefficient Plot of Indicator 1-5, Baseline Sample

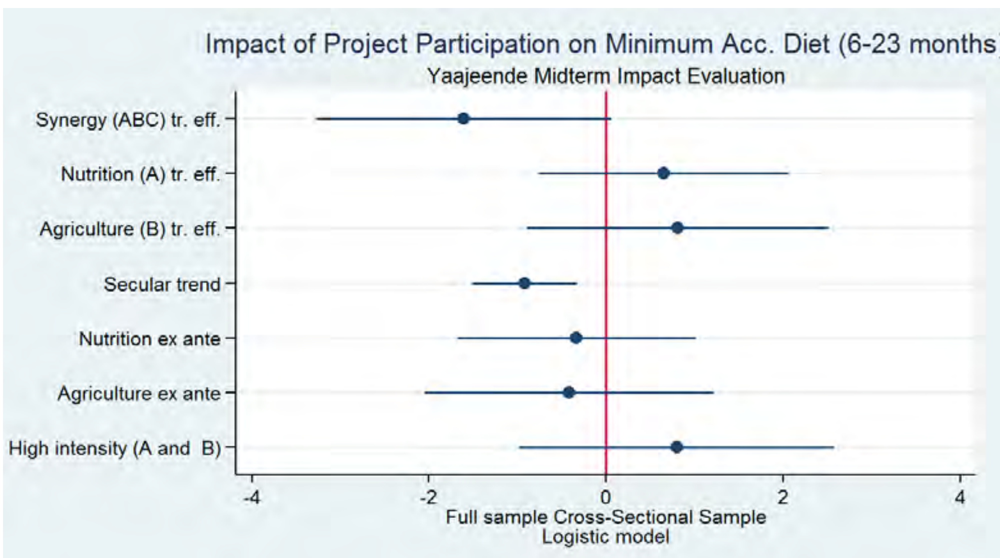

Figure 10: Coefficient Plot of Indicator 1-5, Full Cross-Section Sample

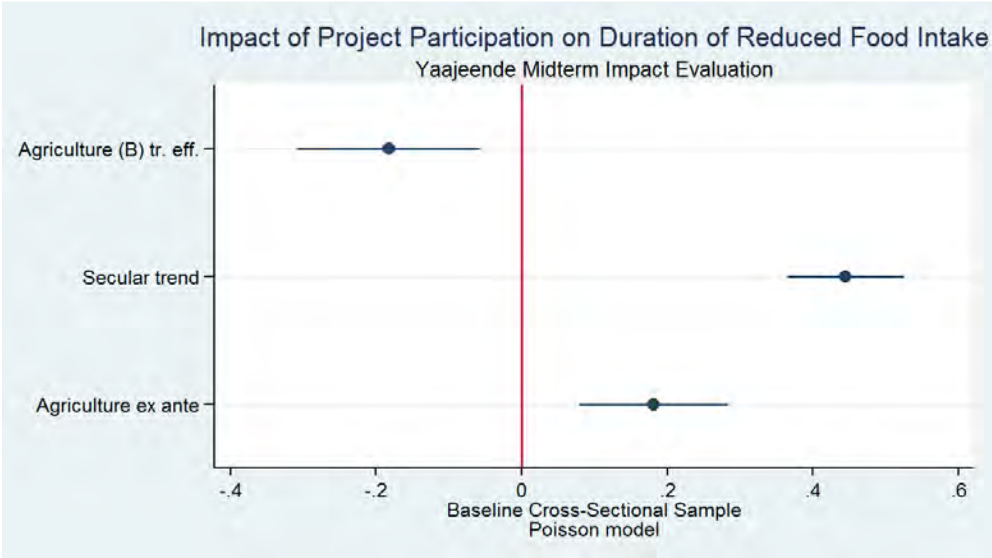

Figure 11: Coefficient Plot of Indicator 1-6, Baseline Sample

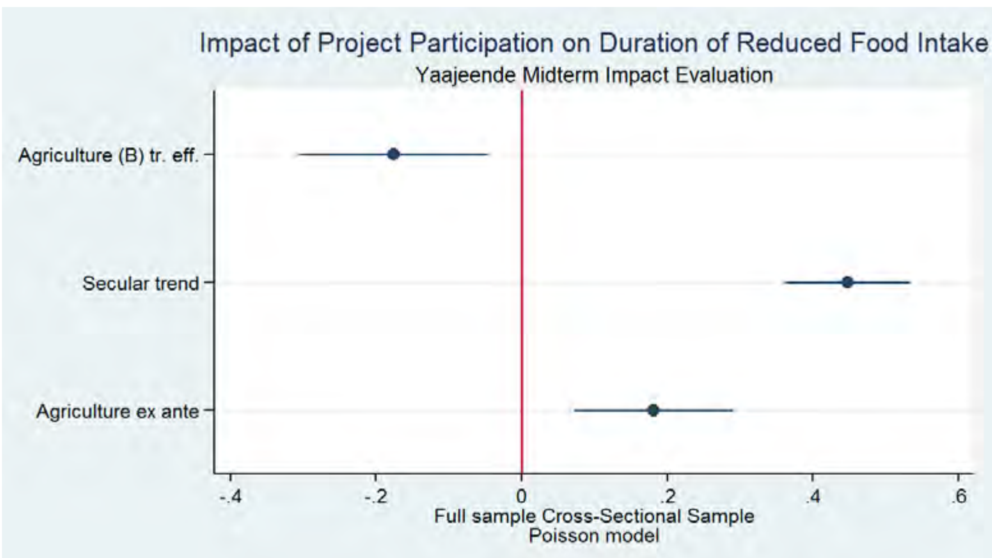

Figure 12: Coefficient Plot of Indicator 1-6, Full Cross-Section Sample

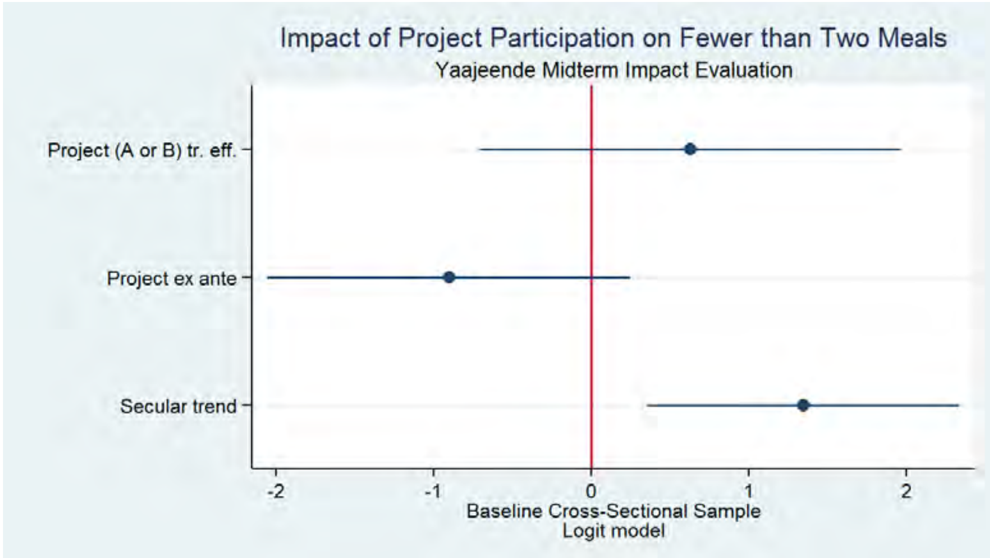

Figure 13: Coefficient Plot of Indicator 1-7, Baseline Sample

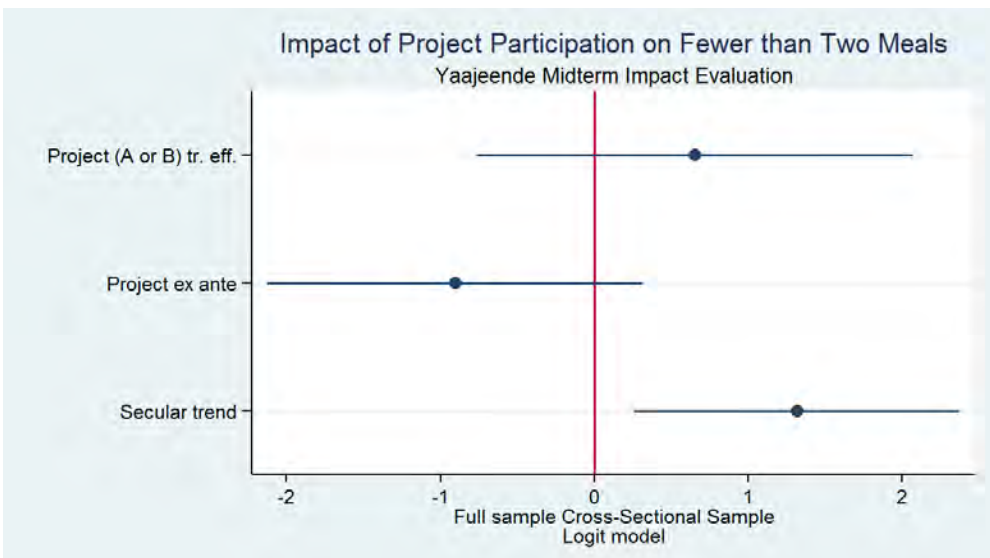

Figure 14: Coefficient Plot of Indicator 1-7, Full Cross-Section Sample

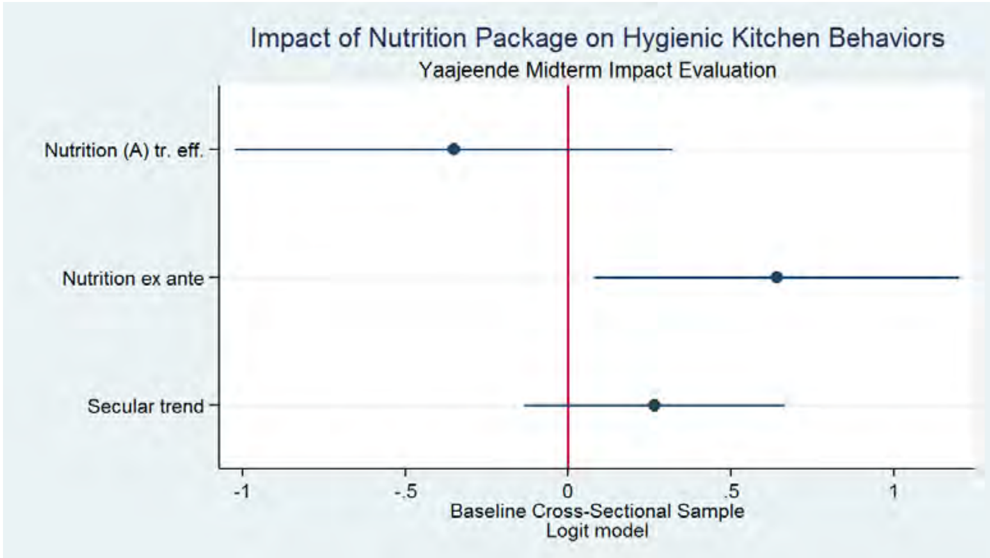

Figure 15: Coefficient Plot of Indicator 2-1, Baseline Sample

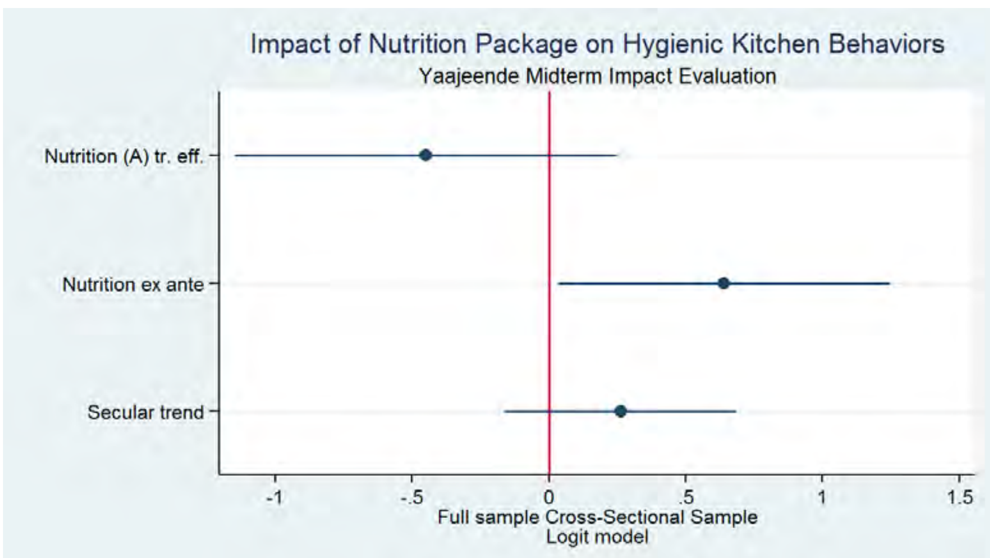

Figure 16: Coefficient Plot of Indicator 2-1, Full Cross-Section Sample

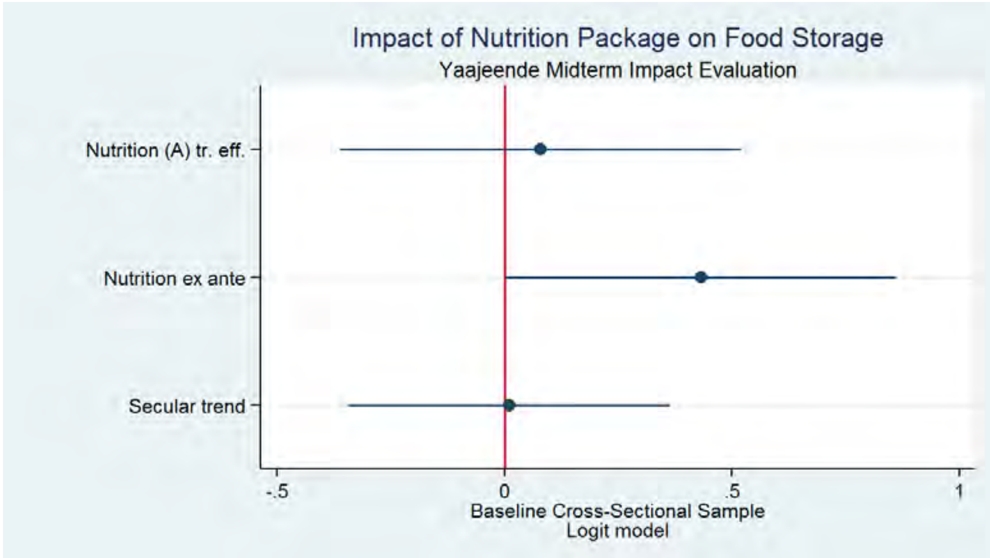

Figure 17: Coefficient Plot of Indicator 2-2, Baseline Sample

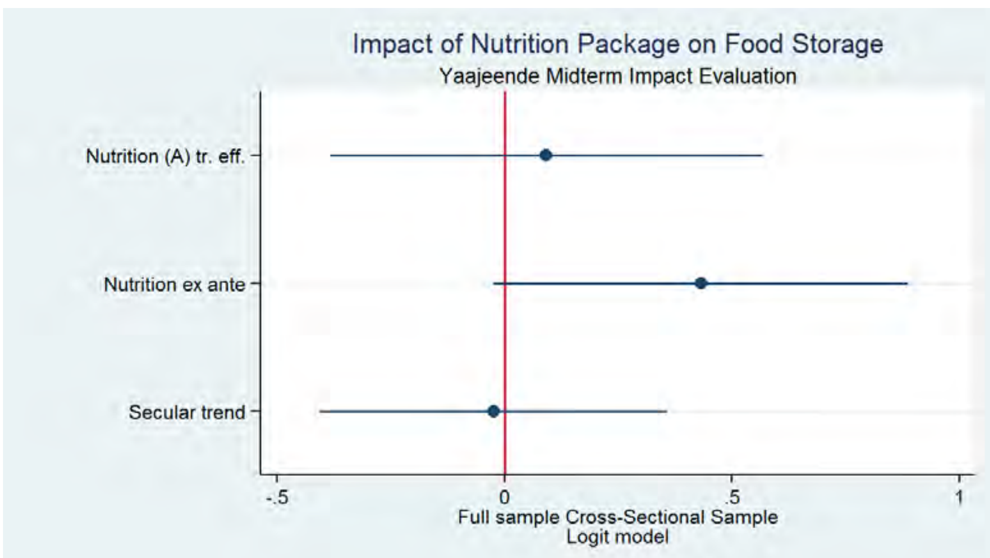

Figure 18: Coefficient Plot of Indicator 2-2, Full Cross-Section Sample

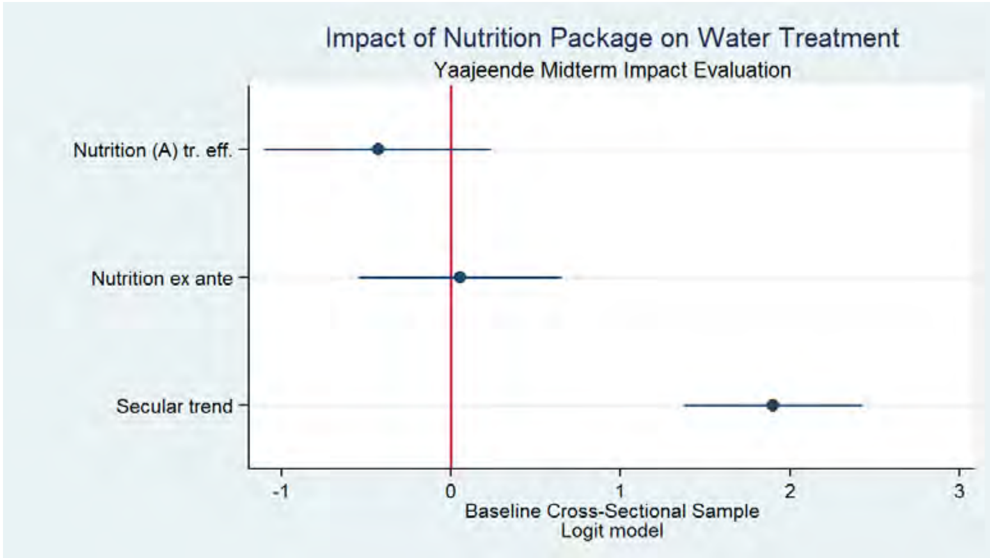

Figure 19: Coefficient Plot of Indicator 2-3, Baseline Sample

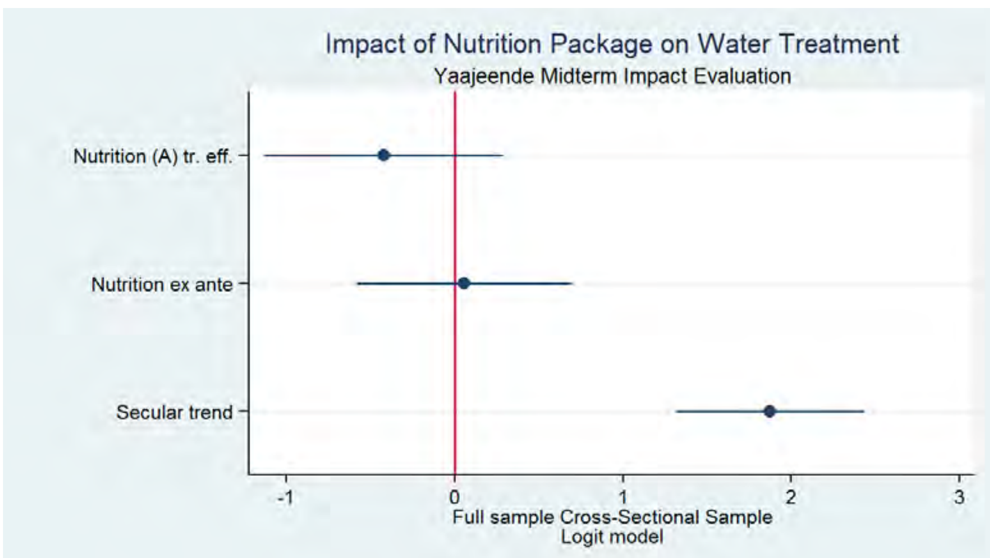

Figure 20: Coefficient Plot of Indicator 2-3, Full Cross-Section Sample

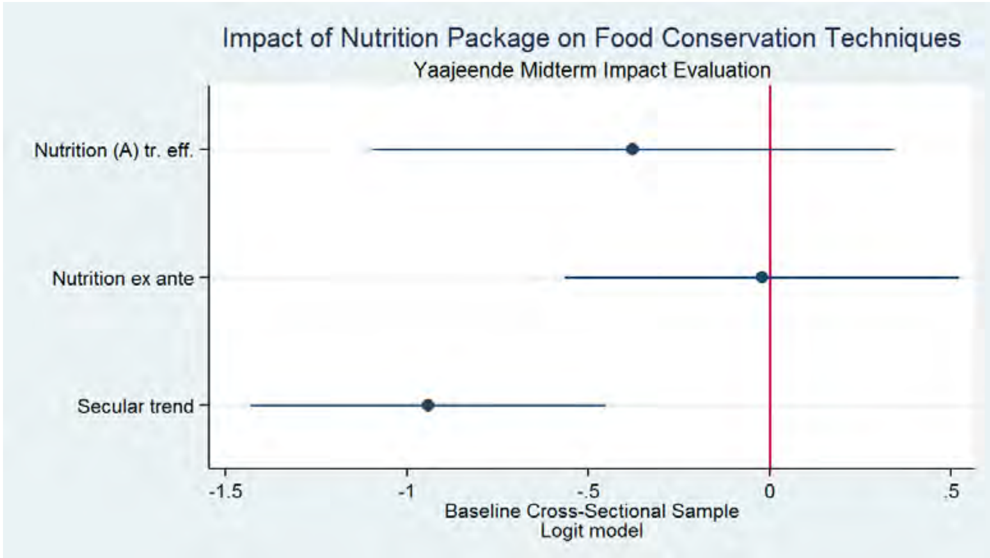

Figure 21: Coefficient Plot of Indicator 2-4, Baseline Sample

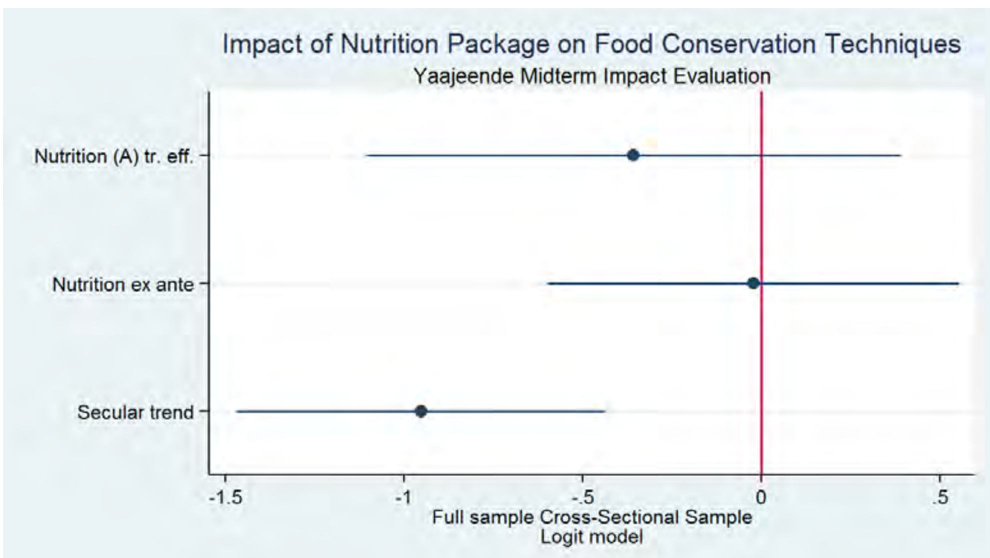

Figure 22: Coefficient Plot of Indicator 2-4, Full Cross-Section Sample

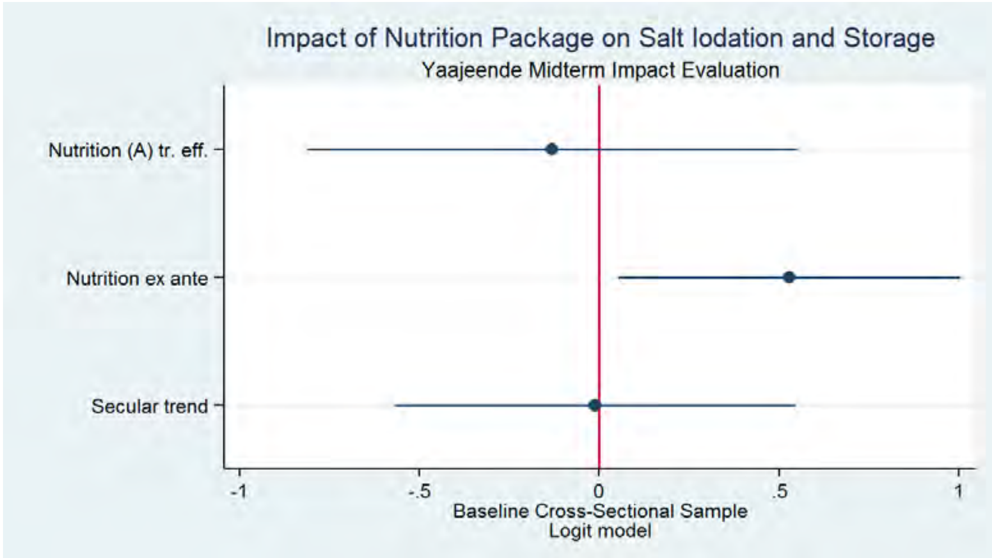

Figure 23: Coefficient Plot of Indicator 2-5, Baseline Sample

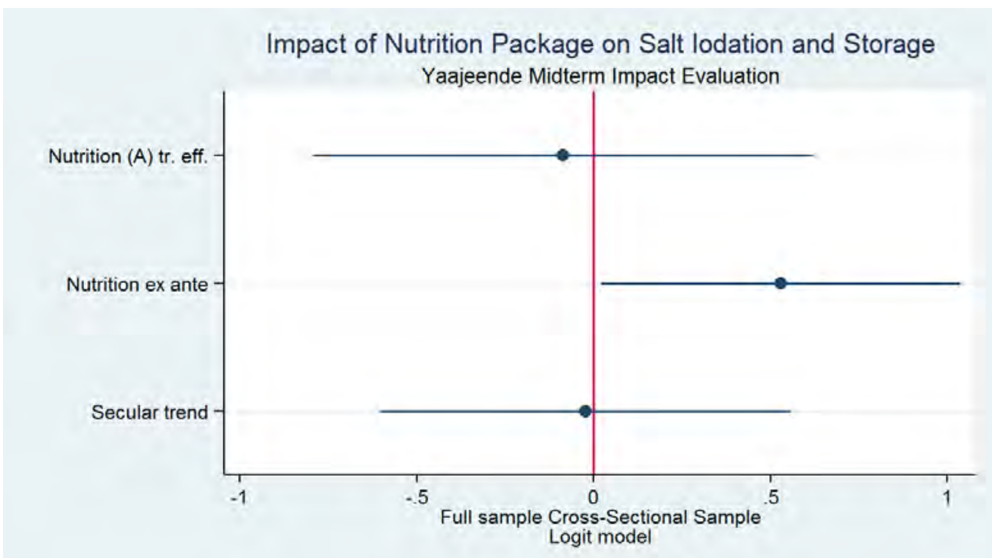

Figure 24: Coefficient Plot of Indicator 2-5, Full Cross-Section Sample

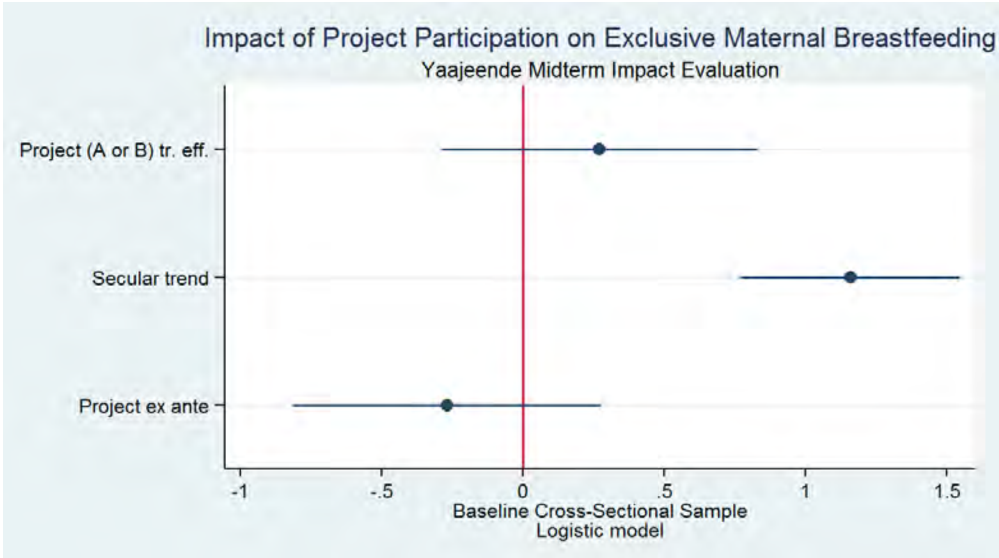

Figure 25: Coefficient Plot of Indicator 2-6, Baseline Sample

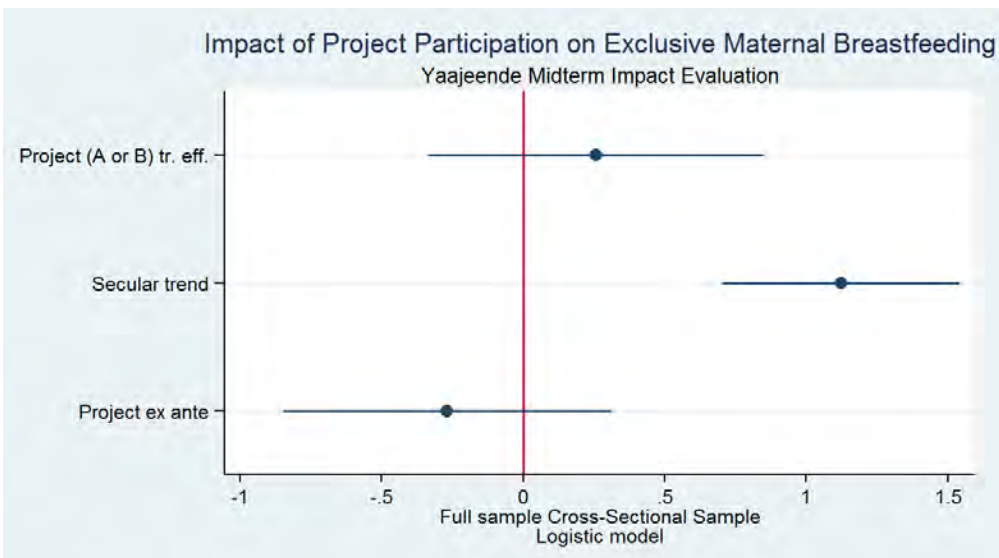

Figure 26: Coefficient Plot of Indicator 2-6, Full Cross-Section Sample

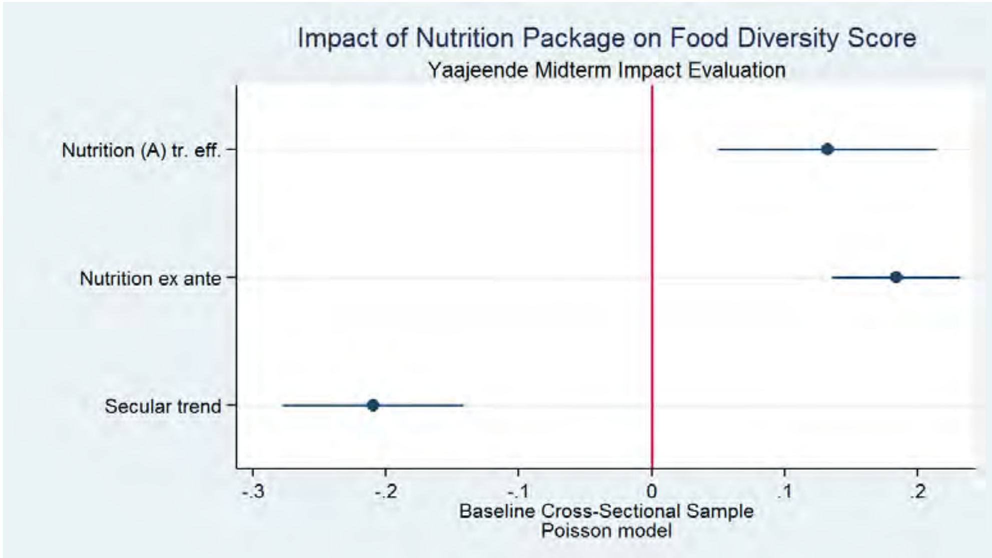

Figure 27: Coefficient Plot of Indicator 2-7, Baseline Sample

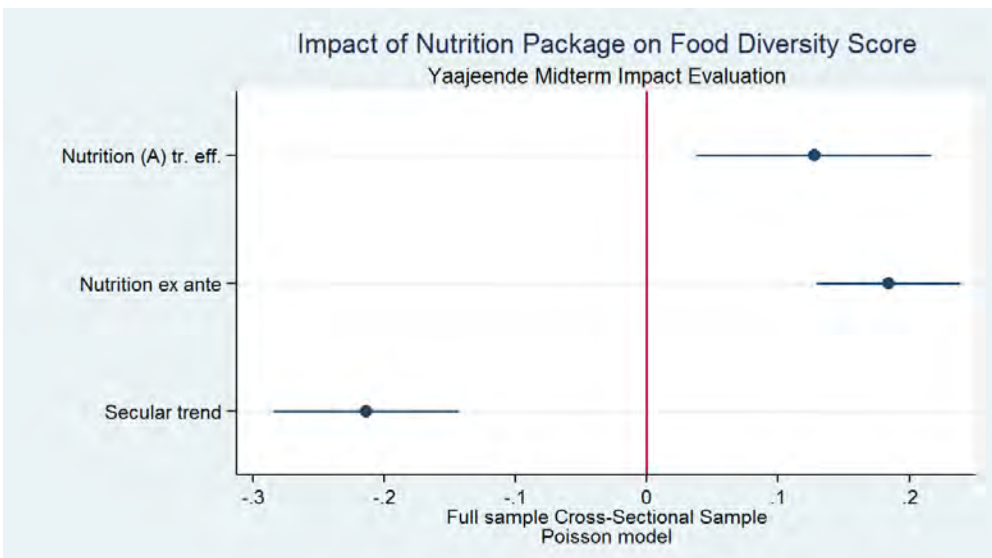

Figure 28: Coefficient Plot of Indicator 2-7, Full Cross-Section Sample

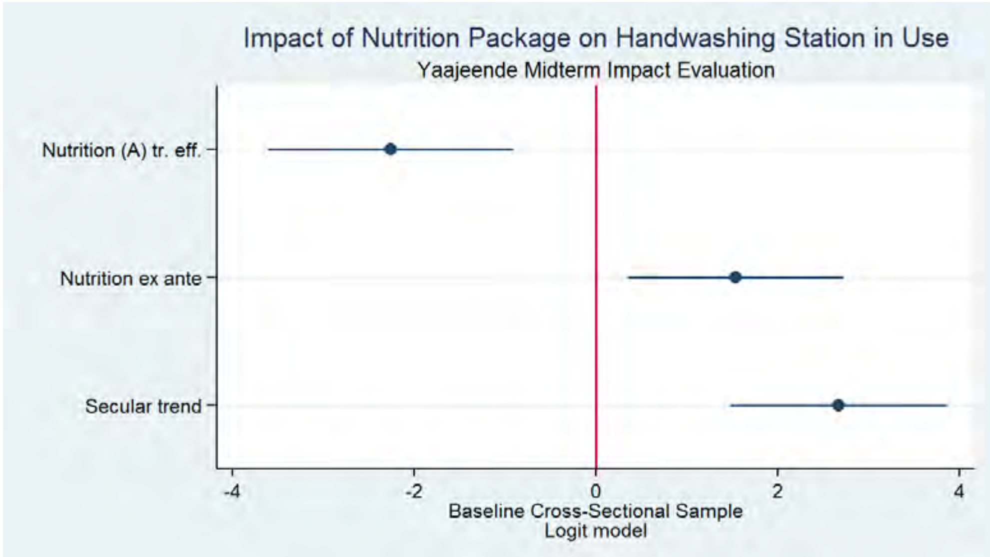

Figure 29: Coefficient Plot of Indicator 2-8, Baseline Sample

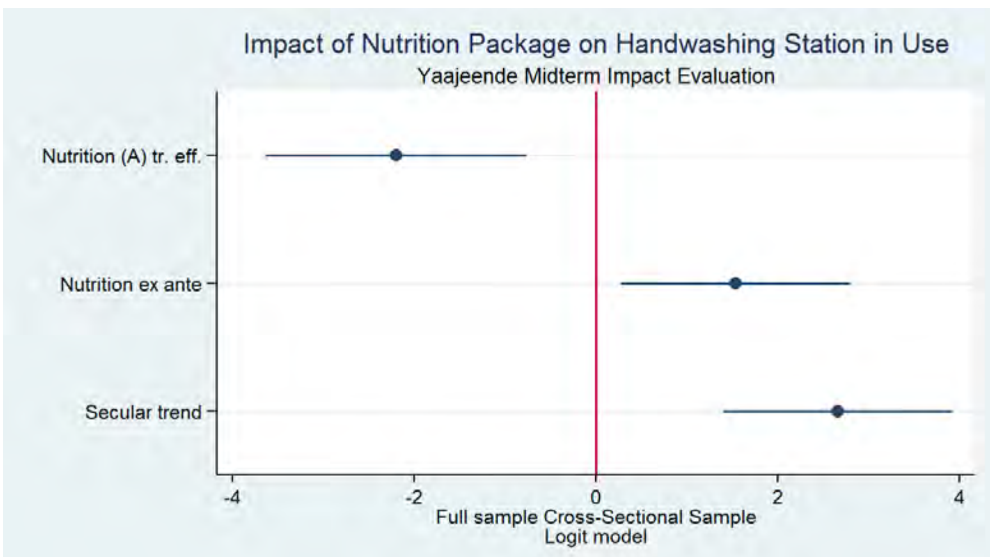

Figure 30: Coefficient Plot of Indicator 2-8, Full Cross-Section Sample

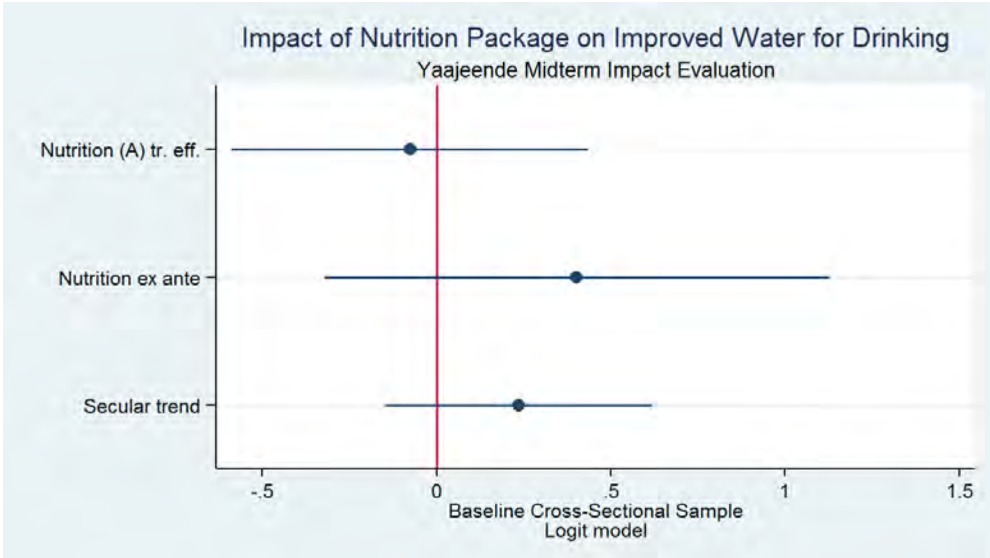

Figure 31: Coefficient Plot of Indicator 2-9, Baseline Sample

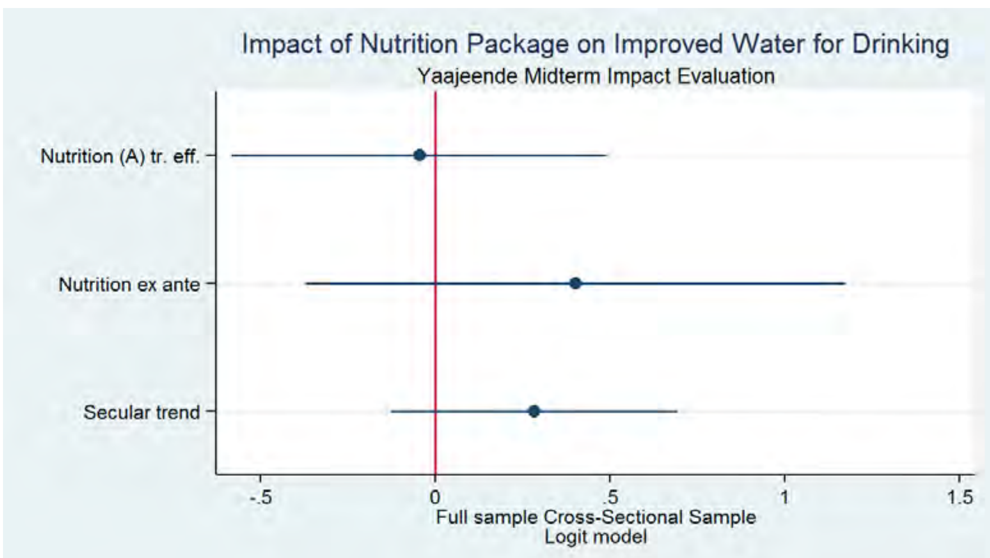

Figure 32: Coefficient Plot of Indicator 2-9, Full Cross-Section Sample

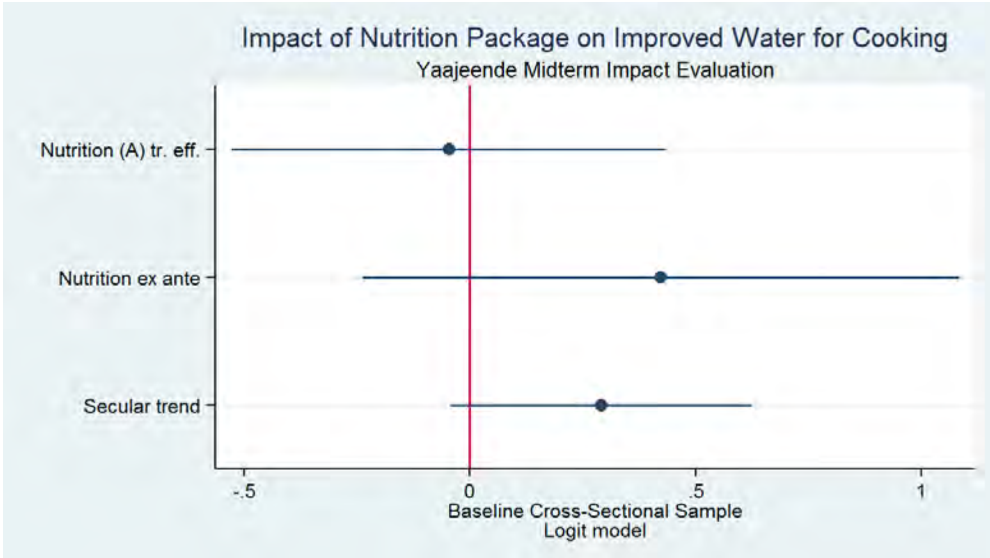

Figure 33: Coefficient Plot of Indicator 2-10, Baseline Sample

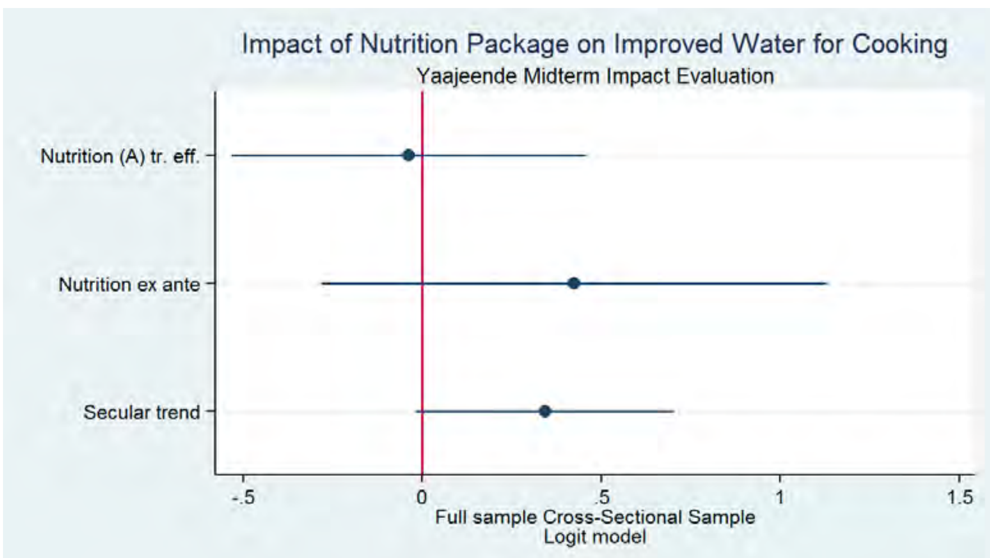

Figure 34: Coefficient Plot of Indicator 2-10, Full Cross-Section Sample

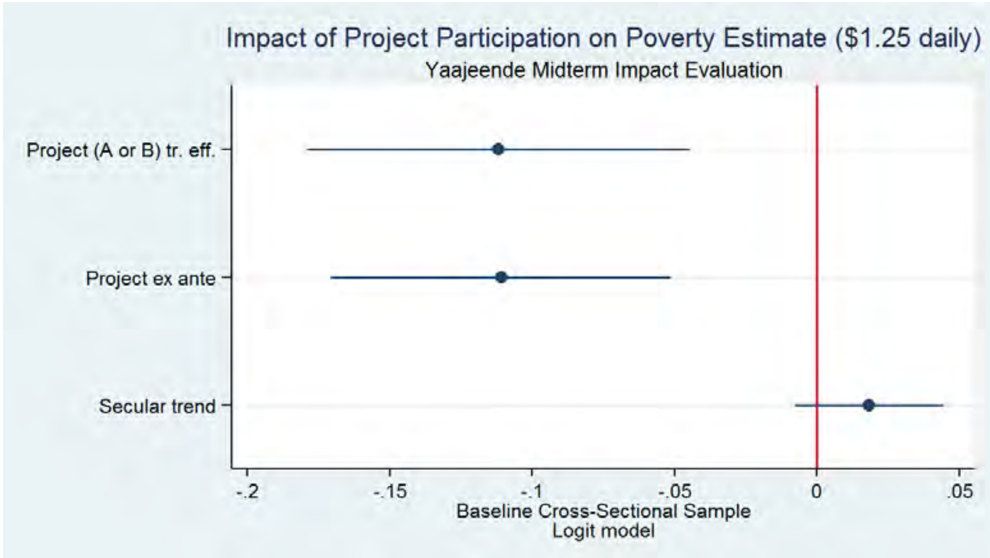

Figure 35: Coefficient Plot of Indicator 3-1, Baseline Sample

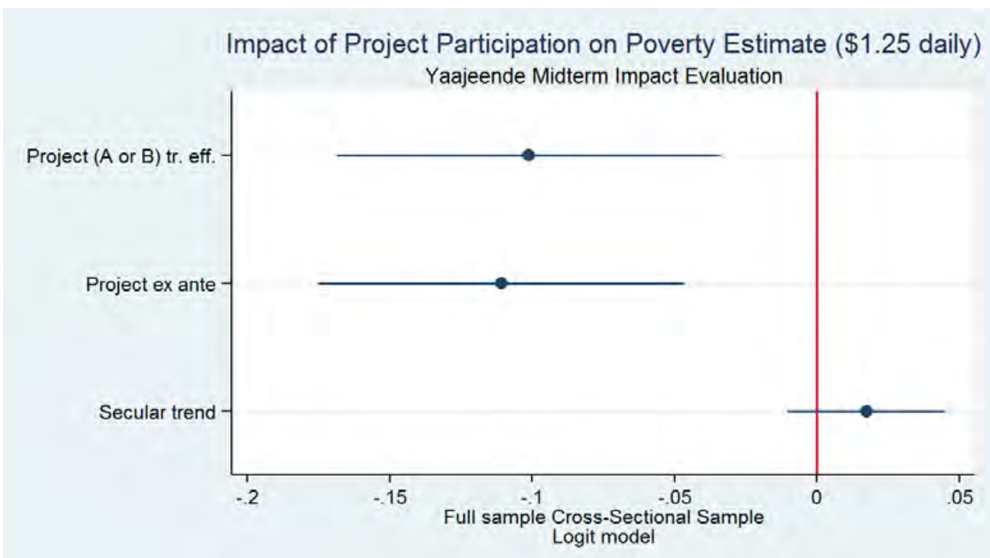

Figure 36: Coefficient Plot of Indicator 3-1, Full Cross-Section Sample

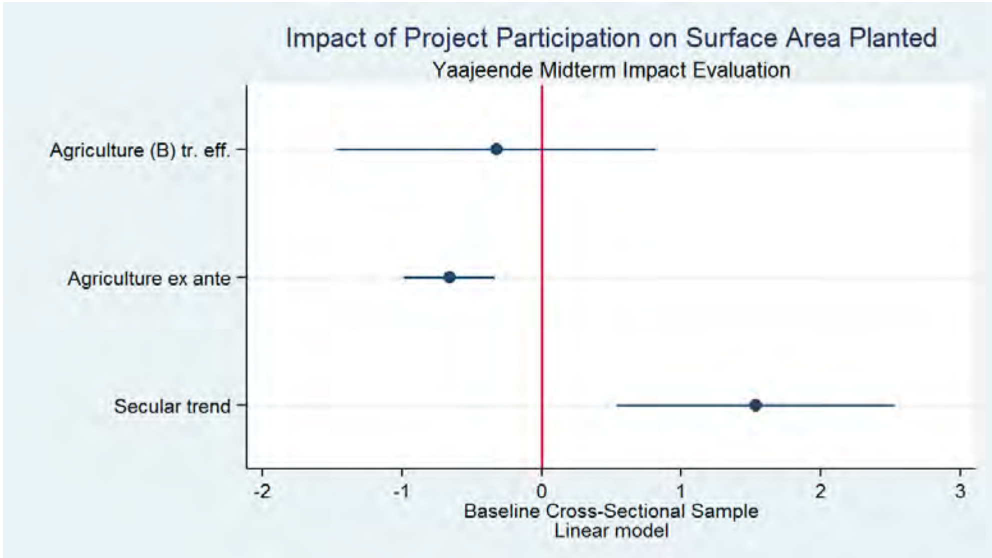

Figure 37: Coefficient Plot of Indicator 3-2, Baseline Sample

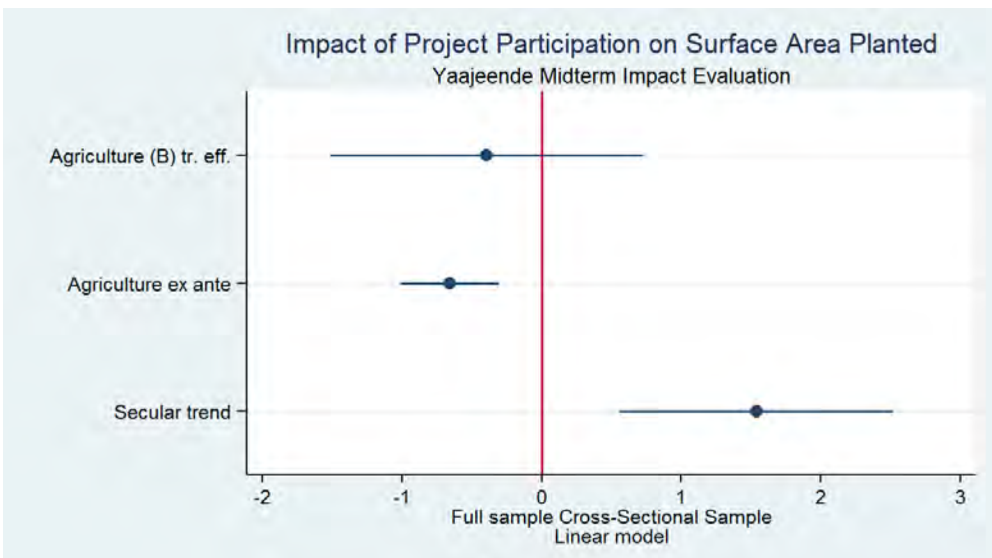

Figure 38: Coefficient Plot of Indicator 3-2, Full Cross-Section Sample

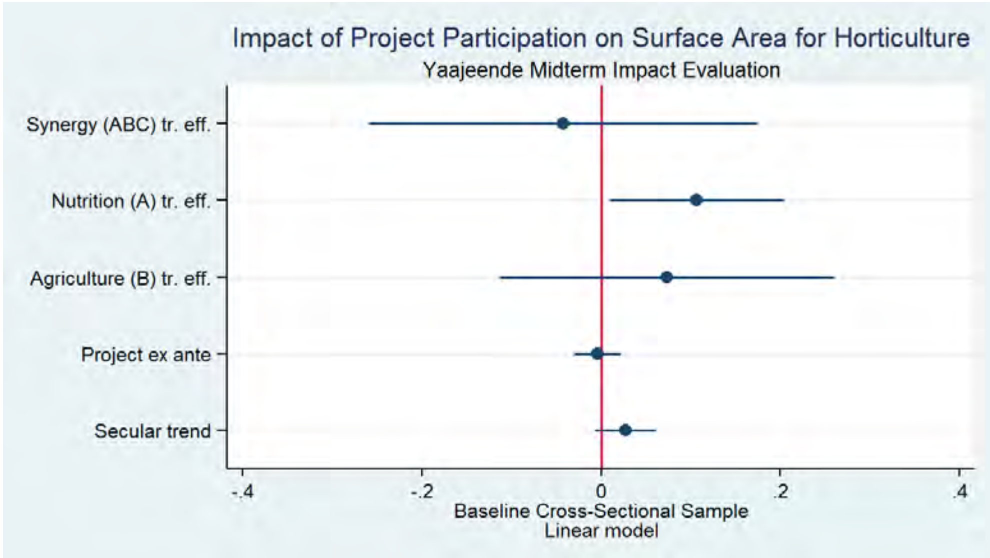

Figure 39: Coefficient Plot of Indicator 3-3, Baseline Sample

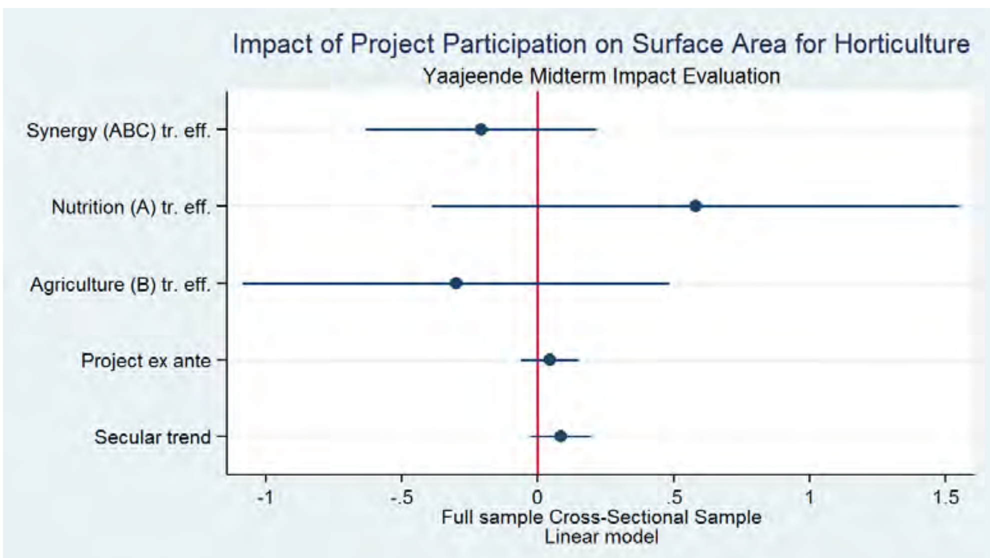

Figure 40: Coefficient Plot of Indicator 3-3, Full Cross-Section Sample

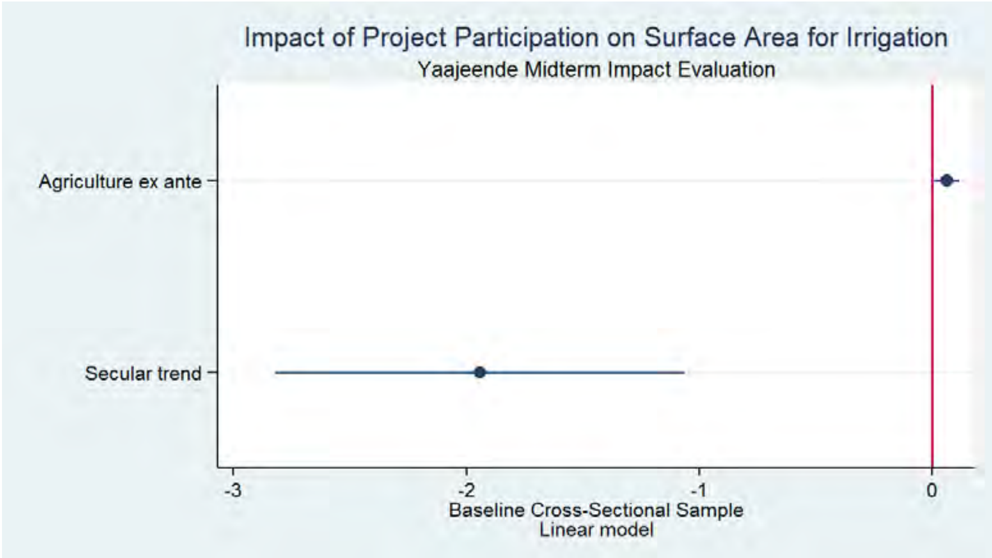

Figure 41: Coefficient Plot of Indicator 3-4, Baseline Sample

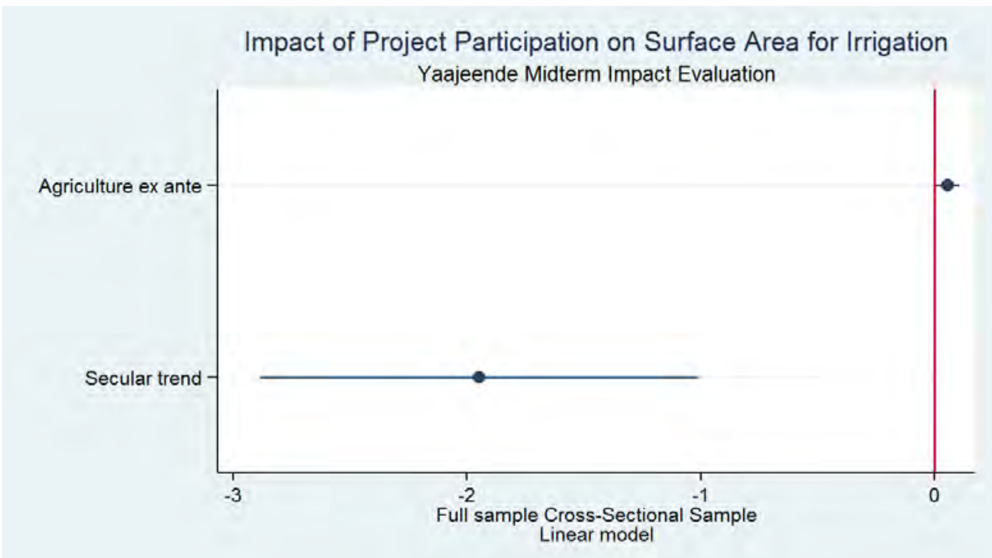

Figure 42: Coefficient Plot of Indicator 3-4, Full Cross-Section Sample

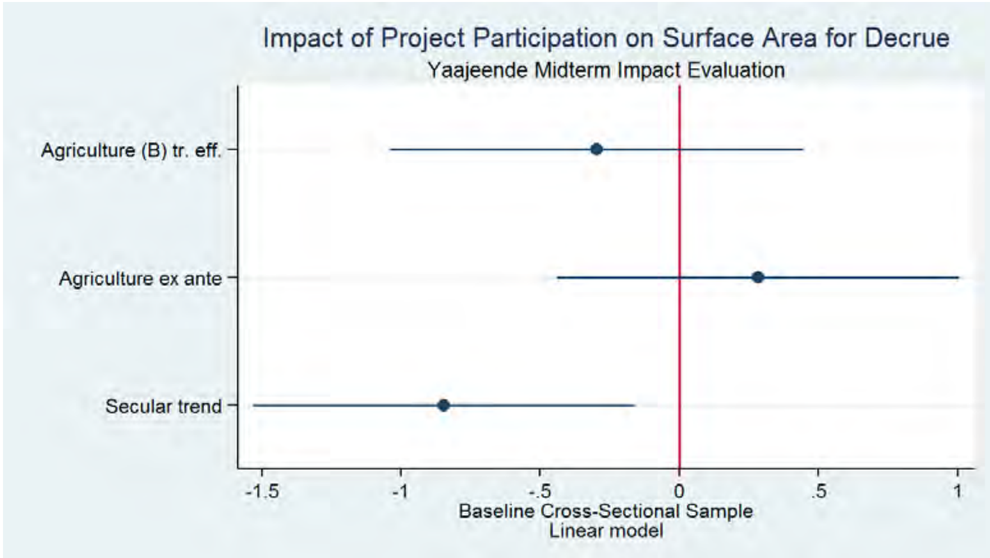

Figure 43: Coefficient Plot of Indicator 3-5, Baseline Sample

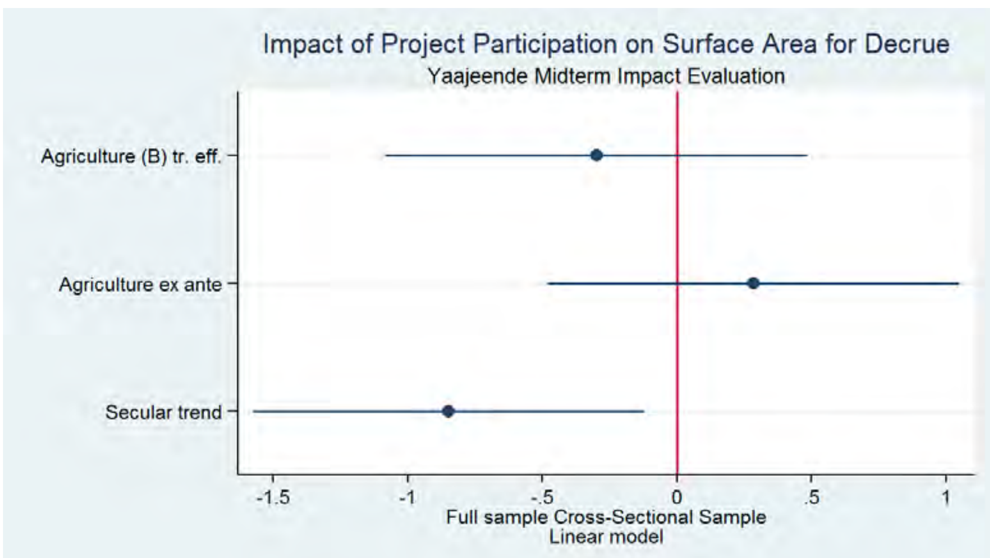

Figure 44: Coefficient Plot of Indicator 3-5, Full Cross-Section Sample

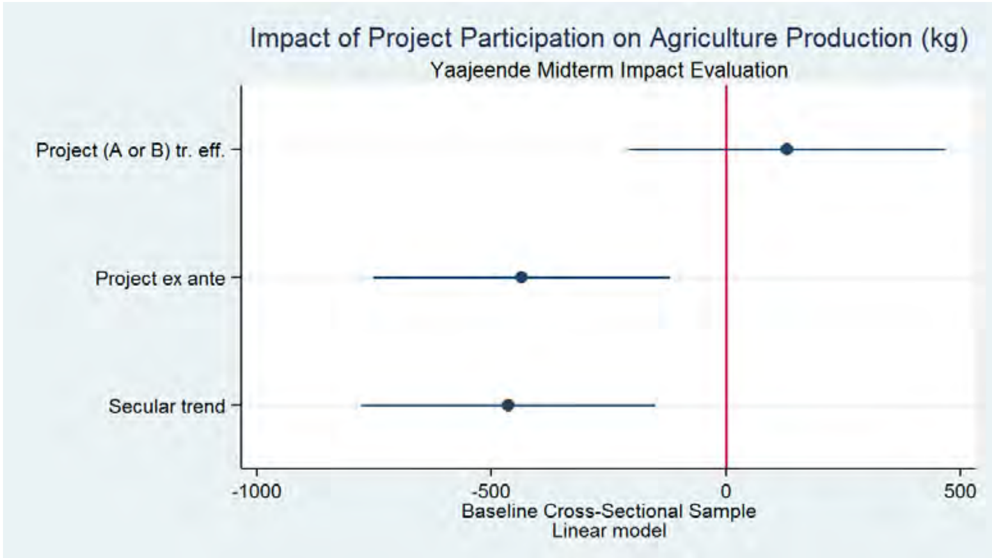

Figure 45: Coefficient Plot of Indicator 3-6, Baseline Sample

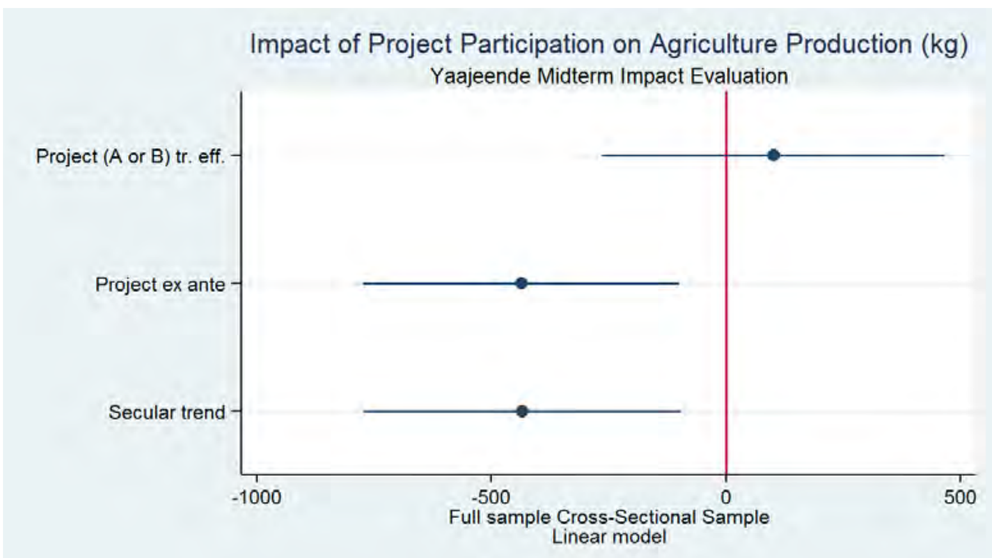

Figure 46: Coefficient Plot of Indicator 3-6, Full Cross-Section Sample

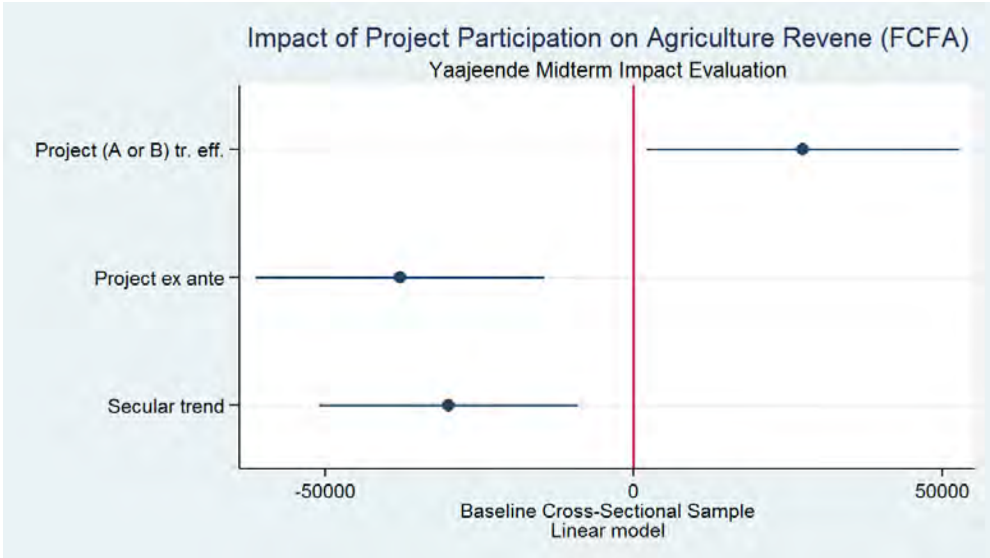

Figure 47: Coefficient Plot of Indicator 3-7, Baseline Sample

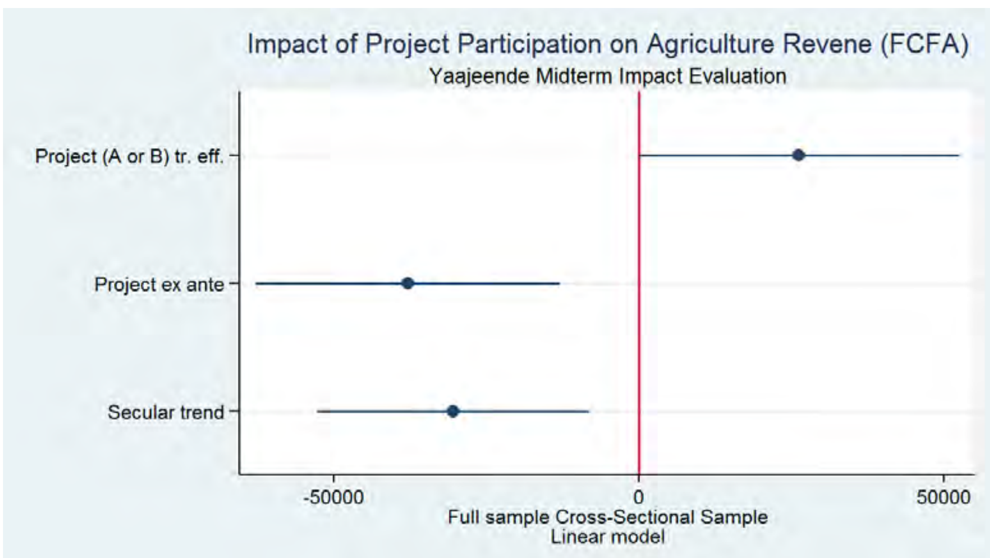

Figure 48: Coefficient Plot of Indicator 3-7, Full Cross-Section Sample

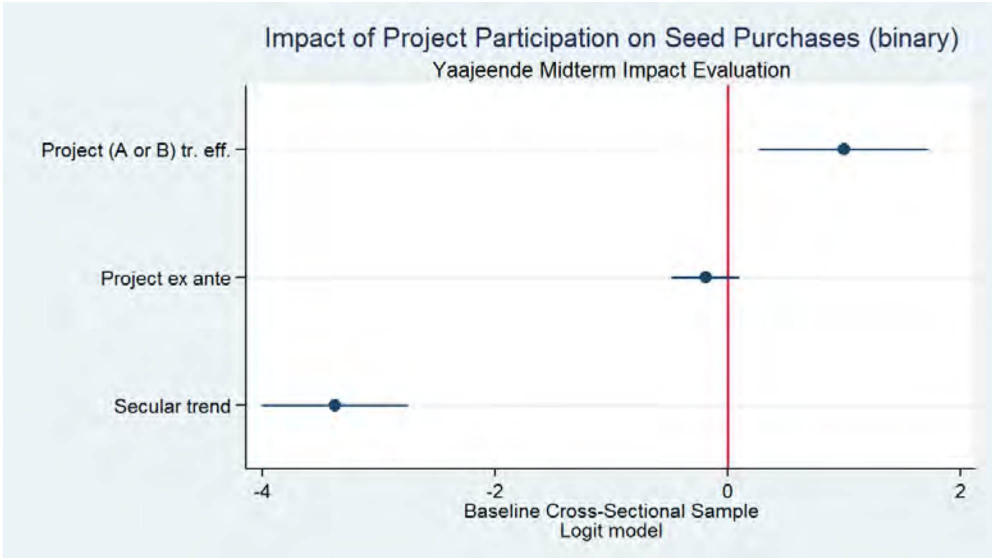

Figure 49: Coefficient Plot of Indicator 3-8, Baseline Sample

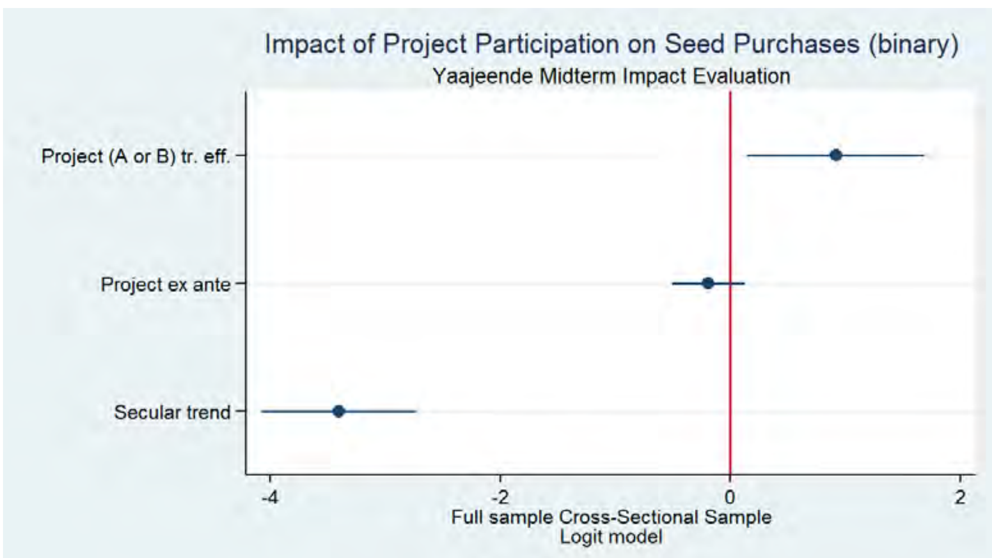

Figure 50: Coefficient Plot of Indicator 3-8, Full Cross-Section Sample

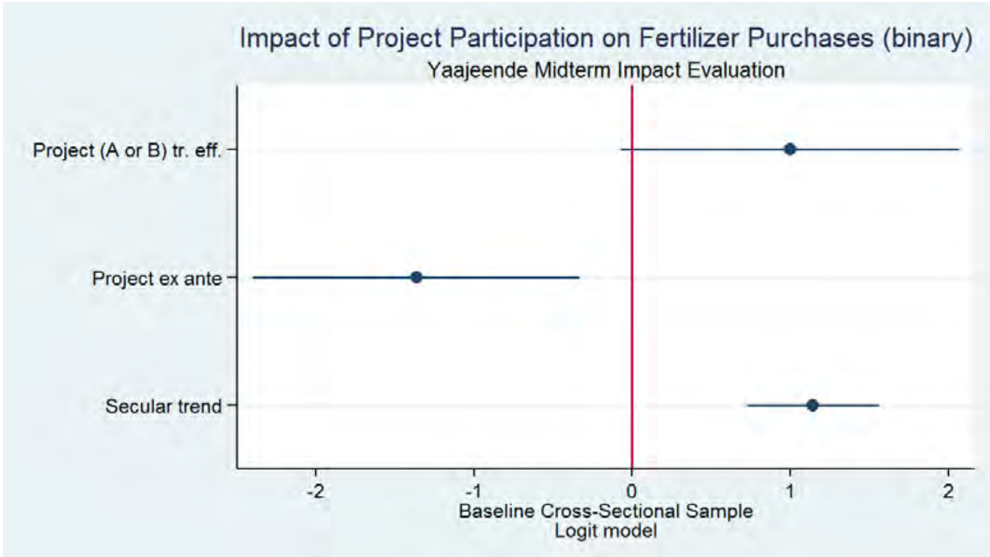

Figure 51: Coefficient Plot of Indicator 3-9, Baseline Sample

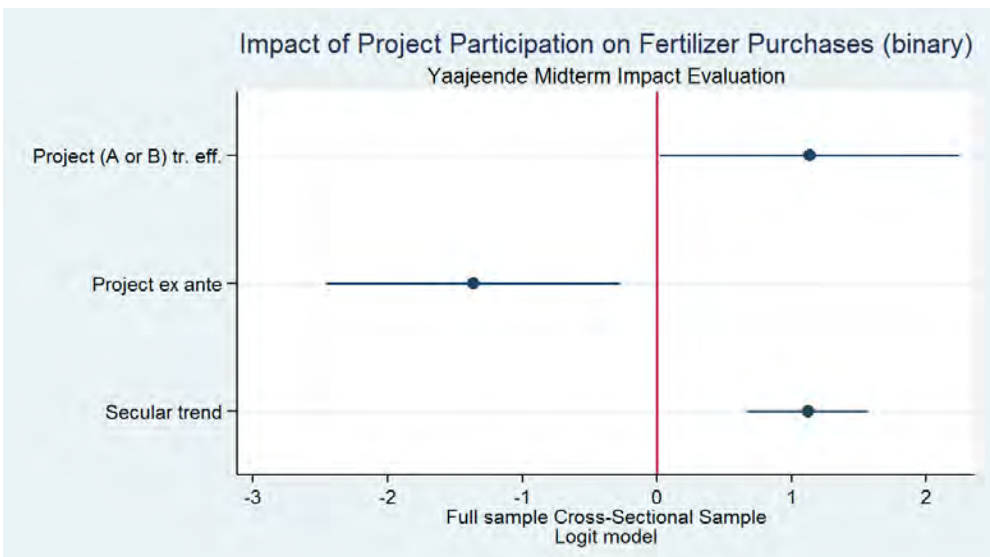

Figure 52: Coefficient Plot of Indicator 3-9, Full Cross-Section Sample

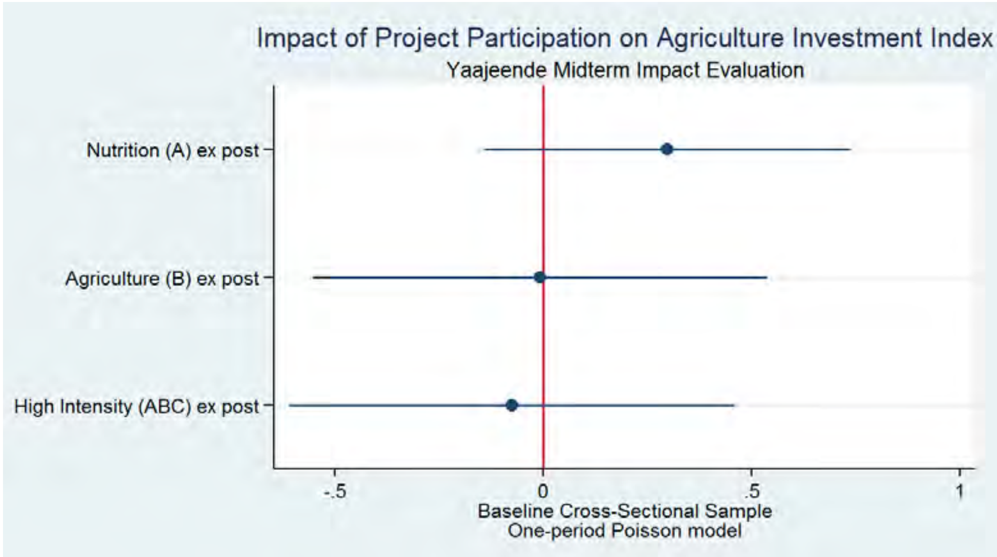

Figure 53: Coefficient Plot of Indicator 3-10, Baseline Sample

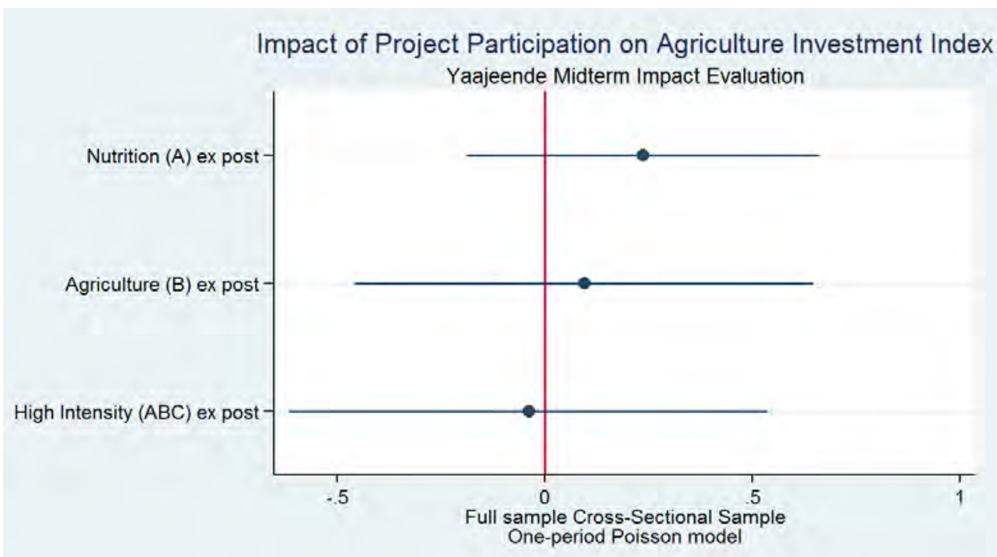

Figure 54: Coefficient Plot of Indicator 3-10, Full Cross-Section Sample

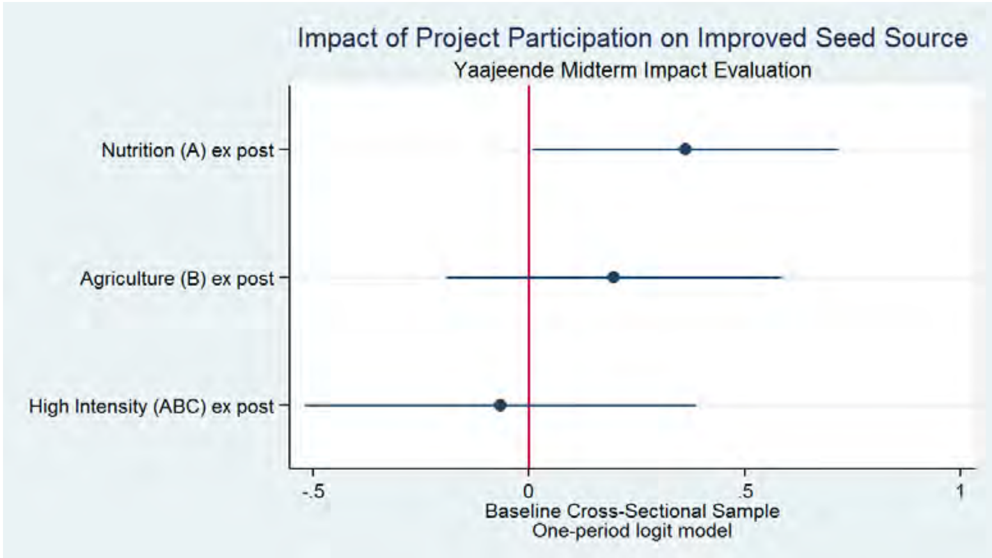

Figure 55: Coefficient Plot of Indicator 3-11, Baseline Sample

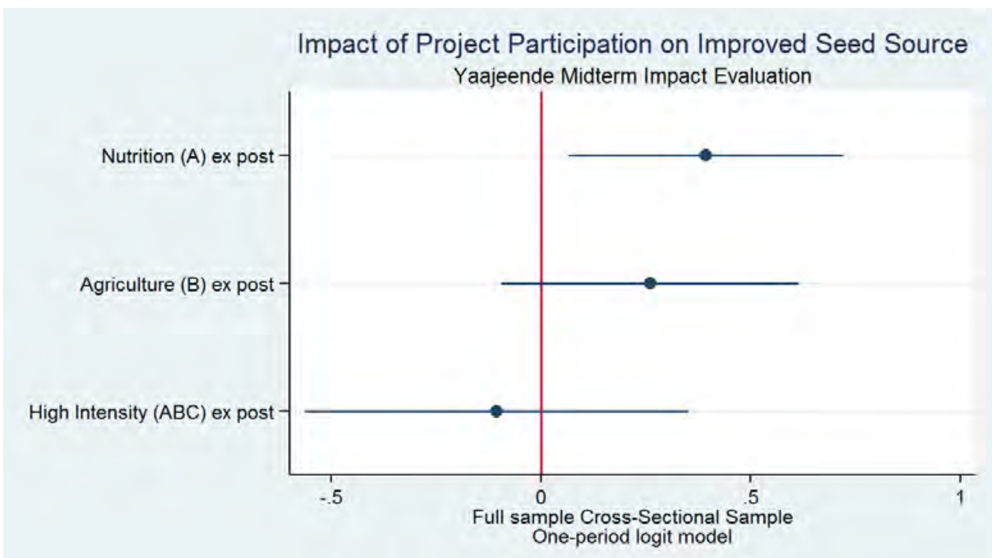

Figure 56: Coefficient Plot of Indicator 3-11, Full Cross-Section Sample

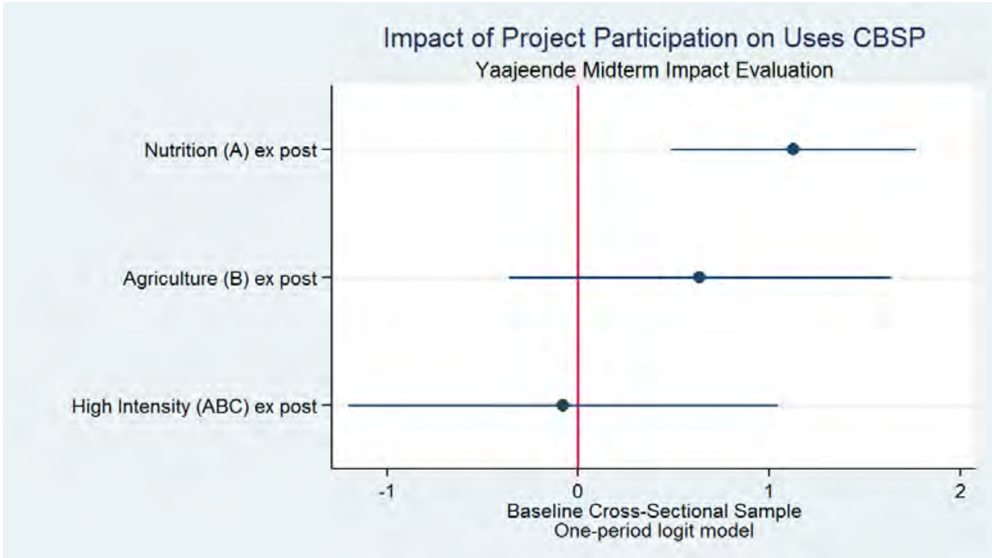

Figure 57: Coefficient Plot of Indicator 3-12, Baseline Sample

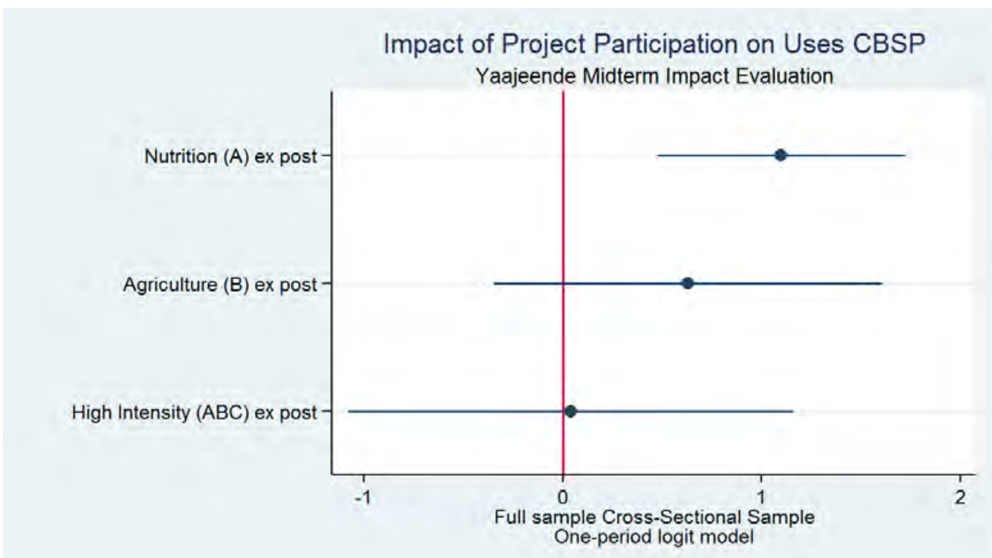

Figure 58: Coefficient Plot of Indicator 3-12, Full Cross-Section Sample

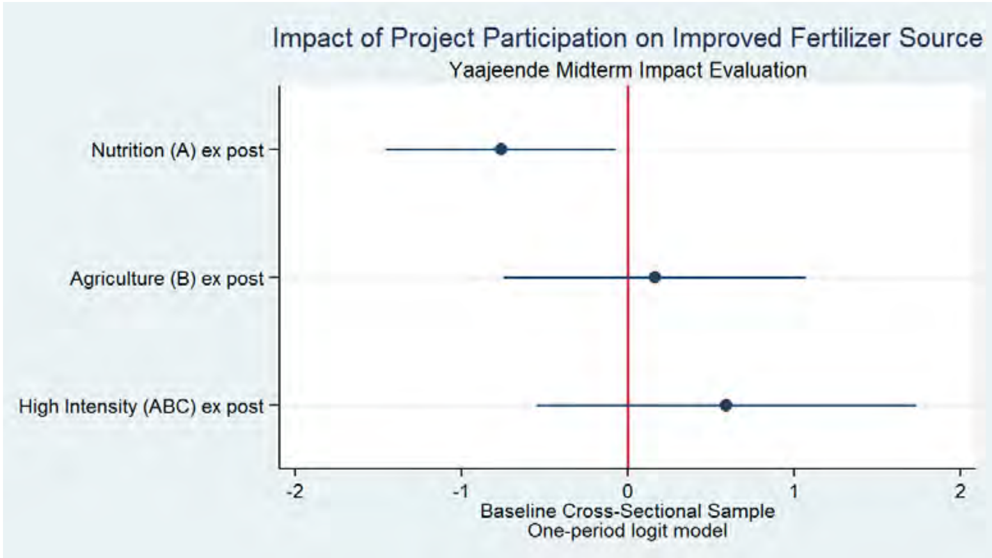

Figure 59: Coefficient Plot of Indicator 3-13, Baseline Sample

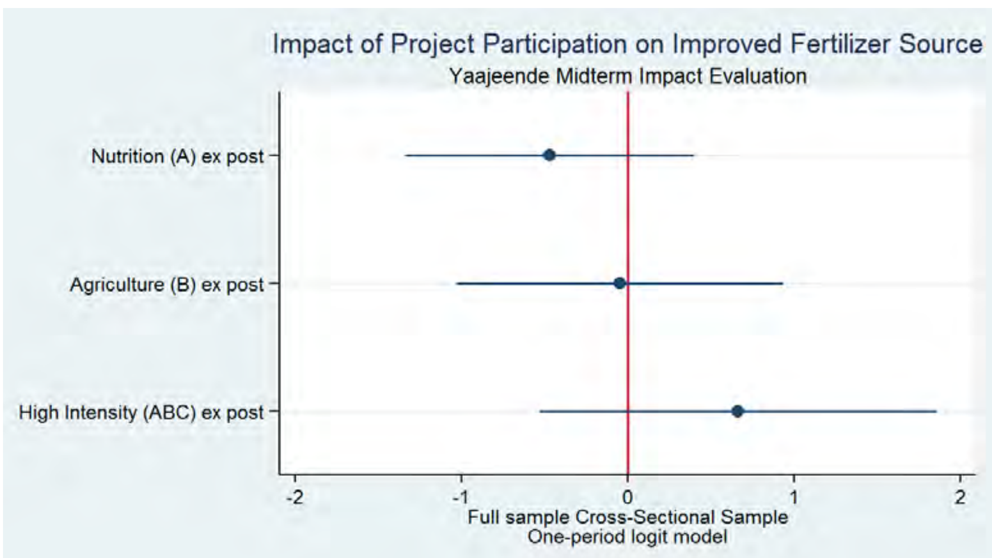

Figure 60: Coefficient Plot of Indicator 3-13, Full Cross-Section Sample

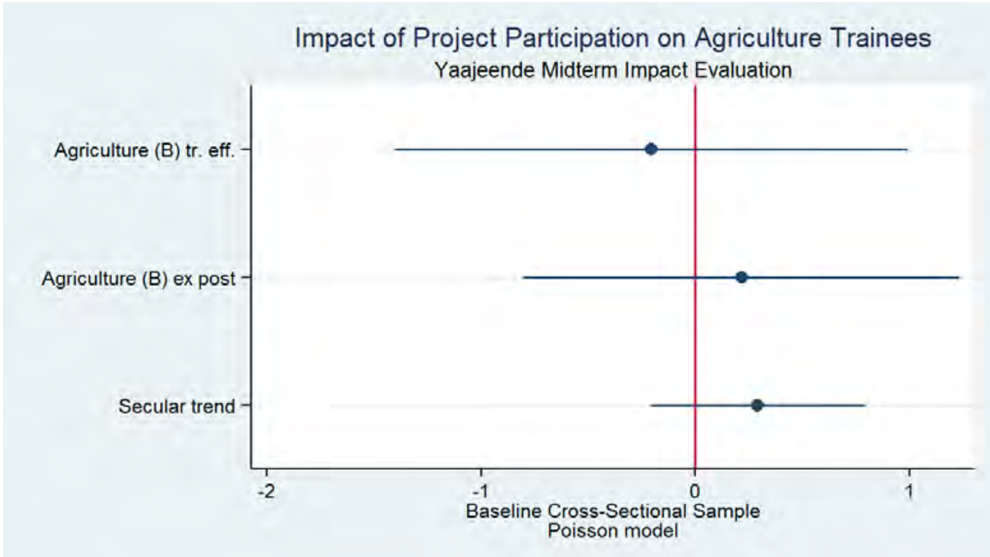

Figure 61: Coefficient Plot of Indicator 3-14, Baseline Sample

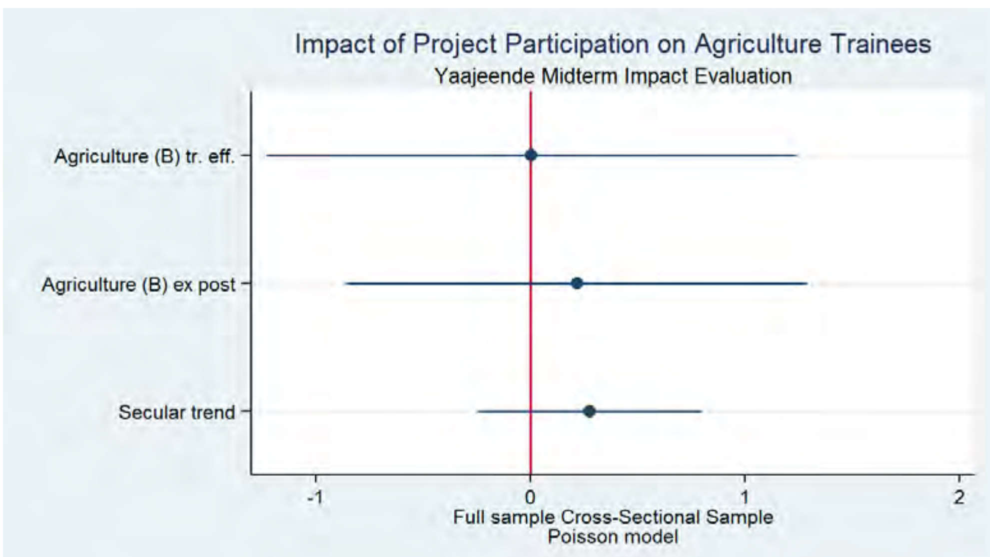

Figure 62: Coefficient Plot of Indicator 3-14, Full Cross-Section Sample

ANNEX VI: CROSS-SECTIONAL REGRESSION MODELS IN DETAIL

Model specification and coefficient interpretation

Five different versions of the generic model have been implemented in order to test independent and joint effects of the various treatments. The five models are designed to test different hypotheses about the nature and scope of project impact and, most important, revolve around different treatment and comparison groups. Ideally, strong treatment effects would be apparent in results from all five models. Model 1 tests whether the project (i.e. *Project*) as a whole had impacts on key indicators, independent of the processes by which those results were obtained. The comparison group consists of households and individuals (depending on the indicator) in villages that were excluded from the project altogether, while the treatment group consists of households and individual in villages that received either the nutrition or agriculture package, or both. There are two control variables. The first is the ex-ante (i.e., at baseline) difference between the comparison and treatment groups. For example, if the individuals and households in the treatment group were much better off than members of the comparison group, it might not be surprising if the treatment effect over the project period was small due to diminishing marginal returns. The second is secular trend, i.e. the difference in the average value as observed in the comparison group at midterm and baseline. Thus, the model estimates the average impact on project beneficiaries, controlling for initial conditions and what would have happened in the absence of any project.

In symbols, Model 1 is

$$Y = \beta_0 + \beta_1 P + \beta_2 T + \beta_3 PT + \varepsilon$$

where

- *Y* is the key indicator in question,
- *P* = 1 if the individual or household located in a project village, 0 otherwise.
- *T* = 1 if the observation was made at Midterm, 0 if at Baseline,
- *PT* = 1 for project households at midterm, 0 otherwise.

In Model 1, as in all the models below, the central test of project impact is whether or not the estimated treatment effects are statistically different from zero. β_1 estimates the ex-ante differences of the key indicator between the project and comparison groups. β_2 is the secular trend in the comparison group. β_3 is the treatment effect of participation in the Yaajeende project. The observed change in the project group is the sum of the secular trend and the treatment effect. The treatment effect is positive only if the project group saw greater improvement than the comparison group, regardless of whether the secular trend is positive or negative.

Even absent of significance, though, the coefficients can hold meaning. First, since the coefficients (apart from those estimating the average difference between treatment and comparison groups at baseline) estimate marginal change in the key indicator over the period 2011-15, sometimes treatment effects will be significant in the real-world sense even if they are not significant in the statistical sense. Second, secular time trend and treatment effect coefficients are additive. The predicted average change in the key indicator over the period 2011-15 for members of the treatment group in Model 1 is the sum of the secular trend and treatment effect coefficients, i.e. $\beta_2 + \beta_3$. Thus, even if statistically insignificant, and assuming that an increase in the key indicator is a positive development, if β_3 is large relative to an also positive β_2 or if β_3 has substantially offset a negative β_2, it may be possible to speak of a real-world positive impact of the project even if β_3 is not statistically significant.

Model 2 tests for the effect of Yaajeende's *Nutrition* package, independent of the other Yaajeende packages.

$$Y = \beta_0 + \beta_4 A + \beta_2 T + \beta_5 AT + \varepsilon$$

where

- *Y* is the key indicator in question,
- *A* = 1 if the individual or household is located in a nutrition package village, 0 otherwise.
- *T* = 1 if the observation was made at Midterm, 0 if at Baseline
- *AT* = 1 for nutrition package households at midterm, 0 otherwise.

β_2 is the secular trend in the comparison group. β_5 is the treatment effect of participation in the nutrition package. The observed change in the nutrition package group is the sum of the secular trend and the treatment effect. Similarly to Model 1, in Model 2, the predicted average change in the key indicator among members of the nutrition treatment group is the sum of the secular trend and nutrition treatment coefficients: $\beta_2 + \beta_5$.[47]

Model 3 tests for the independent effect of the Yaajeende agriculture package.

$$Y = \beta_0 + \beta_6 B + \beta_2 T + \beta_7 BT + \varepsilon$$

where

- *Y* is the key indicator in question,
- *B* = 1 if the individual or household is located in an agriculture or governance package village, 0 otherwise.
- *T* = 1 if the observation was made at Midterm, 0 if at Baseline
- *BT* = 1 for agriculture package households at midterm, 0 otherwise.

In Model 3, β_2 is the secular trend in the comparison group. β_7 is the treatment effect of participation in the agriculture package. The observed change in the project group is the sum of the secular trend and the treatment effect. The predicted average change in the key indicator among members of the agriculture treatment group is the sum of the secular

[47] Despite the shared nomenclature "beta-two", there is no reason to expect that the estimates of secular trend in Model 1 and Model 2 should be close to one another. Since the models have a different comparison group, the trend in the comparison group will differ substantially between the two estimates. If households were assigned at random to project and comparison groups then, in the limit, the secular trends should converge; but that is not the case in this evaluation.

trend and agriculture treatment coefficients: $\beta_2 + \beta_7$.

Model 4 analogously estimates the impact of having been a member of the high-intensity treatment group. Recall that the high-intensity criterion is a shorthand for villages that had the full Yaajeende intervention, or all three of the nutrition, agriculture, and governance packages (A, B, and C). The treatment group consists of households and individuals from villages satisfying the high intensity criterion and the comparison group consists of households and individuals from all villages that do not:

$$Y = \beta_0 + \beta_8 H + \beta_2 T + \beta_9 HT + \varepsilon$$

where

- *Y* is the key indicator in question,
- *H* = 1 if the household is located in a high-intensity village, 0 otherwise.
- *T* = 1 if the observation was made at Midterm, 0 if at Baseline
- *HT* = 1 for high intensity treatment group at midterm, 0 otherwise

In Model 4, β_2 is the secular trend in the comparison group. β_9 is the treatment effect of high-intensity Yaajeende participation. The treatment effect is cumulative and not decomposed into marginal effects of nutrition and agriculture or their interaction. The observed change in the project group is the sum of the secular trend and the treatment effect. The interaction term *HT* estimates a cumulative, rather than a marginal, effect of high-intensity treatment. Model 4 compares the high-intensity group only to the comparison group of villages that received no project intervention at all. Low- and mid-intensity villages are excluded from model 4.

Model 5 is a multivariate specification designed to capture interaction or synergy among project components. The model explores whether, once the secular trend, ex-ante differences between *Project* treatment and comparison group, and the treatment effects of *Nutrition* and *Agriculture* taken alone are controlled for, *HighIntensity* treatment group members experienced significant impacts:

$$Y = \beta_0 + \beta_2 T + \beta_4 A + \beta_5 AT + \beta_6 B + \beta_7 BT + \beta_8 H + \beta_9 HT + \varepsilon$$

where

- *Y* is the key indicator in question,
- *T* = 1 if the observation was made at midterm, 0 if at Baseline,
- *A* = 1 if the household is located in a nutrition package village, 0 otherwise,
- *AT* = 1 for households in a nutrition package village at midterm, 0 otherwise,
- *B* = 1 if the household is located in an agriculture package village, 0 otherwise,
- *BT* = 1 for households in a agriculture package village at midterm, 0 otherwise,
- *H* = 1 if the household is located in a high intensity village, 0 otherwise,
- *H* T = 1 for households in a high intensity village at midterm, 0 otherwise,

β_2 is the secular trend in the comparison group. β_9 is the treatment effect of participation in the Yaajeende project. The observed change in the project group is the sum of the secular trend and the treatment effect. The F-statistic on the synergy coefficient β_9, assesses the goodness-of-fit of the model, meaning whether or not it is statistically appropriate to ignore the synergy coefficient in estimating project impact. When the F-statistic is in the critical region, the data suggest that interaction between the agriculture and nutrition packages is significant.

The different models are suited to test particular hypotheses about project impact. To test whether or not the nutrition package is effective, a good measure is the treatment effect in Model 2. To test whether or not the agriculture package is effective, a good measure is the treatment effect estimated in Model 3. The treatment effect estimate from Model 4 measures the difference between individuals who benefitted from all three packages together to those who did not, but Model 4 suffers from the weaknesses described above. Finally, in order in order to test for synergy between Yaajeende's nutritional and agriculture packages, the most relevant model is the multivariate Model 5, where the synergy coefficient compares the experience of individuals and households who benefitted from all treatments with those who benefited only from a sub-set or from none at all.

Annex VII: Intertemporal Change Among Beneficiaries

This document shows the evolution of values of the key indicators between the baseline (2011) and midterm (2015) periods. With categorical responses, the results are calculated using the command `tabout` frequency estimation command with appropriate `survey` options in Stata. For numerical indicators, the difference in means is evaluated using the appropriate estimation command in the `svy` package of Stata.

Table 1: Indicator 1-1 Global acute malnutrition (GAM) ages 6-59 months

	Midterm period observation (binary)		
Wasting: z-score below -2 on reference weight-for-length curve.	No	Yes	Total
	Prop.	Prop.	Prop.
No	0.85	0.83	0.83
Yes	0.15	0.17	0.17
Total	1.00	1.00	1.00
Pearson: Uncorrected chi2(1) =	1.6321		
Design-based F(1.00, 47.00) =	0.7828	Pr =	0.381

Table 2: Indicator 1-2 Stunting ages 6-59 months

	Midterm period observation (binary)		
Stunting: z-score below -2 on reference length-for-age curve.	No	Yes	Total
	Prop.	Prop.	Prop.
No	0.77	0.84	0.82
Yes	0.23	0.16	0.18
Total	1.00	1.00	1.00
Pearson: Uncorrected chi2(1) =	21.1943		
Design-based F(1.00, 47.00) =	7.6345	Pr =	0.008

Table 3: Indicator 1-3 Underweight ages 6-59 months

Underweight: z-score below -2 on reference weight-for-age curve.	Midterm period observation (binary) No	Yes	Total
	Prop.	Prop.	Prop.
No	0.77	0.80	0.79
Yes	0.23	0.20	0.21
Total	1.00	1.00	1.00
Pearson: Uncorrected chi2(1) =	3.2880		
Design-based F(1.00, 47.00) =	1.1181	Pr =	0.296

Table 4: Indicator 1-4 Underweight among women of reproductive age

Underweight: body mass index (BMI) below 18.5.	Midterm period observation (binary) No	Yes	Total
	Prop.	Prop.	Prop.
No	0.70	0.74	0.73
Yes	0.30	0.26	0.27
Total	1.00	1.00	1.00
Pearson: Uncorrected chi2(1) =	3.8814		
Design-based F(1.00, 47.00) =	1.0403	Pr =	0.313

Table 5: Indicator 1-5 Minimum acceptable diet (MAD) ages 6-23 months

Minimum acceptable diet (MAD) for children ages 6-23 months	Midterm period observation (binary) No	Yes	Total
	Prop.	Prop.	Prop.
No	0.87	0.94	0.91
Yes	0.13	0.06	0.09
Total	1.00	1.00	1.00
Pearson: Uncorrected chi2(1) =	14.5943		
Design-based F(1.00, 47.00) =	5.1220	Pr =	0.028

Table 6: Indicator 1-7 Fewer than two meals in the previous 24 hours

Fewer than two meals per day (binary)	Midterm period observation (binary) No	Yes	Total
	Prop.	Prop.	Prop.
Two or more meals per day	0.99	0.94	0.96
Zero or one meal per day	0.01	0.06	0.04
Total	1.00	1.00	1.00
Pearson: Uncorrected chi2(1) =	28.0361		
Design-based F(1.00, 47.00) =	25.4802	Pr =	0.000

Table 7: Indicator 2-1 Kitchen Hygiene

Household practices at least one Yaajeende kitchen hygiene behavior (binary)	Midterm period observation (binary) No	Yes	Total
	Prop.	Prop.	Prop.
	0.11	0.12	0.12
	0.89	0.88	0.88
Total	1.00	1.00	1.00
Pearson: Uncorrected chi2(1) =	0.6275		
Design-based F(1.00, 47.00) =	0.2302	Pr =	0.634

Table 8: Indicator 2-2 Cold and covered food storage

Houshold practices safer food storage (binary)	Midterm period observation (binary) No	Yes	Total
	Prop.	Prop.	Prop.
None of the behaviors reported	0.39	0.37	0.37
At least one of the behaviors reported	0.61	0.63	0.63
Total	1.00	1.00	1.00
Pearson: Uncorrected chi2(1) =	1.0124		
Design-based F(1.00, 47.00) =	0.7984	Pr =	0.376

Table 9: Indicator 2-3 Water treatment

Houshold treats drinking water (binary)	Midterm period observation (binary) No	Yes	Total
	Prop.	Prop.	Prop.
No water treatment	0.93	0.73	0.81
Drinking water treated	0.07	0.27	0.19
Total	1.00	1.00	1.00
Pearson: Uncorrected chi2(1) =	98.6388		
Design-based F(1.00, 47.00) =	66.9355	Pr =	0.000

Table 10: Indicator 2-4 Food conservation techniques

Houshold conserves food through drying, etc. (binary)	Midterm period observation (binary) No	Yes	Total
	Prop.	Prop.	Prop.
No food conservation	0.13	0.35	0.27
At least one food conservation technique	0.87	0.65	0.73
Total	1.00	1.00	1.00
Pearson: Uncorrected chi2(1) =	110.0148		
Design-based F(1.00, 47.00) =	27.6455	Pr =	0.000

Table 11: Indicator 2-5 Salt iodation and storage

Iodized salt use verified (binary)	Midterm period observation (binary) No	Yes	Total
	Prop.	Prop.	Prop.
Salt not iodized or stored properly	0.80	0.82	0.81
Iodized salt properly obtained and stored	0.20	0.18	0.19
Total	1.00	1.00	1.00
Pearson: Uncorrected chi2(1) =	1.2314		
Design-based F(1.00, 47.00) =	0.5178	Pr =	0.475

Table 12: Indicator 2-6 Exclusive maternal breastfeeding until 6 months of age

Exclusively breast-fed (binary)	Midterm period observation (binary) No	Yes	Total
	Prop.	Prop.	Prop.
No	0.99	0.76	0.84
Yes	0.01	0.24	0.16
Total	1.00	1.00	1.00
Pearson: Uncorrected chi2(1) =	147.3234		
Design-based F(1.00, 47.00) =	124.3400	Pr =	0.000

Table 13: Indicator 2-8 Handwashing station in common use

Verified soap and water handwashing station (binary)	Midterm period observation (binary) No	Yes	Total
	Prop.	Prop.	Prop.
No	0.95	0.92	0.93
Yes	0.05	0.08	0.07
Total	1.00	1.00	1.00
Pearson: Uncorrected chi2(1) =	3.9580		
Design-based F(1.00, 47.00) =	1.6212	Pr =	0.209

Table 14: Indicator 2-9 Drinking water from an improved source

Uses an improved water source for drinking (binary)	Midterm period observation (binary) No	Yes	Total
	Prop.	Prop.	Prop.
No	0.26	0.23	0.24
Yes	0.74	0.77	0.76
Total	1.00	1.00	1.00
Pearson: Uncorrected chi2(1) =	1.9520		
Design-based F(1.00, 47.00) =	0.8719	Pr =	0.355

Table 15: Indicator 2-10 Cooking water from an improved source

Uses an improved water source for cooking (binary)	Midterm period observation (binary) No	Yes	Total
	Prop.	Prop.	Prop.
No	0.28	0.23	0.25
Yes	0.72	0.77	0.75
Total	1.00	1.00	1.00
Pearson: Uncorrected chi2(1) =	5.0596		
Design-based F(1.00, 47.00) =	2.1141	Pr =	0.153

Table 16: Indicator 3-8 Seed purchases

Buys seed for agriculture (binary).	Midterm period observation (binary) No	Yes	Total
	Prop.	Prop.	Prop.
No	0.51	0.92	0.76
Yes	0.49	0.08	0.24
Total	1.00	1.00	1.00
Pearson: Uncorrected chi2(1) =	383.1172		
Design-based F(1.00, 47.00) =	200.4810	Pr =	0.000

Table 17: Indicator 3-9 Fertilizer Purchases

Household buys fertilizer (binary).	Midterm period observation (binary) No	Yes	Total
	Prop.	Prop.	Prop.
No	0.97	0.78	0.86
Yes	0.03	0.22	0.14
Total	1.00	1.00	1.00
Pearson: Uncorrected chi2(1) =	116.1850		
Design-based F(1.00, 47.00) =	25.2632	Pr =	0.000

The following table summarizes the statistical tests for whether quantitative indicators have statistically distinct values between baseline and midterm, using a simple Wald test.

Table 18: Quantitative indicators

Indicator	F-statistic	P-value
1-6 Soudure (months)	42.67	< .0001
2-7 Food diversity	24.24	< .0001
3-1 Poverty rate	9.23	.0039
3-2 Surface planted	22.37	< .0001
3-3 Gardening surface	19.77	< .0001
3-6 Agriculture production	27.62	< .0001
3-7 Agriculture revenue	0.13	0.7184

Annex VIII: Survey Data on Individual Participation in Yaajeende

The dataset does contain a number of variables that detail respondents' direct knowledge of the program. These variables are not used in the regression analysis in this report; but they are available in the dataset for further analysis. Respondents were asked whether they had heard of the Yaajeende project, and then to name the activities of the Yaajeende project without memory aids. These variables differ from a written record of direct participation in the project. Respondents' memories are generally unreliable as a substitute for monitoring data. Several factors work against the measurement of Yaajeende participation through household survey data.

In the impact model studied, the locus of treatment is the community. Where Yaajeende is active, it is intended that even households without a formal role in the project will still benefit from the project. Even if the respondent did not receive a livestock subsidy herself through POG, she may still benefit from the availability dairy products and the demand for labor related to livestock in the village. Even if the beneficiary does not know the name of the project Yaajeende, she may still use water or nutrition or health services that has been improved by the project. Even if the cultivator does not know that the source of the improved seed and agriculture inputs is a Yaajeende CBSP, he may still benefit from the purchase. In other words, direct participation in a nutrition-led agriculture program can take many channels.

Survey fatigue is an important problem in household surveys. It is accepted within the evaluation community that many household surveys visit the same regions of Senegal. For ethical reasons most choose not to compensate respondents for the effort allocated to the interview. The midterm impact evaluation team worked assiduously to omit questions from the questionnaire that were not directly tied to statistical inference. This has the dual benefits of reducing errors during the interview itself, and lowering the rate of noncompletion in this survey and future surveys.

It is difficult to design measures of impact that are tied to respondents' answers to questions about direct participation in Yaajeende. The project's theory of change describes a complex and interlocking series of processes related to nutrition and farm productivity. Measures of direct participation can be binary (participant vs. non-participant), categorical (types of participation), or discrete (number of activities), or continuous (an index of participation, incorporating information about market activity, training, and subsidies received). The project's theory of change is too complicated for the outcome indicators to be linked one-to-one with participation in a single Yaajeende activity. Without a direct link from Yaajeende participation to a statistical model of impact, the midterm evaluation team opted against collecting data for data's sake.

The midterm impact evaluation used a short questionnaire to assess whether respondents recognized the components of the Yaajeende project. Yaajeende M&E staff use a thirteen-part rubric to describe the components of its activity in different CRs. Those components are the best description of beneficiaries' modes of participation that were available at the time of the questionnaire design. The components of that list are CBSPs, biofortified foods, orange foods, wild foods, exclusive maternal breastfeeding, water treatment, flood plain agriculture, intensive livestock, Sahel apples (horticulture), MTM groups, irrigation, gardening, seed production, bioreclamation of degraded lands, community representatives, maternal and neonatal health, improved seed, and CNVs.

First the respondents were asked to name as many of the components of Yaajeende as they could, if they knew of the project components. Male heads of household did not provide in-depth descriptions of participation. Each activity has its own binary variable in the participation data, equal to 1 if the respondent mentioned the activity as part of Yaajeende, and 0 otherwise. Women were asked whether they knew the same programs as the male heads of households.

Women were also asked whether their villages had MTM groups, and if so, whether they had ever attended those meetings. Respondents further described how recently they had attended meetings, and whether they ever used at home what was taught in the groups. Then a series of trainings were suggested, and respondents described whether their MTM had offered such trainings, with details such as how recently, and whether the respondent now used those trainings in the home. The list of trainings so described included: orange foods, wild foods, fruits and vegetables, enriched foods, iodized salt, breastfeeding, dietary diversity, gardening, reclamation of degraded lands, livestock, food preservation, and veterinary care. They were also asked whether and how recently they had worked in a field organized by the MTM group. And they reported whether they kept animals as taught by the MTM group, and what types of animals. Beneficiaries were thus limited to members of well-defined MTM groups. That criterion for membership in Yaajeende potentially excludes many beneficiaries with more limited program contact.

Since the data on beneficiaries' knowledge of Yaajeende and participation in trainings via MTM were not included in the DD impact evaluation models, they were not cleaned as carefully as the rest of the interviews. There are 2514 households in the 2015 phase of interviews. Of those, 1494 are located in project zones; and 1392 are in Yaajeende nutrition package villages. Only one woman per household completed the questionnaire. 55% of the respondents in nutrition zones believed that their village had MTMs, excluding missing values (2%). 63% of such respondents had themselves attended at least one meeting. The subjects within nutrition taught by MTM groups were widely varied, according to participants. Breastfeeding was the most common subject recalled by attendees (39%). Dietary diversity (5%) was the least common. 98% of MTM attendees reported learning gardening and livestock through the group, and 98% reported the MTM group had cultivated gardens together in a field. 30% of MTM attendees believed that there was a person responsible for vaccines in their village.

Several questions can be used to validate whether or not respondents' experiences of the project are authentic. Heads of household in Yaajeende CRs were much more likely (80%) to recognize the Yaajeende project name than in comparison CRs (36%). Female respondents were also more likely, 69% in project CRs vs. 21% in comparison CRs. The more important statistic for data quality, however, is that 89% of respondents who claimed their MTM groups were part of Yaajeende also lived in project CRs, vs 11% who did not. This suggests systematic problems with the participation questionnaire. 76% of the MTM attendees also believed that their MTM was a Yaajeende organization. The proportion that resided in project CRs and believed their MTM was part of Yaajeende was better, 85%, but numbered only 405 in total. A further 205 individuals stated that their village's MTM was part of Yaajeende, but that they had not personally attended the meetings.

In regression analysis, we can exclude respondents with conflicting or incomplete responses, but at the cost of lower sample size. The power calculations for the sample size are based on the full set of beneficiary household at midterm (1494) and their expected populations of children under 5. The midterm sample for the project group would be just 27% of its planned size. We must also consider whether to keep the villages and CRs from the baseline sample, for which (1) the village is located in the Yaajeende project zone, but also (2) no current beneficiaries report direct participation in the project. Excluding some villages would result in a sample size smaller than the 680 currently designated baseline year and project zone.

Respondents' recollection of project participation suffers from the limits of human memory. The period of project implementation is long, at four years. How recently should the question be phrased to ensure accurate responses? Typically, recall periods are as short as possible to avoid erroneous answers. Depending on the type of personal activity studied, the question might focus on the prior day, week, or month. But a recall period of more than three years would be noisy and potentially misleading. Due to the aggressive calendar for questionnaire development, coding, and piloting, there was not time to calibrate a survey module against beneficiaries with known exposure to project components.

The second reason to distrust respondents' account of their own participation in Yaajeende is that they do not necessarily know when they participate in Yaajeende activities. Yaajeende maintains extensive records of village level participation in each project activity. The monitoring dataset describes how many individuals have participated directly in project activities. The monitoring data could in principle be joined to the survey responses village by village, or household by household. Joining the data at the household level would require a significant investment of time. In the counterfactual impact evaluation, the marginal benefit to so doing would be limited. By definition, the expected participation of the comparison CRs in Yaajeende activities is expected to be zero. Working with data about individuals and households in lieu of villages does little to alleviate the problems of nonrandom selection and clustered errors. It does little to address the vague causal channels by which Yaajeende activities are tied to output in the DD model. It has benefits, in that it excludes households with no direct knowledge of Yaajeende from the treatment group, which might alleviate attenuation in the model estimate. On the other hand, it will decrease the sample size considerably.

Those monitoring data could be correlated with the survey responses in any of several ways. First, total number of contacts per village could measure the village's participation, either for the entire project or for specific components. An obvious drawback to this is that large villages will predictably have higher totals than small villages. A second method is to do the same, calculating instead the ratio of participants to village population. Village population statistics are fuzzy at best. The field research control sheets do document the total number of households per village, however, which could be used as a more concrete comparison of the size of villages. A third way would further weight different types of participation according to criteria of interest to the project: such as, perhaps, an estimate of the total subsidy provided to the village, that would account for the livestock of POG and the financing provided to irrigation, tractor, and flood-plain agriculture producers. The evaluation could seek to test whether near-universal participation in MTM groups is demonstrably different from limited participation. Such evaluations should be based on the program's theory of change for how interventions specifically affect beneficiary populations, and estimated only for the outcome indicators related to the theory of change. In this evaluation, the theory of change was that communities treated would see an impact in nutritional status, nutritional behaviors in the home, and agriculture productivity.

Further analysis of the effects of direct project participation on the beneficiaries could proceed with the same regression models as used in this impact evaluation, adjusted to reflect the different sampling procedure. It could follow the PSM procedure and construct a matched sample of households with panel data at baseline and midterm; but the sample size would be smaller again since only 285 (47%) of direct participants in MTM groups were also sampled at baseline, versus 322 (53%) with no baseline data. Finally, the project could take the smaller dataset and use a different family of algorithms, such as machine learning and data mining, to probe the links between exposure to facets of a complex project and household outcomes. The final alternative would not be in keeping with the USAID counterfactual standards for impact evaluation. It might still reveal correlations that would help the project to learn which project components were linked with project outcomes *in this case,* rather than what USAID should believe are the outcomes attributable to the project. The project could then take the correlations to the field and discuss with field staff to evaluate whether the findings are credible.