Can gender- and nutrition-sensitive agricultural programs improve resilience? ANGeL, Cyclone Fani, and Resilience in Bangladesh

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$458,064

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$405,924

Abstract

Between 2015 and 2018, we collaborated with the Bangladesh Ministry of Agriculture on the implementation of the Agriculture Nutrition and Gender Linkages (ANGeL) project. ANGeL was a multi-arm randomized control trial (RCT) with treatment arms aimed at increasing nutrition knowledge, diversification of agricultural production and gender sensitization. Evaluation of endline data showed that it diversified agricultural production diversification, improved diet quality and increased women's empowerment in agriculture. 18 months after ANGeL ended, approximately 25 percent of the study sites were damaged by Cyclone Fani. We propose to re-survey individuals and households that participated in the ANGeL, bringing evidence to bear on three knowledge gaps: (1) Whether agricultural interventions aimed at diversifying income sources have sustainable impacts (on asset bases, income diversification, gender-specific outcomes and women's empowerment, and nutrition) that persist after the intervention ends; that is to say, do such interventions contribute to resilient escapes from poverty; (2) Are such interventions protective when shocks such as Cyclone Fani occur? Do they enhance the "capacity that ensures adverse stressors and shocks do not have long-lasting adverse development consequences"; and (3) Do these interventions promote gender-sensitive resilience.

1. Introduction

There is a seemingly vast literature on resilience. Barrett, Hoddinott and their co-authors are currently undertaking a systematic review of resilience to shocks in the context of developing countries; their PRISMA flow diagram shows more than 9,000 published or grey literature studies. But a closer look reveals that this literature is not nearly as voluminous as it might first appear. Fewer than 250 of these papers meet their criteria for inclusion in their review.[1] Among the quantitative studies included in their review, the vast majority (77%) are household-level cross-sectional studies. There are fewer than ten studies that (a) have a clear definition of resilience and (b) use household panel data. While the importance of building up asset bases and diversifying income sources are recurrent themes in this literature, the Barrett et al database contains virtually no studies that rigorously assess how interventions can enhance resilience to shocks. Their database contains few studies that incorporate a gendered dimension in their analysis of resilience; the literature on resilience has largely ignored the research and policy emphasis on gender and intra-household resource allocation that has taken place in the last 20 years.[2]

Our study seeks to bring evidence to bear on three knowledge gaps: (1) Whether agricultural interventions aimed at diversifying income sources and improving nutrition have sustainable impacts (on asset bases, income diversification, gender-specific outcomes and women's empowerment, and nutrition) that persist after the intervention ends; that is to say, do such interventions contribute to resilient escapes from poverty; (2) Are such interventions protective when shocks occur? That is, following the definition of resilience set out in Constas, Frankenberger, and Hoddinott (2014), do they enhance the "capacity that ensures adverse stressors and shocks do not have long-lasting adverse development consequences"; and (3) Do these interventions promote gender-sensitive resilience.

2. Context (1): The Agriculture Nutrition and Gender Linkages (ANGeL) project

Between 2015 and 2018, the PIs on this proposed study (Ahmed, Hoddinott and Quisumbing) collaborated with the Bangladesh Ministry of Agriculture (MOA) on the implementation of the Agriculture Nutrition and Gender Linkages (ANGeL) project.[3] ANGeL was a multi-arm randomized control trial (RCT) that aimed to increase farm incomes through agricultural production diversification, improve diet quality particularly the consumption of micronutrient rich foods by pre-school children and women, and increase women's empowerment in agriculture. ANGeL received significant financial support from USAID. To meet these objectives, in consultation with the MOA and USAID, we designed a project that implemented and evaluated three alternative intervention modalities for promoting nutrition and gender sensitive agriculture. These were: (1) Agriculture Production: Facilitating the production of the high-value micronutrient rich foods with the aim of diversifying agricultural production (fruits and vegetables; pulses; oilseeds; and poultry, dairy, fish, livestock); (2) Nutrition Knowledge: Conducting

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[1] The inclusion criteria are: Studies: Are situated in low- or middle-income countries (per World Bank definitions); assess resilience to covariate or idiosyncratic shocks; examine resilience at the household or individual level; have some indicator of human wellbeing as an outcome of interest.

[2] While not explicitly framed as a paper on resilience, Quisumbing, Kumar, and Behrman (2017) show, using observational data, that idiosyncratic and covariate shocks affected men's and women's asset stocks differently, with jointly held land and assets better insured against food price increases and women's landholdings disproportionately negatively affected by illness shocks.

[3] Other investigators on the ANGeL project were P. Menon, S. Roy and M. Younus.

high-quality behavior change communication (BCC) training to improve nutrition knowledge of women and men; and (3) Gender Sensitization: Undertaking gender sensitization activities that lead to the improvement in the status/empowerment of women and gender parity between women and men. ANGeL had five treatment arms (T) and one control arm (C):

> T1: Nutrition BCC training delivered to women and men by Sub-Assistant Agriculture Officers (SAAO) from the Department of Agricultural Extension (DAE) of the MOA.

> T2: Nutrition BCC training delivered to women and men by female community nutrition workers hired by the ANGeL project

> T3: Agricultural Production training delivered to women and men by SAAOs

> T4: Agricultural Production + Nutrition BCC training delivered to women and men by SAAOs

> T5: Agricultural Production + Nutrition BCC training delivered to women and men by SAAOs + gender sensitization activities for women and men conducted by Helen Keller International (HKI).[4]

> C: Control

The sample for ANGeL was drawn from 16 rural upazilas (sub-districts) that were agro-ecologically suitable for crop diversification and had good market connectivity. Within each, 10 blocks (sub-sub districts) were randomly selected, yielding 160 blocks. These were randomly assigned to the five treatment arms and the control group: 25 blocks to each treatment arm (25 x 5 = 125 blocks), and 35 blocks to the control group. One village within each block was randomly selected. A 100 percent census of households in each village was conducted and farm households with at least one child under 24 months identified. 25 farm households were randomly selected from each, yielding 625 farm households for each of the 5 treatment arms (25 farmers x 25 blocks) and 875 farm households (25 farmers x 35 blocks) for the control group. This yielded 3,125 farm households belong to the 5 treatment arms (625 x 5) in 125 blocks, and 875 farm households belong to the control group in 35 blocks for a total of 4,000 farm households.

The ANGeL baseline survey was conducted from November 2015 to January 2016. The endline survey was conducted from January to March 2018. Attrition was low (2.6 percent) and was uncorrelated with treatment status or baseline characteristics. Implementation fidelity was high. The impact evaluation of ANGeL (Ahmed et al, 2018) showed that:

- Treatment arms that included agricultural training (T3, T4, T5) were successful in increasing knowledge of agricultural production techniques relevant to vegetable and fruit production.

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[4] The gender sensitization activities of HKI were based on their Nurturing Connections curriculum; a participatory approach to challenging gender norms and building equality and constructive communications skills with every member of a community to create the best environment for improving nutrition. As implemented, these included community conversations and sessions with family members (including husbands and mothers-in-law) to discuss gender roles. For details, see https://www.hki.org/updates/nurturing-connections-bangladesh#.XXWclihKjcc

Both men and women benefitted from this training. The effect on women's knowledge was larger than that on men's knowledge.

- Treatments T3, T4 and T5 lead to adoption of a range of improved agricultural practices. While men showed some evidence of adopting improved practices, women were more likely to adopt these.
- Treatments T3, T4 and T5 increased the diversity (as measured by number of crops) of production in homestead gardens.
- At endline, arms T2, T4 and T5 increased diet diversity by 4.8-5.3% and arms T2 and T4 increased children's diet diversity.
- All treatment arms increased women's empowerment in terms of household income decisions; Treatment arm T5 had the largest impact on women's empowerment in terms of adequacy with respect to asset ownership.

3. Context (2): Cyclone Fani

In May 2019, northeast India and Bangladesh were struck by Cyclone Fani. India suffered most from this storm as it initially made landfall in the Odisha state. Fani then travelled east and north, through Bangladesh. While wind speeds diminished as Fani moved northwards, gusts of up to 70km/hr were reported and there was heavy rain and widespread flooding. Four of the 16 districts (25 percent) included in the ANGeL study were reported damage, primarily to cropland and housing. The Ministry of Disaster Management and Relief estimated that 13,000 houses were damaged nationwide, while the Ministry of Agriculture estimated that around 63,000 hectares of crops were affected in 35 districts. *Boro* rice—among the leading crops cultivated by the ANGeL participants—was the most affected (Daily Star 2019).

4. Proposed study

Our study aims to answer the following research questions:

(RQ1) Did ANGeL contribute to resilient escapes from poverty by leading to sustained improvements across four domains: Asset holdings – assessing not only total household assets but also disaggregating these impacts on men's, women's, and jointly held assets; agricultural diversification; diet diversity at the household and individual level; and women's empowerment.

(RQ2) Was ANGeL protective across these domains in the aftermath of Cyclone Fani?

(RQ3) Did the gender-sensitive activities undertaken as part of T5 enhance the beneficial impacts of ANGeL on gender-specific outcomes?

Below we describe the data we will collect; the outcomes that we will focus on; our estimation model; attrition and balance; statistical power; and IRB review.

Data to be collected

We propose re-surveying ANGeL households found in the following treatment arms: T3 (agricultural production), T4 (agricultural production + nutrition BCC), T5 (agricultural production + nutrition BCC + gender sensitization) and the control group, C. We will not re-survey arms T1 and T2; these arms

showed the smallest impacts at endline and including them would make the study too costly. We would undertake this re-survey in January- February 2020, two years after the endline and seven months after Cyclone Fani.

Outcomes

We will assess impact over four outcome domains:

Assets: Assets include both land and nonland assets. Information on assets was collected in the questionnaire administered to the male household head, based on an extensive listing of assets (including agricultural productive assets, nonagricultural productive assets, consumer durables, jewelry—an important asset for women—and housing). The survey also collected information on land and water bodies, which are important for aquaculture. The land and assets modules allowed the respondent to name the three owners of the asset, allowing us to classify all assets as male-owned, female-owned, or jointly-owned assets. The respondent also gave information on the current market value of each asset. This allows us to calculate asset ownership in terms of levels for both individuals and the household as well as asset shares owned by different members, including women.

Income diversification: As we did at the ANGeL endline, we will measure this by the number of non-staple crops grown by the household. We consider this in terms of crops grown in the field plots, in homestead plots and in both.[5]

Diet diversity: We will measure diet diversity at the household level using the Food Consumption Score. We will construct diet diversity scores for women (including MDD-W, an indicator used by USAID) and for children 0-23m.[6]

Women's empowerment: Women's empowerment was measured at baseline using the Abbreviated Women's Empowerment in Agriculture Index (A-WEAI) (Malapit et al. 2017); at endline, a later version of the WEAI developed for project-level use, pro-WEAI, was administered (Malapit et al. 2019). Both are modifications of the WEAI (Alkire et al. 2013). A-WEAI can be recovered from pro-WEAI, so the impact evaluation report (Ahmed et al. 2018) used A-WEAI comparisons. In this resurvey, we will collect pro-WEAI, because it collects more information related to other aspects of women's empowerment such as intrahousehold harmony, attitudes towards IPV, and mobility, and because A-WEAI can be computed from a pro-WEAI data set.

Estimation model

Define:
Y_{i0} Value of outcome variable for household i at the time of the ANGeL baseline
Y_{i1} Value of outcome variable for household i at the time of the ANGeL endline
Y_{i2} Value of outcome variable for household i post Cyclone Fani
T_{ij} Treatment status of household i in treatment group j. j=3,4,5; corresponding to treatment groups T3, T4 and T5. Tij is a binary variable=1 if a household is in treatment group j, =1 otherwise.
$\mathbf{T_i}$ =∑T_j ; ie =1 if household in any treatment group, =0 otherwise

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[5] We will explore alternative outcome measure, the Simpson Diversity Index (SDI) which captures both the number of different crops grown by the household and the amount of land devoted to each crop.
[6] WHO is in the process of finalizing a new set of diet diversity indicators for children 0-23m. These will be available in late 2019; we will ensure that we collect the data needed for these.

S_i =1 if household residing in a district affected by Cyclone Fani.

X_{i1} A vector of control variables measured at baseline: household head education and sex; education levels of adult female household members; land holdings; access to electricity; location.[7]

β Parameters to be estimated

ε_I Disturbance term

We will estimate the following ANCOVA treatment effect equations:

(1) $Y_{i2} = \beta 1 \bullet Y_{i0} + \beta T \bullet T_i + \beta_x \bullet X_{i1} + \varepsilon_I$

Equation (1) addresses research question RQ1. Controlling for baseline outcome values and control variables, βT tells us if ANGeL had a sustained impact on our outcomes of interest.

(2) $Y_{i2} = \beta 1 \bullet Y_{i0} + \beta T \bullet T_i + \beta S \bullet S_i + \beta TS \bullet T_i \bullet S + \beta_x \bullet X_{i1} + \varepsilon_I$

Equation (2) addresses research question RQ2. βT tells us if exposure to ANGeL led to further improvements in the outcome variable after the intervention ended; remember that time period 1 refers to the measurement of the outcome variable as ANGeL was ending. βS tells us if exposure to Cyclone Fani affected the outcome variable. We expect βS to be negative. If βTS is positive, it tells us that exposure to ANGeL attenuated the malign effects of Cyclone Fani. Note that if $\beta S + \beta TS < 0$, ANGeL partially reduced the effects of Cyclone Fani; if $\beta S + \beta TS = 0$, ANGeL fully offset the impact of the cyclone.

(3a) $Y_{i2} = \beta 1 \bullet Y_{i0} + \sum \beta_j \bullet T_{ij} + \beta_x \bullet X_{i1} + \varepsilon_I$, j =3,4,5

(3b) $Y_{i2} = \beta 1 \bullet Y_{i1} + \sum \beta_j \bullet T_{ij} + \beta S \bullet S_i + \sum \beta S_j \bullet T_{ij} \bullet S_i + \beta_x \bullet X_{i1} + \varepsilon_I$, j =3,4,5

Equations (3a) and (3b) address research question RQ3. We are particularly interested in the values of $\beta 5$ in equation (3a) and $\beta S5$ in equation (3b). These tell us if the gender-sensitive activities undertaken as part of T5 affected our outcomes, particularly our gender-specific outcomes.

Standard errors will be corrected for clustering at the unit of randomization, the block.

Attrition and balance

The baseline survey for ANGeL successfully completed interviews of all 4,000 target households. At endline, we successfully traced and interviewed 3,898, an attrition rate of 2.6 percent over two years. The primary reason for attrition was household migration (76 households) with only 26 not interviewed because they had dropped out of the study, refused to be interviewed or could not be found. Probit regressions were run on the impact of the treatment arms on attrition. The null hypothesis that participation in the treatment arms affected attrition was not rejected; further, the coefficients on treatment status are small, typically less than one percentage point.

The survey company, DATA, that collected the baseline and endline surveys will collect these new data. With their agreement, DATA had retained contact information on the households who participated in the ANGeL study. Given DATA's excellent record in tracing and re-interviewing study participants (not only for this study but also for other longitudinal surveys we have undertaken in

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[7] These were the control variables used in Ahmed et al (2018).

collaboration with them), we are confident that we will be able to trace the vast majority of ANGeL participants. That said, we will again assess whether attrition is random. If attrition is non-random in treatment status and if it exceeds 10 percent of our baseline sample, we will assess the robustness of our findings to the use of inverse-probability-of-attrition weights (Fitzgerald, Gottschalk and Moffitt, 1998) and Lee (2009) bounds.

Ahmed et al (2018) assessed balance across a wide range of baseline characteristics including those relating to household demographics, farm size, tenancy status, asset ownership and consumption. There was little evidence of differences across these characteristics by treatment status.

Statistical power

As is well understood, sample size calculations need to account for: (1) the study's primary outcomes; (2) the minimum size of change in those outcomes; (3) the degree of variability in those outcomes; (4) the extent to which there is correlation in outcomes within localities; (5) the desired level of statistical power; and (6) the level of desired statistical significance. We follow the standard practice of calculating the sample size that, given the expected change in the selected outcome indicators, would provide an 80 percent chance (the power of the test) of correctly rejecting the null hypothesis that no change occurred, with a 0.05 level of significance. We give two examples.

A useful outcome to be estimated using equation (1) are the value of assets (jewelry, livestock, consumer durables) owned by the spouse of the male household head. Using baseline data on assets (mean values, standard deviations, intra-cluster correlations), our sample size, and number of clusters(blocks) we are powered to detect a 25 percent increase in asset value. Our analysis of the endline data suggested that ANGeL increased women's asset holdings by 24 percent; this power calculation tells us that we can assess whether the asset gains observed at endline persist two years after the intervention ended.

A useful outcome to be estimated using equation (3a) is the share of household assets (jewelry, livestock, consumer durables) held by the spouse of the male head. Again drawing on our baseline data, we are powered to detect a decline of 3.5 percentage points in women's asset share.

IRB review

We will have our study protocol reviewed by Cornell's Institutional Review Board and we will request letters of authorization to conduct the survey from the Ministry of Agriculture, Government of Bangladesh prior to commencing fieldwork.

5. Policy relevance and contribution to host country research capacity

The proposed study has significant policy relevance in Bangladesh. In Bangladesh, weather-related hazards such as cyclones are increasing in frequency and intensity, largely driven by the effects of climate change (Osmani et al 2016). While the original ANGeL study generated evidence on how to most effectively diversify agriculture, diets, and empower women, this proposed study has the potential to build upon this knowledge base to assess whether ANGeL's interventions may also inform the design of appropriate policies to address transient poverty by building resilience against climate change.

Furthermore, as climate change, food security, and nutrition are interlinked, identifying layered and integrated policies and programs that address all three has intrinsic value and policy significance.

The Bangladesh Government and in-country development partners are committed to identifying multisectoral actions to improve food security and nutrition, and to build resilience against climate change. While Bangladesh's existing resilience-building efforts have mitigated damages and saved countless lives; more research is needed to inform how to most effectively protect vulnerable households from and build resilience against weather-related hazards like Cyclone Fani. Various policy frameworks support these efforts, including the Second Country Investment Plan for Nutrition-Sensitive Food Systems (2016-2020) (CIP-2) and the Seventh Five Year Plan (2016-2020). Bangladesh's National Social Security Strategy (NSSS) 2015 is a concerted effort of the government to improve the country's social protection system. However, the NSSS is based upon programs designed for a stable setting. The increasing vulnerability to climate-induced shocks highlights the need for complementary approaches beyond the existing social protection system.

One of the PIs (Ahmed) is based in Dhaka and his presence there provides a natural conduit for conveying the results of this study. We will meet with MOA officials prior to survey implementation to discuss this work and to solicit their input on outcomes that will be especially informative to them. We will host a workshop at study end to convey our principal findings with a view to informing the 8th Five-Year Plan (2021-2025). Our 2018 workshop that disseminated the results of the ANGeL endline was attended by about 140 participants from government, NGOs, and donor agencies. The workshop was opened by the Minister of Agriculture, Matia Chowdhury, who was particularly enthusiastic about the women's empowerment findings, commenting that she was pleased to see substantial gains in women's control of income, asset ownership, and production over the project period. Following the workshop, MOA committed to scaling up the most effective ANGeL interventions nationally, which is currently underway. We are confident that the proposed dissemination workshop for this study will attract similar attention.

We will undertake two, related capacity building activities.

(1) We will develop and implement a 1.5 day course on how to do impact evaluations. This course will be aimed at local researchers - junior academics, PhD students and researchers at Bangladesh-based think tanks. The objective of this workshop is to enhance the ability of this audience to be "skilled producers" of impact evaluations.

(2) We will develop and implement a one day course on how to understand impact evaluations. This will be aimed at mid-level civil servants. We have identified a number of government ministries and agencies that would benefit from this course, including the Agricultural Policy Support Unit (APSU) of the MOA, the Bangladesh Institute of Research and Training on Applied Nutrition (BIRTAN)—both of which are involved in the current ANGeL national scale-up efforts – as well as the Ministry of Food, the Economic Relations Division of the Ministry of Finance, the Ministry of Planning, and the Governance Innovation Unit (GIU) in the Prime Minister's office, who are responsible for monitoring SDGs among other activities. The IFPRI-Bangladesh office has an MOU with the GIU, which emphasizes analytical capacity development of GIU officials. The objective of this workshop is to enhance the ability of this audience to be "intelligent consumers" of impact evaluations.

If there is sufficient demand for these workshops, we will offer them more than once.

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Timeline

We are confident that we could complete this study in one year. Assuming an October 15, 2019 start date, we would have three months for survey preparation (hiring and training enumerators; obtaining permissions for fieldwork; completing IRB requirements etc). This is feasible because we would use the existing ANGeL endline questionnaire with only minor modifications, along with the existing data entry programs and data cleaning routines. We think the survey would take approximately two months (January – February 2020) and we would need an additional two months (March-April 2020) for post-survey data processing. This would give us six months for data analysis and write-up (May-October 2020). Our capacity building workshops would take place between May and September 2020 (exact dates to be confirmed after we have liaised with some of the potential participating institutions) and the dissemination workshop would take place in October 2020.

BUDGET JUSTIFICATION

Can gender- and nutrition-sensitive agricultural programs improve resilience?
ANGeL, Cyclone Fani, and Resilience in Bangladesh

Senior Personnel:
John Hoddinott (Co-PI), H.E. Babcock Professor of Food & Nutrition Economics and Policy in the Division of Nutritional Sciences, will be responsible for the overall administration and direction of the project at Cornell University. He will oversee development of survey instruments, lead data analysis and write up and participate in project dissemination activities. He will also be responsible for ensuring that activities undertaken for sub-contractors meet project requirements. Funds will cover his effort for 0.75 month in Year 1 of the project. **Dr. Hoddinott will provide 0.25 month effort and associated fringe as a leveraged funding contribution in Year 1 (equivalent to $11,979).*

Escalations:
Faculty and staff salary reflects an anticipated 3% escalation effective July 1 of each year.

Fringe Benefits:
The negotiated rate in place at the time salary costs are incurred will be charged to the project.
Fringe benefits are calculated at the university established rates of 63.9% (07/01/19 – 06/30/20), 65.0% (07/01/20 – 06/30/21) 66.20% (07/01/21-06/30/22) and 67.50% thereafter.

Find current rates at *https://www.dfa.cornell.edu/capitalassets/cost/employee*

Travel:
Foreign Travel: **Dr. Hoddinott will provide ($3,250/year in Years 1 and 2; $6,500 total) as a leveraged funding contribution for international travel.* Leveraged funding will cover costs to travel to Bangladesh each year for field research. The budget covers 1 trip each year at cost of $3,250/year. Anticipated costs ($3,250/trip) include: airline tickets ($1,200), accommodations ($135/night for 9 nights), per diem ($75/day for 10 days), ground transportation and miscellaneous fees ($85).

Other Direct Costs:
Subawards/Consortium/Contractual Costs: Cornell will establish **s**ubcontracts for this research project with the following institution(s):

($260,000)	DATA	Led by Dr. Ahmed
($61,000)	IFPRI	Led by Dr. Quisumbing

Each institution has a work plan established to indicate their commitment of the deliverables and expected outcomes and is included in the project description. See separate budgets in the MS Excel spreadsheet. **IFPRI will provide $33,661 as a leveraged funding contribution on the project.*

Indirect Costs:
F&A (indirect) costs are proposed at Cornell's Federally-Negotiated Indirect Cost Rate Agreement (NICRA) rate on Modified Total Direct Costs (MTDC). MTDC includes exclusions, if applicable, of GRA tuition and health insurance, capital equipment in excess of $5,000, rental costs of off-site facilities, participant support costs, and subcontracts in excess of $25,000. Predetermined NICRA rates are 57% through June 30, 2021, and provisional NICRA rate of 57% thereafter.

We formally request the leveraged funding contribution identified above not be considered formal cost share. As such, the sponsor will not require Cornell University or its subcontractors to track monitor, or report on the funds as cost share. The leveraged funding contribution is only provided in order to demonstrate Cornell University's level of commitment to the proposed project and to satisfy the sponsor's proposal submission requirements.