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Design of a collaborative monitoring and evaluation system for a community-based nutrition project in rural Bangladesh

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ARTICLE INFO

Keywords:

Impact evaluation

Process evaluation

Positive Deviance/Hearth (PD/Hearth)

Income generating asset transfer

Collaborative monitoring and evaluation system

ABSTRACT

Poor diet and undernutrition are common among children living in Bangladesh. To promote appropriate complementary feeding of young children, an economic development (ED) program involving income-generating asset transfer was implemented alongside a social and behavior change (SBC) program. This paper introduces a collaborative monitoring and evaluation (M&E) system in which diverse collaborators (“research group”, “implementation team”, and “coordinators”) facilitate M&E data acquisition by leveraging their comparative advantages. The implementation team built a monitoring system to track the ED (n = 2960) and SBC participants (n ~ 10,000) over 12 months. Based on the baseline design and the monitoring records, the collaborators planned an impact evaluation introducing a quasi-experimental design using two cross-sectional surveys and a prospective cohort survey of child feeding and nutritional status. Using various data sources generated from the M&E system, the collaborators will also reveal the program impact pathway through which each intervention component is delivered, received, and utilized alongside the context-specific facilitators and barriers, including the programs’ uptake. The collaborative M&E system enables the sharing of program goals, strengthens collaborators’ commitment to the program, and extends the understanding of the program’s progress and evaluation activities.

1. Introduction

Early childhood stunting is associated with high mortality and morbidity, defective cognitive development, poor academic performance, and low productivity (Black et al., 2013). In South Asia, three out of ten children under five (31.7 %) are stunted, with estimates projecting 55.9 million stunted children living in this region (Edition of the Joint Child Malnutrition Estimates, UNICEF, WHO, IBRD, & The World Bank, 2020). Despite a notable decrease in the prevalence of stunting among preschoolers (43.2 % from 2007 to 30.8 % in 2017) and substantial improvement of dietary diversity among young children (defined as consumption from 4 or more food groups: from 25.2 % in 2011 to 38.7 % in 2017) in Bangladesh (NIPORT & ICF International, 2013, NIPORT &

ICF International 2019; NIPORT & Macro International, 2009), under-nutrition remains a severe public health burden. Social and behavior change (SBC) strategies are effective in promoting optimal complementary feeding in low- and middle-income countries (LMIC) (Bhutta et al., 2013; Kimmons et al., 2004; Lassi et al., 2020; Osendarp & Roche, 2016). However, food insecurity and the absence of diversity in the food system limits access to animal protein-rich and micronutrient-rich foods that are essential for children’s balanced diet and subsequent linear growth.

Agriculture production activities have been beneficial to child health and nutrition by improving dietary quality, even in poor-resource households (Mulmi et al., 2017). A few cross-sectional studies reported that home gardening, diversifying crops, or raising small

Abbreviations: M&E, monitoring and evaluation; WVB, World Vision Bangladesh; WVK, World Vision Korea; KOICA, Korea International Cooperation Agency; BRDMCN, Bangladesh Rajshahi Division Maternal and Child Nutrition; PD/Hearth, Positive Deviance/Hearth; SBC, social and behavior change; ED, economic development.

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<https://doi.org/10.1016/j.evalprogplan.2020.101892>

Received 19 January 2020; Received in revised form 4 September 2020; Accepted 7 October 2020

Available online 28 November 2020

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livestock were positively related to women’s and children’s dietary diversity in some LMIC’s (Murendo, Nhau, Mazvimavi, Khanye, & Gwara, 2018; Rammohan, Pritchard, & Dibley, 2019). Furthermore, nutrition-sensitive agricultural programs that augment crop production, diversification, and livestock vaccination led to income generation, improved the consumption of micronutrient-rich foods, enhanced utilization of better health services, and benefited maternal and child nutritional status (Knueppel, Cardona, Msoffe, Demment, & Kaiser, 2010; Ruel, Quisumbing, & Balagamwalab, 2018).

With an increase of multi-sector nutrition interventions, particularly involving agriculture practices, there is a demand for strengthening monitoring and evaluation systems, and evaluation capacity, to understand the progress and impact of the interventions. Yet the efforts to meet the demand require pooling human and financial resources, advanced methodological skills, and maintaining close coordination across various stakeholders. Until now the literature describing such comprehensive monitoring and evaluation systems in the area of nutrition-sensitive agriculture programshas been scarce (Bach, Gregor, Sridhar, Fekadu, & Fawzi, 2020; Nordhagen, Nielsen, van Mourik, Smith, & Klemm, 2019).

Collaborative monitoring and evaluation (M&E) is a stakeholder involvement approach to developing the entire process and components of the evaluation, through the active participation of the key stakeholders, including the implementers, evaluators, and administrators (Fetterman, Rodríguez-Campos, A., W., & Goldfarb O’Sullivan, 2014; O’Sullivan, 2012). Unlike the traditional evaluation methods emphasizing the independence of roles, especially between the program implementers and the evaluators, the collaborative M&E system involves active engagement of different stakeholders in the M&E process. Collaboration among these different key stakeholders promptly recognizes the changes in the program environment, enables the collection of good-quality data in a timely and flexible manner, and permits the results or lessons from the data analysis to be more practically translated towards achieving the program goals (Donis-Keller, Meltzer, & Chmielewski, 2013; O’Sullivan, 2012; Rodríguez-Campos, 2012).

This study introduces a collaborative M&E system to monitor and evaluate a multifaceted community-based nutrition project, the Bangladesh Rajshahi Division Maternal and Child Nutrition (BRDMCN) Project (Fig. 1). This study introduces a procedure in which diverse collaborators established the collaborative M&E system and unfolded

varying roles and responsibilities to effectively manage the M&E system. Also, this study describes the various elements of the M&E system to show the program impact pathway and share the lessons learned throughout the implementation process of the M&E system. The data collection of this M&E system began in November 2018 and is still partially in progress.

2. Bangladesh Rajshahi Division Maternal and Child Nutrition (BRDMCN) Project

The BRDMCN was designed and implemented in three upazilas (the second-lowest tier of regional administration) in the Rajshahi Division, by World Vision Bangladesh (WVB) and World Vision Korea (WVK), funded by the Korea International Cooperation Agency (KOICA) (March 2018-December 2020). The BRDMCN was mainly driven by the SBC and economic development (ED) approaches to support household livelihood, enhance caregivers’ optimal caring and feeding practices, and address child undernutrition (Fig. 1). Led by the BRDMCN manager and main staff, intervention delivery and monitoring activities werewere conducted by 285 community facilitators, 29 community supervisors, and 9 program officers. Each community facilitator was responsible for 300 households and frequently visits their assigned households for relevant activities.

SBC program: A Positive Deviance/Hearth (PD/Hearth) program was a central component of the SBC program. PD/Hearth programs have positively impacted caregivers’ behaviors, as well as, child nutrition and health in LMICs (Bisits Bullen, 2011; Roche et al., 2017).

In the BRDMCN, the PD/Hearth program was designed following previously generated guidelines (Nutrition Working Group and Child Survival Collaborations and Resources Group (CORE) (2002)). Positive deviant inquiries (PDI) were made by the implementation team and community members to identify healthy behaviors that are considered to benefit child nutrition and increase awareness of the importance of child nutrition. In each village, community facilitators screened children 6–59 months of age whose weight-for-age z-score (WAZ) was less than -2.0. The child and mother pairs were then invited to a two-week Hearth session led by community facilitators. These sessions were different from conventional Hearth sessions where mothers of underweight children are matched to positive deviants.

Six contextualized messages (i.e., breastfeeding, complementary

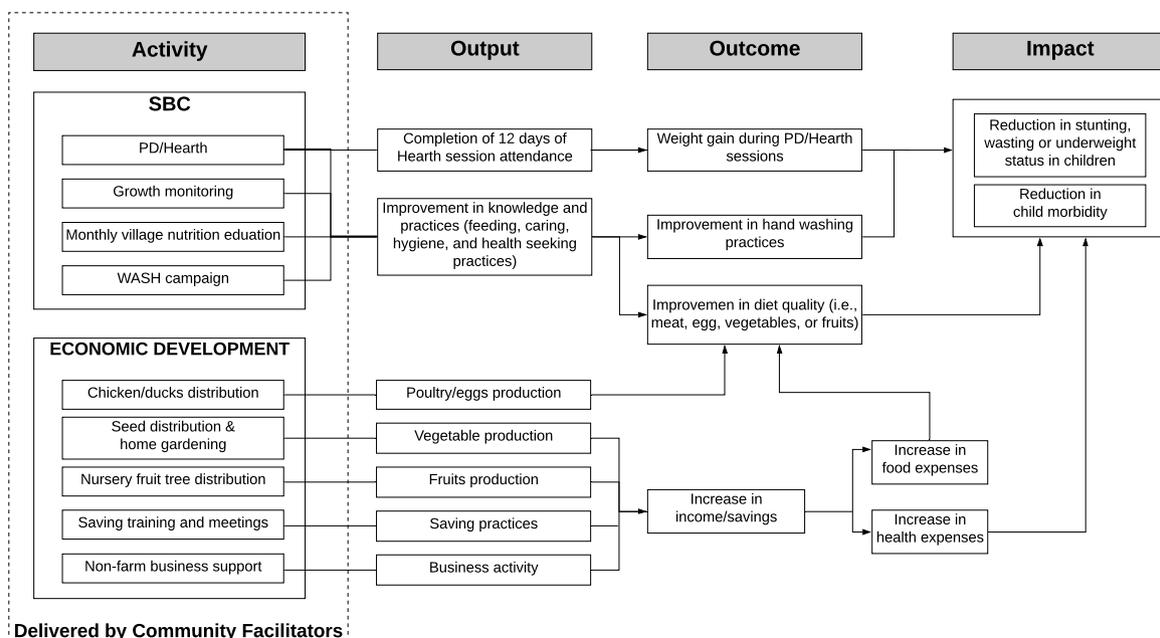


Fig. 1. Conceptual framework of the Bangladesh Rajshahi Division Maternal and Child Nutrition (BRDMCN) project: SBC, social and behavior change.

feeding, hygiene practices, caring, health-seeking, and family planning) based on PDI findings were discussed in the PD/Hearth sessions. A complementary meal was prepared by participant mothers using locally available, low cost, and micronutrient-dense food ingredients (i.e., rice, vegetables, eggs). Mothers fed their children the complementary meal and demonstrated appropriate handwashing practices during the session. Mothers were also encouraged to continue practicing what they learned from Hearth sessions. Community facilitators conducted 2–3 home visits over a two-week period after each Hearth session.

Since the BRDMCN project started, a total of five batches of PD/Hearth sessions were conducted. A total of 2701 children were enrolled to the 1st batch (September 2018), 2564 children to the 2nd batch (November–December 2018), 2148 children to the 3rd batch (March–April 2019), 1901 children to the 4th (August 2019), and 781 to the 5th batch (November 2019).

Apart from the PD/Hearth program, monthly growth monitoring sessions, aligning with the government's Expanded Program on Immunization (EPI) schedule, were held at 295 centers, with support from community facilitators. Through November 2019, community facilitators measured the weight, height, and mid-upper arm circumference of a total of 17,893 children (boys: 8927; girls: 8966) aged 0–59 months. Education sessions were held twice per month to build capacity on health and WASH behavior change. A total of 55 Classroom Education Sessions were hosted at 53 schools for adolescents.

The **Economic Development (ED) program** was developed using an ultra-poor graduation approach to alleviate poverty and strengthen rural livelihoods (World Vision Bangladesh & BRAC, 2018). The asset transfer, with multifaceted training for ultra-poor community members, was acknowledged for the positive health effects on the nutritional status of children and their neighbors (Raza, Van de Poel, & Van Ourti, 2018). The ED program attempted to build the capacity of the beneficiaries by increasing homestead production and providing income and earning opportunities for women to meet the food and nutritional needs of children and mothers.

With the support of community leaders, a total of 2960 poor or ultra-poor households were screened by community facilitators and the BRDMCN project team using national wealth criteria. Selected participants received assets for income generation or household food sources based on their living environment (i.e., some space for home gardening or pond for rearing ducks) or previous microbusiness experience. A total of 2089 households received 11 ($n = 1688$) or 17 ducks ($n = 401$) each, and 870 received 11 chickens each. A total of 2075 households received vegetable seeds and two days' of gardening training, and 1511 households received 1–4 nursery fruit trees. Non-farming support included training on shop operation business techniques for those ($n = 230$) who had previous microbusiness experience.

All beneficiaries received a quarterly savings training and attended monthly savings group meetings managed by community facilitators and supervisors. As part of a coordinated effort, the Department of Agriculture Extension and Livestock provided technical support to the households.

3. Collaborative process for building monitoring and evaluation system

Collaboration across different actors intended to establish a comprehensive M&E system to reveal and evaluate a program impact pathway of the BRDMCN project in improving child nutritional status. We hypothesize that better access to various food ingredients through asset transfer, crop production/diversity, and income generation improves the nutritional status of children more effectively than implementing the PD/Hearth program alone (Fig. 1). Also, attending PD/Hearth sessions could remind the ED participants about the importance of child nutrition and encourage them to use their assets for food or health expenses of family members including young children. This hypothesis needs to be comprehensively demonstrated using a substantial

amount of data collected through various data sources.

The main actors of the M&E system consisted of a research group, the WVB intervention implementation team (hereafter, implementation team), and WVK communication coordinators (hereafter, coordinators). The M&E system received administrative support from WVB headquarters and WVK headquarters, as needed since the BRDMCN project began. The roles and responsibilities of each collaborator in the M&E system were agreed upon through a Memorandum of Understanding (MOU) in the early stage of the research, which has been updated and adjusted frequently through site visits and continuous online discussion (Supplemental File 1).

Research group: established the overall impact and process evaluation strategies of the BRDMCN project. The research group took advantage of the existing baseline survey design, which was planned by the implementation team and WVB headquarters, before establishing this collaborative M&E system and strengthened the monitoring activity of the implementation team. The research group developed survey tools for impact and process evaluation and supported field data collection. The research group also conducted an in-depth analysis of all survey data, as well as monitoring data (PD/Hearth and ED programs), and communicated the analytical results to the implementation team and other partners.

WVB Intervention Implementation team (implementation team): built and managed a monitoring system of the PD/Hearth and ED programs. A monitoring tool for the PD/Hearth program was universally available, while the implementation team developed its own monitoring tool for the ED program. The implementation team trained and managed community facilitators, who were the frontline workers, for intervention delivery and monitoring activities. This team also facilitated monthly meetings to discuss ongoing events and share the progress of activities and management issues. An M&E officer of the implementation team was responsible for the overall monitoring activities and data management.

WVK communication coordinators (coordinators): played a key role in bridging the research group and the implementation team, as well as connecting the research team to the WVB and WVK headquarters for administrative support. The coordinators were involved in budget execution, overseeing the intervention implementation, and communicating with the donor organization (KOICA). Initially, the coordinator communicated with various collaborators and headquarters to synchronize the impact and process evaluation planning of the BRDMCN implementation schedule and structure with available financial and human resources.

4. Monitoring system

The monitoring system was initially established and managed by the implementation team to track the main program's progress. The PD/Hearth and ED programs were considered to be the critical drivers of improving child nutritional status through discussion among the collaborators.

Our monitoring system tracks whether the PD/Hearth and ED programs have been implemented as planned and whether the program participants have benefited as expected. This monitoring system was designed to evaluate the short- and mid-term outcomes of the PD/Hearth and ED programs. The monitoring system also enabled identification of communities, or individual participants, that were not achieving the minimum output, so that the implementation team could provide these participants with follow-up assistance or troubleshooting efforts.

Paper forms detailing the monitoring indicators of the PD/Hearth and ED programs were prepared by community facilitators and regularly submitted to a BRDMCN M&E officer. The information from the individual forms was entered into an excel-based database by the data management staff. The implementation team completed a descriptive analysis of this data for beneficiary management and donor reporting

purposes. The monitoring data were regularly shared with the research group for in-depth data analysis. This collaboration helped the implementation team assure quality and establish a revised plan for improving outcomes.

4.1. PD/Hearth program

An excel-based monitoring tool, developed by the World Vision Global Nutrition team, has been used for PD/Hearth programs in various developing settings.

WV has promoted PD/Hearth programs globally and applied an equal monitoring tool to follow up with PD/Hearth participants for up to one year. The PD/Hearth monitoring data included 1) general information for tracking (child’s name, mother’s name, village location, community facilitator name, session enrollment date, date of birth), 2) activity-related information (immunization, deworming, and vitamin A supplementation), and 3) child weight records as an outcome (weight measured at the following times: enrollment, after 12 days, 1 month, 3 months, 6 months, and 1 year). Community facilitators collected this information on-site and in participant’s homes after 12 days, using it to provide guidance/support to the households. A 200 g weight gain at the end of two weeks and 400 g weight gain at the end of one month are universal indicators to assess if a child is on track for recovery in the PD/Hearth programs (Table 1).

Table 1
Objective, methodology, study population, and indicators of a monitoring and impact evaluation system.

Objective	Methodology	Study population	Indicators (examples)
<i>Monitoring system (implementation team)</i>			
To measure weight change of PD/Hearth children	Weight measurement at enrolment and 12 days, 1, 3, 6, and 12 months after Hearth session by community facilitators	PD/Hearth participants (n = 10,095)	Weight gain (g) at 12 days 1, 3, 6, and 12 months after enrolment
To track economic development (ED) activities among participants	Household visit by community facilitators every three months	ED participants (n = 2960)	Amount of produced vegetables or eggs in the past three months Number of chicks/ducklings born in the past three months Household income generated by selling poultry/ or eggs in the past three months
<i>Evaluation system (Research group)</i>			
To examine the difference in nutritional status of children between program and comparison district	Two cross-sectional surveys	Children 0–59 months of age in program and comparison district (n = 1500)	% stunting % minimum dietary diversity
To examine the difference in nutritional status of children between PD/Hearth plus ED and PD/Hearth only	Cohort surveys, one year apart	Children who enrolled at PD/Hearth (n = 593) only or PD/Hearth plus ED participants (n = 532) at 5–13 months of age	% stunting % minimum dietary diversity

The first batch of PD/Hearth sessions was in September 2018, and all 10,095 enrolled children received weight monitoring follow up. If the child reached 59 months in the middle of the follow-up period, further monitoring visits were not conducted.

The list of all PD/Hearth children, with enrollment information, was used as a potential participant pool from which young children were selected as subjects for a prospective cohort study. The research group also analyzed the longitudinal weight data of the 7102 PD/Hearth children to examine the sustained program impact of PD/Hearth programs on child nutritional status and if the program impact differed by enrolled child age. The additional analysis provided evidence to inform decision making for the program’s scaling to the implementation team and headquarters.

4.2. Economic Development (ED) program

Given its high potential as a nutrition-sensitive approach to addressing child undernutrition, ED programs, specifically their implementation processes and program impacts, are amassing attention from the implementation team and donor organizations.

The implementation team developed its own excel-based monitoring tool to record the ED participants’ livelihood activities: production of vegetables, chicken/duck rearing, and income generation activities. Community facilitators tracked all beneficiaries, monitoring the number/amount of assets they received, loss of assets, production, purchases, sales, consumption, and derived income every three months (Table 1). All 2960 households had the 1st monitoring visit between Jan-Mar 2019, the 2nd visit from Apr-June 2019, the 3rd visit during Jul-Sep 2019, and the 4th visit between Oct-Dec 2019.

Regular household visits, in addition to recording key monitoring data, also allowed community facilitators to determine whether the beneficiary household required additional support/guidance regarding asset management. Changes in the quantity of assets, or generated income, can be used to provide timely support at either the individual level or to entire villages.

A long-term trend (i.e. over a year) and seasonal effects of asset production, consumption, and household income will be analyzed by the research group using repeatedly assessed data.

5. Evaluation system

5.1. Cross-sectional surveys

A quasi-experimental cross-sectional survey design was proposed to evaluate the two-year impact of the BRDMCN project on child nutrition. The decision-making process was developed through multiple online discussions between the coordinators, the research team, and the implementation team. Since the collaborative M&E system was suggested after the baseline was implemented, an advanced evaluation design based on the utilization of the existing baseline design was considered.

We hypothesized that compared to children living in the comparison upazilas, children in the program upazilas would have improved health and nutritional statuses two years after the program implementation. The sample of the baseline was determined using the following parameters: taking 0.33 as the proportion of stunted pre-school children, with a margin of error set at 5%, and considering a 95 % confidence level with a design effect of 1.2, the expected sample size was 1,757.

From each of three intervention and two comparison upazilas, two to five unions (the smallest rural administrative unit in Bangladesh) were randomly selected, for a total of 16 selected unions. From each union 3–4 villages, as clusters, were selected. The villages of each union were divided into 2 or 3 blocks, consisting of 200–250 households. Two blocks were then randomly selected. Within each union, 100 households were enrolled in the survey (n = 900 in intervention; n = 700 in comparison).

The baseline survey was completed for 1600 households with children aged 0–59 months of age out of a total of 1800 households visited. Child length/height and weight measures were converted to growth z-scores and mapped to a nutritional status (i.e. stunting, wasting, or underweight). Data on infant and young child feeding practices were collected using the WHO standard methods (World Health Organization, 2010). An endline survey will be conducted in August 2020, two years after the baseline survey. The choice of the quasi-experimental design sought to utilize the baseline design and available data, to reduce the possible variation in the impact estimates, and to estimate the program impact as accurately as possible. Thus, the same study design used in the baseline survey will be applied to find clusters and 1800 eligible households for the endline survey (Table 1). The program impact will be estimated using a propensity score weighted difference-in-differences approach, given the nature of the non-randomized settings (Khandker, Koolwal, & Samad, 2010).

5.2. Prospective cohort study

This prospective cohort study aimed to examine if exposure to both the PD/Hearth and the ED programs is associated with a lower prevalence of undernutrition and higher growth z-scores compared to exposure to the PD/Hearth program only.

The data pool established by the PD/Hearth monitoring system was a core resource that identified the subjects of the prospective study. It cannot be inferred at what age an individual child became underweight, and when they decided to enroll in the PD/Hearth sessions. Therefore, without the monitoring system for children enrolled in the PD/Hearth program by the implementation team, the implementation of this study component would not be possible. The cohort of children was selected out of 5141 PD/Hearth participants (age range: 3–59 months) from the 1st and 2nd batches, which were implemented in September 2018 and in November 2018, respectively. Out of 5141 children, the research team selected a total of 1125 children aged 5–13 months who attended the PD/Hearth session. Out of these children, 532 of their households were exposed to the ED program, in addition to the PD/Hearth program, while 593 households attended the PD/Hearth session only. The sample size of 1125 households enabled detection of an 8% difference in the prevalence of stunting, with 5% type 1 error and 80% power, between the PD/Hearth only participants and those who participated in the PD/Hearth alongside the ED program.

This cohort data will be analyzed in accordance with the longitudinal data structure. First, multivariable logistic regression analysis will be used to test the association between exposure (PD/Hearth only vs. both PD/Hearth and ED programs) and child nutritional status, adjusting for maternal (i.e., age, occupation, and education), child (i.e., age and gender), and household characteristics (i.e., socio-economic status and food insecurity). Secondly, by using a generalized estimation equation model, we will compare the nutritional status or child feeding status of children exposed to the PD/Hearth program only with those exposed to both the PD/Hearth and ED programs.

The research team developed survey tools for the cohort survey and modified the cross-sectional survey for the endline evaluation. The implementation team and the coordinators reviewed these tools, and the implementation team hired a survey firm in Dhaka to conduct the surveys. The research team trained the survey firm interviewers and partnered with the implementation team to supervise data collection in the field.

5.3. Process evaluation

Process evaluation aimed to describe a program impact pathway, which lays out the theoretical causal links between the program’s activities, outputs, outcomes, and impact (Table 2). Although evaluating implementation processes is recognized as critical to interpreting the effects of various community trials for health programs, few systematic

Table 2
Components, methodology, study population, and indicators of process evaluation.

Component	Methodology	Study population	Indicators/potential outcomes (examples)
(1) Degree of implementation	Progress report PD/Hearth monitoring record ED monitoring record	PD/Hearth participants (n = 10,095) ED participants (n = 2960)	Number of PD/Hearth participants per village Number of ED participants by type of asset received
(2) Activities of community facilitators	Cohort survey	PD/Hearth participants (n = 593) PD/Hearth plus ED participants (n = 532)	% of mothers who replied that community facilitator encouraged her to follow the lessons of the PD/Hearth or ED program % of mothers who replied that community facilitator provided physical and emotional support for implementing the PD/Hearth or ED program % of children gaining ≥200 g after 12 days of PD/Hearth session Amount of vegetable produced (kg) in the past three months Amount of asset (i.e., eggs, vegetables) consumed per household in the past three months % of ED participants generating income using asset received in the past three months
(3) Program exposure/ utilization	PD/Hearth monitoring record ED monitoring record	PD/Hearth participants (n = 10,095) ED participants (n = 2960)	% of children having four or more food groups in the past 24-hr
(4) Dietary behaviors among child and women	Cohort survey	PD/Hearth participants (n = 593) PD/Hearth plus ED participants (n = 532)	Experience of increased self-esteem and economic empowerment in their household Dual burdens of housework and managing assets together Willingness of ED participants to invest in children’s nutrition with their increased income
(5) Facilitators and barriers of program uptake	FGD IDI	FGD: 4 groups IDI: PD/Hearth women (n = 9) and men (n = 9), PD/Hearth plus ED women (n = 9) and men (n = 9)	

PD/Hearth, Positive Deviance/Hearth; ED, Economic development; FGD, Focus group discussion; IDI, In-depth interview.

implementation studies are available in community nutrition programs (Kim et al., 2015; Nguyen et al., 2014; Rawat et al., 2013). This process evaluation takes advantage of various data sources collected from the monitoring system and the prospective cohort survey, according to the potential conceptual framework (Fig. 2 and Table 2). The planning of process evaluation sought to maximize the strength of collaboration between the implementation team and the research group, as well as increase the value of the utilization of monitoring data and survey data.

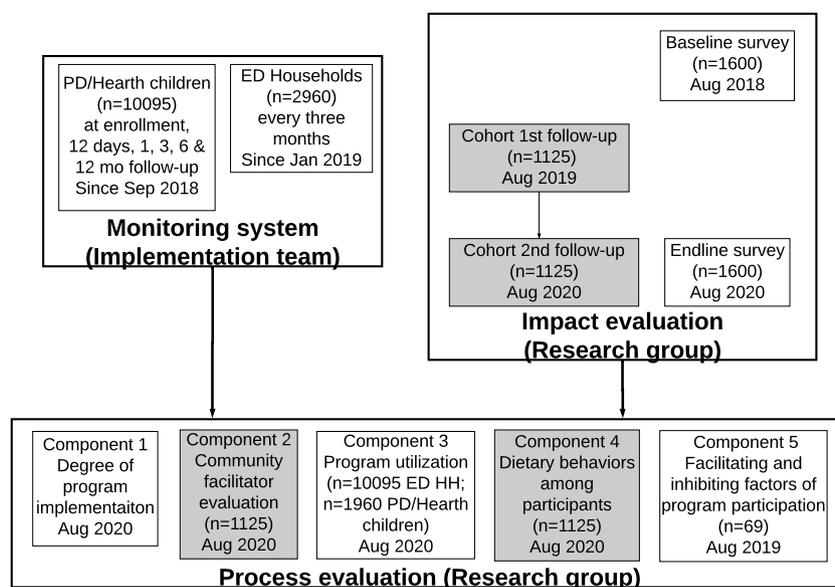


Fig. 2. Monitoring and evaluation system managed by implementation team and research group. Component 2 and 4 in the process evaluation are assessed among cohort group. PD/Hearth, Positive Deviance/Hearth; ED, Economic development; HH, Household.

This planning motivated the implementation team to strengthen the quality control of the monitoring system. Data/records/reports collected through the end of the BRDMCN project in October 2020 will be used in the process evaluation.

- 1) **Degree of implementation:** This component will describe the extent to which each intervention component in the SBC and ED programs were delivered by community facilitators (dose delivered) or received by target children/mothers (dose received). Summary of the monitoring records and annual or periodic progress reports will be extracted when BRDMCN ends in December 2020., by leveraging data from the monitoring system, we will calculate the type and amount of assets received by the 2960 ED households and the number of sessions per community for the 10,095 PD/Hearth children.
- 2) **Activities and leadership of community facilitators:** The degree of intervention implementation is influenced by the community facilitators who delivered each intervention component of the SBC and ED programs as frontline workers engaging with beneficiary households and children. All mothers in the 2nd prospective cohort survey (n = 1125; August 2020) will be asked how they perceive the leadership and activities of community facilitators regarding the PD/Hearth or ED programs.
- 3) **Program utilization:** This component evaluates immediate or short-term changes at the participant/beneficiary level. The percentage of children who gained the minimum amount of weight (200 g after two weeks; 400 g after 1 month) will indicate the utilization of the PD/Hearth program. Using the ED monitoring tool, we will calculate asset multiplication (mean number of ducklings/chicks born, mean number of eggs produced, mean amount of vegetable produced), consumption of assets (number of eggs consumed, quantity of vegetables consumed), and income from selling assets at the household level every three months.
- 4) **Dietary behaviors among child and women:** This component assesses intermediate outcome differences between the PD/Hearth only children (n = 593) and the children exposed to both the PD/Hearth and ED programs (n = 532) through two times of cohort surveys (August 2019 and August 2020). We will compare the dietary practices (i.e., minimum dietary diversity), assessed by WHO infant and young child feeding practices (World Health Organization, 2010), among children and their mothers between the two groups.

- 5) **Facilitators and barriers of program participation:** This component sought to understand the differences in behaviors and utilization paths of the program between participants enrolled in only the PD/Hearth and participants assigned to both the PD/Hearth and ED program. Data collection of the component 5 was completed in August 2019. The interviewees were asked to reflect on facilitators, barriers, and perceived changes while participating in the programs.

Focus group discussions (FGD) and in-depth interviews (IDI) were conducted using purposive sampling considering several criteria, such as the general household socioeconomic status and performance of expected activities, to explore the various perceptions and experiences of participants. A total of 69 participants, selected by the implementation team and community facilitators, were divided into four groups as follows: PD/Hearth only participants (n = 8 for FGD; n = 11 for IDI), husbands of PD/Hearth only participants (n = 9; n = 9), participants of both the PD/Hearth and ED programs (n = 8; n = 9), and husbands of participants in both the PD/Hearth and ED programs (n = 8; n = 9). In general, 6–8 participants are suitable for an effective discussion in an FGD (Krueger, 1994). IDI continued until a saturation point was reached, where there were no new findings or discourses.

6. Ethical procedures and approval

Oral informed consent was administered in the local language, Bangla, and obtained from all study participants included in the various study components described above. Interviewers trained in ethical matters collected all data. The impact evaluation study was approved by the institutional review boards at (one of author's affiliated organizations) (IRB 9594) and the Dhaka University Health Economics Department (IRB FWA00026031) in Bangladesh.

7. Limitations

The monitoring and evaluation system has several limitations due to the establishment of the collaboration system after the baseline survey and the implementation of initial intervention elements.

First, we have a short period of program implementation, and subsequently, not a long evaluation period, while the impact on main outcomes, child nutritional status, takes a long time to observe relatively. Given the unchangeable BRDMCN's schedule, our best option was to

follow the youngest children enrolled in the PD/Hearth program (5–13 months of age), who may be more sensitive to the intervention effects than older children, longitudinally for 2 years.

Second, there was no baseline information obtained before exposure to the interventions for the prospective cohort study to ensure the comparability between program and comparison areas and to accurately track the indicators within the same individual/area. Our research plan was proposed after the 1st and 2nd batch of the PD/Hearth sessions and the distribution of assets was completed. Thus, data collection on child height, which could measure linear growth or stunting of the PD/Hearth participants, and information regarding the amount of existing assets (poultry or vegetable production) among the ED participants was not feasible.

Third, there is a high possibility that the ED participants are more likely to be poorer than those who received the PD/Hearth only because beneficiary selection prioritized the poor or ultra-poor. However, despite the lack of baseline information, the repeated measurement of outcomes in the cohort children would show a change due to the intervention over time.

Fourth, monitoring data were collected by 260 community facilitators for the 10,095 PD/Hearth children and the 2960 ED households. Thus, there is a limitation in ensuring high-quality data in the program setting, as the main responsibility of this personnel was to deliver the interventions and manage beneficiaries. Monitoring child weight, or asset utilization, while also providing practical guidance and support to each participant could be potentially burdensome for community facilitators. This also accounts for situations in which asset indicators were recorded based on recall rather than direct measurements.

7.1. Lesson learned

We reflect on some lessons learned from implementing a collaborative monitoring and evaluation system.

- 1) The collaborative M&E system enables in-depth understanding of program implementation: The collaborative M&E system across the research group, the WVB implementation team, and the WVK communication coordinators enabled a deeper understanding of what the programs have achieved. The collaboration provided an opportunity for the implementation team to make more meaningful use of the monitoring data, which was further enhanced by the research group's high-quality data analysis. Sharing and review of collected data enabled the collaborators to maintain a common understanding, as well as provided an opportunity for course correction during scaling up the program.
- 2) Close communication is essential among M&E collaborators: Close communication through continuous on-line discussion and site visits enabled an agreement on the value of monitoring data utilization for research and enhanced the implementation team's ownership of the analysis. Initially, the collaborators had frequent discussions regarding the intervention activities, including anticipated impacts and what type of monitoring data should be collected or managed. During a later field visit, the research group identified details of the monitoring activity on-site and incorporated the ED monitoring data into the process evaluation as a key data source.
- 3) The collaboration needs substantial time and effort to achieve a harmonized agreement: Although the collaborative M&E system had significant advantages for data collection and utilization, the collaboration required a substantial amount of time and effort to achieve harmonious agreement among the collaborators. The communication between collaborators was occasionally challenging due to the complexity of the working structure and the differences in the understanding of evaluation methods. The coordinators played a key role in linking the research group and the implementation team, fostering smooth and trusting communication. Nevertheless, it was a meaningful procedure to establish an agreement regarding how to

deal with different perspectives on the program and who is accountable for achieving harmony.

- 4) Monitoring data provides intermediate outcomes beyond simple counts of activities: One of the advantages of the monitoring system was the ability to collect monitoring data of the intermediate outcomes. Monitoring data, in combination with the midline results, provided affluent insights into the program impact pathway. The implementation team was able to develop its capacity to understand data and administered a sound monitoring system by establishing the M&E collaboration. Eventually, the M&E system enhanced the collaborators' ownership of the programs by making them actively participate in the decision-making process (Bamberger, Clark, & Sartorius, 2004).
- 5) Mobilizing community facilitators for monitoring activity is cost effective: Community facilitators collecting monitoring data was cost-effective since it did not involve additional human resources for data collection. The monitoring household visit itself was a pre-determined activity through which the community facilitators consult and encourage the beneficiary households to continue the recommended behaviors while simultaneously recording their progress. However, refresher training for effective monitoring activities of the community facilitators was needed to maintain standardized measurements. Also, a periodic review of data quality and proper data management had to be reinforced.
- 6) The work balance of community facilitators is important to maintain the programs: The reinforced monitoring activity became an additional responsibility of the implementation team, particularly burdening community facilitators, as evidenced by their high turnover rate. Indeed, engaging community members or volunteers to public health surveillance or collection of health information has increased (Technical Contributors To The June WHO Meeting, 2019). Thus, communication through ongoing training, appropriate remuneration, motivation, supervision, and compensation was critical to program success and reinforced M&E system.

8. Conclusion

This paper introduces a monitoring and evaluation system constructed collaboratively by the research group, the implementation team, and the coordinators based on a community-based nutrition program in rural Bangladesh. We described detailed planning for monitoring activities for the PD/Hearth and ED programs, impact and process evaluation using various data resources, and shared the current progress of data collection. Using the already-implemented baseline survey design and a monitoring system designed by the implementation team, the collaborators developed an advanced monitoring and evaluation strategy, bridging a quasi-experimental study design and an expanded data collection process.

Programs and policymakers need effective monitoring and evaluation systems and must build the capacity to track the progress of implemented interventions and strategies. The support to meet this demand is often limited by scale and lack of effective coordination. Numerous community-based nutrition programs involving a substantial amount of monitoring and evaluation data have no comprehensive roadmap of data utilization and results translation and advanced analytical capacity.

The collaborative M&E system enables the sharing of a common understanding of the programs' goal, strengthens collaborators' commitment to the program, and extends the understanding of the program's progress and evaluation activities. The collaborative M&E system increases the utilization of data and produces in-depth knowledge for implementation research. The collaborative M&E system saves financial and human resources by pooling resources from the WVB implementation team and the research group while simultaneously ensuring the acquisition of a large amount of data by involving community facilitators in the monitoring data collection.

Funding

This research was supported by World Vision Bangladesh, Dhaka, Bangladesh; the Korea International Cooperation Agency (KOICA), Sungnam-si, South Korea; and World Vision Korea, Seoul, South Korea.

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Declaration of Competing Interest

The authors report no declarations of interest.

Acknowledgments

All authors thank all staff at Joyphurhat project office, World Vision Bangladesh, including Jaganmay Prajesh Biswas and Md.Iqbal Hossain for kindly providing detailed information on relevant interventions and the monitoring system of the BRDMCN project and for providing committed support for a prospective cohort survey. We also thank Shinhye Min, World Vision Korea, for communication with World Vision partners and providing administrative support during field visits. We also thank Bipasha Dutta, World Vision Bangladesh, for her administrative support to this research and reviewing this manuscript. We thank Heeyeon Kim for this manuscript and scientific inputs. The authors also thank Anna Marie Young and Alec Aaron for their editing support.

Appendix A. Supplementary data

Supplementary material related to this article can be found, in the online version, at doi:<https://doi.org/10.1016/j.evalprogplan.2020.101892>.

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