“Estimating the Incalculable”: Economic Evaluation of a multi-sectoral nutrition program in Nepal

Siddhant Gupta

A thesis
submitted in partial fulfillment of the
requirements for the degree of

Master of Public Health

University of Washington
2023

Committee:

Carol Levin

Deepa Rao

Program Authorized to Offer Degree

Department of Global Health

University of Washington

Abstract

"Estimating the Incalculable": Economic Evaluation of a multi-sectoral nutrition program in Nepal

Siddhant Gupta

Chair of the Supervisory Committee:

Carol Levin

Department of Global Health

Malnutrition remains a significant cause of death and disability for children in low-income countries. To address this, multi-sectoral interventions have shown potential. However, there is a lack of economic evaluations for such programs. This study aimed to assess the cost-effectiveness and benefit-cost analysis of a multi-sectoral nutrition intervention in Nepal. We used costing estimates of the Suaahara II program from SEEMS-Nutrition group at University of Washington. We measured program outcomes in terms of prevented premature deaths, reduced stunting cases, and reduced diarrhea incidence using the Lived Saved Tool (LiST). We evaluated the benefits by estimating averted DALYs (disability-adjusted life years) and the value resulting from lowered premature mortality, increased lifetime productivity, and reduced non-fatal health risks. We estimated cost-effectiveness ratio at $24,352 per DALY averted assuming standard life expectancy. We estimated the benefit-cost ratio at 1.93-1.95. In conclusion, although the program is not cost-effective, it could still be considered a good investment as the benefit-cost analysis confirmed that the program yielded a positive return on investment.

Introduction

Malnutrition, a problem that encompasses undernutrition, overweight and obesity, and micronutrient deficiencies, affects women and children in low- and middle-income countries disproportionately. Among these, child undernutrition is a particularly complex global health problem. In 2018, 149.2 million and 45.4 million children were affected by childhood stunting and wasting respectively, globally. This disease burden can have long term consequences for cognition and development of children. (1) Three Systematic reviews published recently have covered literature on economic evaluations of nutrition interventions in global south countries. These include cost-effectiveness (CEA), cost-utility (CUA) and benefit-cost analyses (BCA) across nutrition sensitive interventions like cash transfers for nutrition, biofortification and nutrition-specific interventions like treatment of Severe and Moderate Malnutrition, infant and young child feeding practices, micronutrient supplementation etc. (2–4) The main aim of this paper is to perform an economic evaluation of Suaahara II, a multi-sectoral nutrition program implemented in Nepal. The objectives of this paper are threefold. First, to estimate the potential deaths averted associated with Suaahara II intervention components using the Lives Saved Tool (LiST) model. Second, to estimate cost-effectiveness of the SII program, using changes in intervention coverage from the SII program evaluation and using cost data available from the SEEMS Nutrition project. Third, to combine information on costs and benefits for a benefit-cost analysis of the program. The paper begins with a detailed description of the program as it was implemented in Nepal, followed by an explanation of the methods used for the economic evaluation. The paper then discusses the results obtained from the evaluation and highlights any limitations encountered during the process. Finally, the paper concludes its findings based on the economic evaluation of the Suaahara II program.

Regional Context:

The largest number of stunted children worldwide live in South Asia. 37% of the South Asian children under five years of age or 65 million children were estimated to be stunted in 2014. (5) Nepal has been at the forefront of innovations for Nutrition. Nepal holds the distinction of being the first country to implement the Nepal National Vitamin A Program (NVAP), which is now considered a highly successful and exemplary initiative. Through the years, the program steadily expanded its reach, covering 32 districts by the end of 1997, and aiming to achieve nationwide coverage by 2003. The core of the program involved the distribution of high-dose vitamin A capsules to all children aged 6 to 60 months during biannual campaigns. This distribution is carried out by a network of Female Community Health Volunteers (FCHVs), whose involvement has been revitalized by the visible and widely acclaimed successes of the NVAP. One of the key factors contributing to the program's triumph is the empowerment of the FCHVs. The Nepal National Vitamin A Program was a remarkable model of success in combatting vitamin A deficiency and has set an example for other countries to follow in their efforts to address this critical public health issue. (6,7)

More recently, today Nepal among the first few countries today to adopt and scale a multi-sectoral approach to Nutrition. Investments in multisectoral nutrition strategies have the potential to be highly cost-effective in South Asian countries. Although nutrition interventions are cost-effective individually as well, it is estimated that scaling up a set of 10 nutrition specific interventions as a package is significantly more cost-effective. (8) Nepal has made substantial progress in addressing the problem of malnutrition and child undernutrition rates have declined significantly. Stunting among children under five decreased

from 57% in 1996 to 32% in 2019, prevalence of underweight reduced from 42% to 24% and wasting declined from 15% to 1%.(8) These improvements have been attributed to increase in household income, sanitation, parental education and increase in access to health and nutrition services.(9) Although this progress is remarkable and Nepal has been recognized as an 'exemplar country' for success in reducing stunting, current rates of undernutrition indicators are still high.

Nepal adopted a multi-sectoral approach to nutrition across the life cycle, and a federalist structure enabling local governments to have more authority in developing plans and allocating resources to determine priorities. They achieved this improvement through scale up of Vitamin A supplementation, IFA supplementation and salt iodization and promotion of community-based platforms to deliver health and nutrition services. For further strengthening nutritional outcomes, Nepal can emphasize improvements in dietary diversity of children, adolescents and women, sustain community based delivery platforms for service delivery, address disparity in access to services, strengthen local leadership and management and continue emphasis on generating data and evidence to assess programs and inform decision making.(9)

Evidence from Economic Evaluation of Nutrition interventions:

Studies have shown that multi-sectoral nutrition interventions have the potential to alleviate malnutrition in children, a leading cause of death and disability in low-and-middle-income countries. M, Interventions across multiple sectors can have a significant impact towards eliminating malnutrition. However, the evidence base for economic evaluations for such programs is limited, especially for strategies that cover both nutrition-specific and nutrition-sensitive interventions. Additionally, there are methodological challenges in estimating potential benefits of these interventions due to their plurality of benefits. (10,11)

The evidence supporting the effectiveness of antenatal multiple micronutrient supplementation in reducing the risk of stillbirths, low birthweight, and babies born small-for-gestational age has become stronger. Additionally, there is ongoing support for providing supplementary food in areas with food insecurity, using community-based approaches and locally produced supplementary and therapeutic food to address acute malnutrition in children. Some emerging interventions, like preventive small-quantity lipid-based nutrient supplements for children aged 6–23 months, have demonstrated positive effects on child growth. To prevent and manage childhood obesity, integrated interventions involving diet, exercise, and behavioral therapy are the most effective, although there is limited evidence from low- and middle-income countries (LMICs). Lastly, indirect nutrition strategies, such as malaria prevention, preconception care, and water, sanitation, and hygiene promotion, both within and outside the health-care sector, also offer significant nutritional benefits. (12)

The costs of scaling up multisectoral interventions vary greatly across different countries, ranging from US$13 million in Togo to US$837 million in Nigeria. These differences in costs can be attributed to variations in the number of beneficiaries, baseline coverage of the interventions, and unit costs. It is estimated that scaling up these interventions would save a significant number of disability-adjusted life years (DALYs) in each country, ranging from 115,000 in Togo to 6.3 million in Nigeria. Additionally, the scale-up would save between 3,000 and 180,000 lives and prevent between 60,000 and 3 million cases of stunting annually in each country. According to the WHO-CHOICE criteria of cost-effectiveness,

investing in the full intervention package is considered very cost-effective in all four countries.(5) Another study aiming to assess the cost-effectiveness of cash transfers and food vouchers in Pakistan found that the intervention was effective in reducing stunting with a cost per case averted of $1290 and cost per DALY averted ranged from $434-$641.(14) In these studies, if the cost per Disability-Adjusted Life Year (DALY) saved by an intervention is lower than a country's Gross Domestic Product (GDP) per capita, the intervention is categorized as "very cost-effective." If the cost per DALY saved falls between one and three times the country's GDP per capita, the intervention is considered "cost-effective." However, if the cost per DALY saved exceeds three times the GDP per capita, the intervention is regarded as "not cost-effective". (5)

A benefit-cost analysis of a large-scale nutrition program in Indonesia aimed at reducing stunting, examined whether the economic benefits of investing in such a program outweigh the costs, considering gains from increased productivity, reduced mortality rates, and savings from avoided diarrhea costs. Using a discount rate of 5%, the benefit-cost ratio was 2.08. The results showed positive net benefits through the productivity impact of lower malnutrition, even without including the benefits of mortality reduction in sensitivity analysis. (13) Benefit-cost ratios for similar multisectoral interventions have demonstrated positive return on investment and ranged from 1.5 to 18 (Table 1).

Table 1: Benefit-cost ratios of comparable multisectoral interventions

Intervention	**Country**	**Sectors**	**BCR**	**Source**
Essential nutrition-specific interventions	17 countries	Nutrition, health	18 (3.6 – 48)	(15)
Essential nutrition-specific interventions	Haiti	Nutrition, health	5.2 (2 – 8.4)	(16)
NEEP (Integrated nutrition/ECD)	*Malawi*	*Nutrition, agriculture*	*3.6 (3.6-24.7)*	(17)
Rural sanitation project	India	WASH	2.5 – 5	(18)
Community-led total sanitation	Hypothetical SSA	WASH	1.6 (1.2 – 2)	(19)
Integrated nutrition and ECD	Nicaragua	Nutrition, education	1.5 (1.3-2.3)	(20)

Quantifying stunting related outcomes is a challenge in economic evaluations of such programs. The Lives Saved tool is a common tool used to standardize approaches towards this issue. The Lives Saved Tool (LiST) constitutes a computerized framework designed to forecast the potential outcomes of scaling up essential interventions aimed at enhancing the health status of mothers, newborns, and children. Originally conceptualized to contribute insights to the Lancet Child Survival Series of 2003, LiST's capabilities and ambit have undergone substantial improvements over the preceding decade. This tool

has gained widespread adoption by various stakeholders such as benefactors, international entities, governmental bodies, non-governmental organizations, and academic establishments. Its utility spans program evaluation, strategic planning founded on empirical data, informed decision-making, and advocacy for interventions yielding substantial impact.(21)

Different organizations have adopted distinct approaches in their utilization of LiST. Some have assimilated the tool within their internal operational frameworks, fostering an in-house proficiency in its utilization. Conversely, certain entities have opted to leverage the expertise of the LiST team, outsourcing analytical endeavors and soliciting support. Beyond its standalone application, LiST is also used as a computational engine for diverse applications. Its contributions have been lauded in the realm of maternal, neonatal, and child health, showcasing its utility in this domain. Given sustained dedication, LiST is poised to remain an integral component of the global health toolkit, pivotal in the appraisal of programs targeting maternal, newborn, and child health.(21)

Systematic reviews have found that CEA is the most common economic evaluation method used for most interventions for malnutrition across settings. (3,4,7) Systematic review by Ramponi et al categorized studies by intervention type: preventative; therapeutic; fortification and delivery platforms, nutritional deficiencies addressed and characteristics and economic evaluations (eg. Costs, outcomes, type of model). Differences in CEAs of interventions have often been found between interventions delivered within the health sector, like preventative interventions, versus those outside the health sector, like cash transfers. Despite these differences, it is unclear if this is due to them targeting different decision makers or the difference in perspective adopted for evaluation. Choice of costs and outcomes was also influenced using evaluation tools. Studies that applied recently developed models often justified perspective adopted and costs included. The authors found that use of “off-the-shelf” tools can be misleading and conceal the outcomes, costs and value judgments used. (4) Thus, there is a need to call attention to these aspects of economic evaluations to achieve consistency and adoption of results by policy makers by developing an all-encompassing economic framework. Furthermore, this review did not cover nutrition-sensitive interventions, so there is a need for more focus on these interventions in research.

Njunga et al, in their systematic review covered economic evaluations for treatment for child undernutrition only and no other nutrition interventions. Studies found that treatment costs varied from US$0.44 and US$1344 per child with main cost drivers being personnel, therapeutic food and productivity losses. Cost per DALY averted for CMCM program was found to range between US$26 and US$53, while facility-based management was much higher at US$1344. Costing methods were found to be heterogeneous and there is need for standardized methods and reporting for economic evaluations for facilitating ease of understanding and comparability for costs and cost-effectiveness of interventions. Perspective, costing approach and sensitivity analysis were often missing. (22)

Another systematic review by Wun et al highlights the challenges in synthesizing evidence from multi-sectoral interventions due to the range of possible benefits and methodological variations in sectors for measurement. This review classified available literature on interventions, sectors, benefit terminology and benefit types included in cost-effectiveness, cost-utility, and benefit-cost analysis. 87% of the studies had interventions from only one sector, and only 9% of the studies evaluated programs from one sector only (Health, WASH, social protection, agriculture). Furthermore, about 60% studies measured only one benefit category of nutritional outcomes and other health benefits, cognitive or educational

gains, dietary diversity etc. were evaluated in less than 10% of the economic evaluation ratios (CEA, CUA, BCA).(2) Therefore, there is need for evaluations of multi-sectoral interventions that emphasize benefits other than nutritional outcomes.

In this paper, the objective was to conduct an economic evaluation of Suaahara II, a multi-sectoral nutrition program in Nepal and estimate cost-effectiveness and benefit-cost ratio of this program. We start with a description of the implemented program in Nepal; elaborate on the methods for economic evaluation, discuss the results and limitations; and finally conclude.

Program Description

Suaahara II is a multi-sectoral nutrition initiative supported by USAID, operating in alignment with Nepal's Multi-Sector Nutrition Plan (MSNP). Commencing in 2016, the program was implemented across 42 out of Nepal's total 77 districts during 2016 to 2022. Its primary objective entailed the mitigation of stunting, wasting, and underweight conditions prevalent among children below the age of five, alongside addressing anemia incidences among women of reproductive age and children aged 6-59 months. The strategic focus of Suaahara II revolved around community-based interventions that specifically target vulnerable households and communities, particularly during the crucial initial 1,000 days of a child's life—spanning from a woman's pregnancy to her child's second birthday. The interventions included a range of thematic domains encompassing nutrition, health, family planning, water, sanitation, hygiene, homestead food production, and governance. Notably, the program integrated cross-cutting methodologies and overarching themes, such as social and behavior change communication (SBCC), and the promotion of gender equality and social inclusion (GESI) within the fabric of all Suaahara II endeavors. The first phase of the program was implemented over a period of five years (2011-2016) in 20 districts of Nepal across three agroecological zones of mountains, hills and Terai. The program had a multi-sectoral orientation for achieving following outcomes:

(1) Improved household nutrition, sanitation, and health behaviors
(2) Increased use of quality nutrition and health services by women and children
(3) Improved access to diverse and nutrient-rich foods by women and children
(4) Accelerated roll-out of the Multi-sectoral Nutrition Plan (MSNP) through strengthened local governance

Program Interventions of first phase included health and family planning (FP), nutrition, agriculture/homestead food production (HFP), and water, sanitation, and hygiene (WASH). Diverse social and behavior change communication (SBCC) interventions were implemented to increase demand for access to improved services and to mobilize households to adopt optimal health, nutrition, and WASH behaviors and practices.

Methodology

This paper is based on the economic evaluation framework of Strengthening Economic Evaluation of Multisectoral Nutrition Strategies (SEEMS-Nutrition) led by University of Washington.(17) The benefit-

cost analysis was done as per Reference Case Guidelines for Benefit-Cost analysis in Global Health and Development and BCA of a similar program by Wong et al for a multi-sectoral program in Haiti.(16,23)

Costing and Cost Efficiency Analysis

We used costing estimates from Costing of this program by the SEEMS Nutrition team at University of Washington, Seattle (Table 2). Cost data were analyzed using a standardized approach that estimates financial and economic costs of multi-sectoral nutrition programs by applying a standardized mixed methods costing approach to estimate total and unit costs of the program. Financial expenditure data from national and subnational levels are being combined with economic cost estimates assessed using in-depth interviews and focus group discussions with staff, volunteers, community members, and government partners in four representative districts of Dhading, Sindhupalchok, Bajhang and Nawalparasi. (24)

Table 2: Cost estimates for Suaahara II program

District	Total financial cost per district	Total economic cost per district	Total cost per district	Average Unique Households reached per year	Cost per household
Dhading	$1,451,631	$1,230,105	$2,681,737	16,561	$132.61
Sindhupalchok	$1,570,144	$1,831,841	$3,401,985	16,855	$145.43
Bajhang	$1,325,991	$1,523,121	$2,849,112	8,683	$146.24
Nawalparasi	$2,144,430	$1,696,742	$3,841,172	27,662	$114.33
Total for 4 sample districts	$6,492,196	$6,281,809	$12,774,006	69,761	-
Estimated total for 42 Suaahara districts (weighted for region and population)	-	-	$169,121,492	-	-

Program Effectiveness

The Suaahara II program employed a rigorous Monitoring, Evaluation, and Research (MER) system, with a key element being annual monitoring surveys. These surveys, initiated in 2017 and continued subsequently, were pivotal in assessing the program's progress across different aspects over time. The target group included households with children under five, where mothers were primary respondents. Other household members, like male decision makers, grandmothers, and adolescent girls, were also interviewed. Data was collected from Female Community Health Volunteers (FCHVs) and health facility informants.

The surveys encompassed diverse inquiries covering exposure, knowledge, and practices within the program's focus areas. Anthropometric measurements and anemia assessments were performed on specific demographics, providing critical health insights. Additional questionnaires for FCHVs and health facilities captured training, motivation, and work-related details.

Table 3 lists key intermediary coverage related indicators for the control and intervention arms of the evaluation that we utilized for estimating impact on stunting outcomes in this paper. These indicators include outcomes around Breastfeeding, Antenatal Care (ANC) and Water Sanitation and Hygiene (WASH).

Table 3: Impact Assessment indicators from 2022 surveys (Baseline vs Endline)

Intermediary Indicators	Control (baseline)	Control (endline)	Intervention (baseline)	Intervention (endline)	DiD
Exclusive breastfeeding (0-5 months)	57%	58%	50%	60%	9%
Early initiation of breastfeeding (0-24 months)	47%	67%	35%	67%	12%
Women with 4+ ANC	63%	86%	69%	92%	0%
Appropriate drinking water treatment	6%	21%	6%	28%	7%
Availability of soap and water at handwashing stations	41%	80%	35%	88%	14%

Cost-effectiveness Analysis

To estimate cost-effectiveness, we combined empirical cost data from the SII program with the net benefits from the program, defined as the Disability Adjusted Life Years (DALYs) associated with improved coverage of key program interventions. To estimate DALYs, we first estimated Years of Life Lost (YLLs) and Years Lived with Disability (YLDs) based on potential deaths due to stunting averted and cases of stunting averted respectively. We calculated DALYs averted which is the sum of YLLs and YLDs. We then estimated the cost effectiveness which is the ratio of incremental costs and DALYs averted. Table 4 lists key assumptions used to estimate the above. A detailed approach for estimating cost-effectiveness is as follows.

Table 4: Key assumptions and parameters for cost-effectiveness analysis

Assumption	Parameter	Source
Standard life expectancy at age 1-4 years old	77.8 years for men 80.3 years for women	(19)
Nepal life expectancy at age 1-4 years old	Men 69.83 years~~,~~ Women 73.49 years~~,~~ Both sexes 71.75 years	(25)
Stunting disability weight	0.002	(26)

Stunting Averted

We estimated likely stunting averted among children aged 6-24 months in the program area by using the Lives Saved Tool (LiST). The Lives Saved Tool (LiST) is a well-established analytical framework for such analyses. In essence, LiST relies on published data that elucidate the association between suboptimal growth in children, particularly stunting, and its correlation with all-cause mortality. By utilizing these associations, the tool allows for a robust modeling of the effects of reducing stunting prevalence on child mortality within specific regions, contingent upon the prevailing child mortality rate.(27)

We estimated the potential cases of stunting averted in Nepal. This assessment relied on intermediate indicators derived from the impact assessment, as specified in the 'Program Effectiveness' section. The evaluation considered the relative changes observed in these indicators between the intervention and control groups during the impact evaluation. Subsequently, we extrapolated this estimate to cover 42 Suaahaara II districts, out of the total 77 districts in Nepal, to project the number of stunting cases averted in our targeted intervention area.

Deaths Avoided

We estimated the overall reduction in premature mortality in Suaahara intervention districts using LiST tool. Through LiST, we assessed the potential number of lives saved in Nepal based on intermediate indicators from the impact assessment listed in section 'Program Effectiveness', taking into account the relative change in these indicators in the intervention and control groups of impact evaluation. We then scaled that number for 42 Suaahara districts out of the total 77 districts in Nepal, to estimate deaths averted in our intervention area.

DALYs Averted

We estimated DALYs averted through the following approach:

(1) We estimated Disability-adjusted life years (DALYs) averted by the decrease in prevalence of stunting as well as the associated reduction in child deaths.
(2) We calculated Years of life lost (YLLs) with an assumption that early deaths associated with stunting transpired at an average age of 2.6 years, assuming standard life expectancies at that age of 77.8 years for men and 80.3 years for women and Nepali life expectancies at that age of 69.83 years for men and 73.49 years for women. (28)
(3) We then calculated Years lived with Disability (YLDs) with assumptions that morbidity due to stunting continued for the timeframe of the same standard years of life expectancy and disability weight was 0.002.(26)
(4) We also estimated DALYs by adding YLLs and YLDs and calculated incremental cost-effectiveness ratios (ICERs) by dividing incremental cost estimates by assumed incremental effectiveness.

Benefit-Cost Analysis

We estimated benefits from 3 benefit streams of (1) Benefits form Deaths averted, (2) Benefits from reduced non-fatal health risks and (3) Benefits from increased lifetime productivity; discounted them with 3 different discount rates and estimated the Benefit-cost ratio of the program that is the ratio of projected costs and sum of the three benefit streams. Key assumptions for estimating these benefits are listed in Table 4. A detailed approach for the benefit-cost analysis is as follows.

Table 4: Key assumptions and parameters for benefit-cost analysis

Assumption	Parameter	Source
Benefits from Deaths Averted		
The value of a statistical life (VSL) by transferring value derived from the US	$8.6 million	(29)
GNI per capita PPP estimates	Income (Nepal) – 4,230 Income (Base) – 70,480	(30)
Life expectancy birth of an average Nepali adult of 70.88 years in 2019	70.88 years	(31)
VSL values of OECD and US	$3 million in 2005 for OECD $8.6 million for US	(16,30)
Benefits from reduced non-fatal health risks		
Individual WTP for averting diarrheal diseases (2002)	Int$ 35.40	(33)
Each diarrhea case incidence translates to	0.0019 YLDs	(34)
Children under 5 get diarrhea and are not taken to health care facilities for treatment	19%	(35)
Household outpatient visit cost in Nepal for diarrhea	NPR 184	(36)
Children under 5 with diarrhea and seeking care in health facilities	14%	(35)
% Costs borne by public or NGO health facilities	60%	
Cost of inpatient visit in Nepal	NPR 184	(34)
Average duration of a case of diarrhea	6 days	(34)
Benefits from Improved Lifetime Productivity		
Increase in wages due to averting stunting incidence	46%	(32)
Average wage of a rural Nepali in 2022	NPR 35,000 monthly	(33)
Labour Participation (2038-2082)	100%	

To estimate the value of future deaths averted, increase in productivity and dietary diversity of mothers, we needed to forecast GNI per capita growth since these benefits can be assumed to increase with income. The International Monetary Fund (IMF) had forecasted growth for Nepal at approximately 4.4% for 2023. We assumed the same rate for the next 5 years and beyond.(34) We used discount rates of 3%, 8% and 12% following (1) guidelines of iDSI reference case,(35) (2) rate of twice the expected near term growth rate as per the Ramsey rule (36) and (3) value used in other such analysis respectively. (16)

Benefits from Deaths Averted

(1) We estimated the value of a statistical life (VSL) by transferring value derived from the US (USD 8.6 million (29) in 2021 US Dollars) with an assumed income elasticity of 1.5, GNI per capita PPP estimates from World Bank estimates (37) and the following formula: (30)

$VSL_{target} = VSL_{base} * (Income_{target} / Income_{base})^{elasticity}$
$= 8.6 \text{ million} * (4{,}230/70{,}480)^{1.5}$
$= 126{,}447 \text{ NPR or } 962 \text{ USD}$

(2) We estimated a constant value of statistical life year (VSLY) by dividing the population average VSL for each year as per the above approach by life expectancy at birth of an average Nepali adult of 70.88 years in 2019.(31) The VSLY was estimated to be 1783 NPR (USD 13) in 2021, growing proportionally with VSL growth mentioned above. As per Nepali life tables, an avoided child death at age 1-4 years could be estimated to 71 years of life lost (YLLs). We multiplied these YLLs by deaths avoided by the SEEMS Nutrition multisectoral program and the VSLY to estimate mortality benefits.

(3) An alternative approach suggests using an income elasticity of 1 and base VSL values of OECD (USD 3 million in 2005 or USD 4.1 million in 2021) and US (USD 8.6 million) respectively. This translates to VSL of USD 1871 and 3925 USD respectively. (16,30)

Benefits from reduced non-fatal health risks

We valued benefits from non-fatal health risks with 2 approaches used in literature (1) with WTP estimates, and (2) valuing years lost to disability (YLDs) at constant VSLY. (16,38)

For estimating these benefits with WTP estimates, we assumed individual WTP for averting diarrheal diseases as this issue constitutes a significant proportion of benefits from non-fatal health risk and is a common cause of childhood stunting. This was estimated to be Int$ 35.40 (2002) that is 1.6% of annual per capita income of population of rural China.(39) Assuming income elasticity of 1.0 and GNI per capita PPP (Int$ 4230 in 2021), this was estimated to be Int$ 67.68 or 2271.34 NPR or USD 17.27 per diarrheal disease case averted in 2021.

Alternatively, we calculated these benefits where each YLD was estimated at a constant VSLY (1783 NPR or USD 13.57 from previous section) and costs borne by third parties. As per the Global burden of disease study 2016, each diarrhea case incidence translates to 0.0019 YLDs.(40) We estimated 3 types of costs: (1) Outpatient costs (2) Inpatient costs, and (3) Costs of caregiver time. Since there is a combination of private, public and non-profit healthcare in Nepal, we assumed that some costs were paid for external stakeholders. We included cost of caregiver time as VSL and VSLY estimates are as per WTP and did not include costs incurred by others.

Assumptions for calculation of outpatient costs:

- 19% of children under 5 get diarrhea and were not taken to health care facilities for treatment. (41)

- Household outpatient visit cost in Nepal for diarrhea was NPR 184 or USD 1.43. (42)
- 60% of all costs were borne by public or NGO health facilities.

Assumptions for calculation of inpatient costs:

- 14% of children under 5 were diarrhea patients and seek care in health facilities.(41)
- Each inpatient visit in Nepal costs NPR 184 or USD 1.43.(42)
- 60% of all costs were paid for by public or non-profit health facilities.

Assumptions for calculation of caregiver costs:

- One adult does the caregiving during the entire duration of a diarrhea case.
- The average rural wage was NPR 35,000 per month.(33)
- The cost of time is about 50% of rural wage.
- Average duration of a case of diarrhea was assumed at 6 days. (40)

We estimated that total value of monetized YLD and third-party costs was 3220 NPR or USD 24.61 per case of diarrhea in 2021.

We estimated diarrheal diseases cases by the program through the LiST tool with the same approach as mentioned in Cost Effectiveness Analysis section. This amounts to 298,214 cases of diarrhea averted by the Suaahara II program.

Benefits from Improved Lifetime Productivity

We have discussed in an earlier section that the Suaahaara II program, led to reduction of 2868 cases of stunting averted during the program duration in the 42 Suaahaara II districts. Several studies have assessed long term benefits of reductions in stunting as an improvement in lifetime productivity. (15,43)

Assumptions for estimating Improved Lifetime Productivity

- Averting stunting incidence increases wages by 46% from age 16 to 60. (32)
- Average wage of a rural Nepali in 2022 is NPR 35,000 per month and increases with respect to GNI per capita growth estimate of 4.4%.(33) We assume 100% labor force participation as projections are estimated for over multiple decades and accurately reflect lost earning potential.

Results

Costing

The intervention was estimated to cost $169,121,492 for the 42 intervention districts of the Suaahara II program. This included financial as well as economic costs associated with the intervention.

Cost Effectiveness Analysis

The intervention averted 2868 cases of stunting and 85 premature deaths due to stunting. This resulted in 6945 DALYs assuming standard life expectancy at age 1-4 years and 6282 DALYs averted assuming Nepali life expectancy. The cost of the intervention was $24,352 per DALY averted assuming standard life expectancy at age 1-4 years and $26,923 per DALY averted assuming Nepali life expectancy.

Benefit Cost Analysis

Benefits from Deaths averted

The benefits from avoided mortality for the program are summarized in the Table 5.

Table 5: Estimates for Benefits from Deaths averted

Discount Rate	Base Case: Deaths avoided valued at 962 USD VSL	Alternative 1: Avoided YLLs valued at 13.57 USD VSLY	Alternative 2: Death avoided valued at 1871 USD VSL	Alternative 3: Deaths avoided valued at 3925 USD VSL
3%	$ 350,658	$ 351,251	$ 682,388	$ 1,431,351
8%	$ 312,514	$ 313,043	$ 608,160	$ 1,275,652
12%	$ 286,879	$ 287,365	$ 558,274	$ 1,171,013

The findings suggest that the selection of different estimation methods significantly impacts the results. Under the base case scenario, the annualized value of prevented mortality is estimated to be USD 350,658 at a discount rate of 3%. However, transitioning from a Value of a Statistical Life (VSL) to a Value of a Statistical Life Year (VSLY) approach has a negligible positive effect on the calculation of benefits. Consequently, this alternative approach yields an annualized mortality benefit value of USD 351,251 representing a marginal increase over the base case value. Employing alternative VSL estimates proposed by Robinson et al results in mortality benefits that exceed the base case dramatically several times. Notably, the choice of the discount rate appears to exert minimal influence on the value attributed to avoided premature mortality.

Benefits from non-fatal health risks

The results of the analysis are summarized in Table 6.

Table 6: Estimates for Benefits from non-fatal health risks

Discount Rate	Base Case: Benefit transfer – Each case of diarrhea averted valued at 2271.34 NPR or USD 17.27	Alternative case: Monetized YLD and third part costs – Each case of diarrhea averted valued at 3220 NPR or USD 23.12
3%	$ 4,776,010	$ 6,393,583
8%	$ 4,248,062	$ 5,686,826
12%	$ 3,895,925	$ 5,215,424

Results suggest that the based case for valuing non-fatal health risks based on diarrhea cases averted is about $4.7 million. The alternative approach based on valuation using monetized YLDs and costs borne by third parties indicates a higher value of about $6.3 million that is notably higher than the base case.

Benefits from Improved Lifetime Productivity

The results of this estimation are summarized in Table 7.

Table 7: Estimates for Benefits from Improved Lifetime Productivity

Discount Rate	Estimate of benefits
3%	$ 321,609,674
8%	$ 57,503,203
12%	$ 19,319,419

Clearly the discount rate has a dramatic effect on lifetime productivity benefits. This is not surprising since the benefits include potential benefits till 60 years after the intervention and the fact the benefits of increased productivity start 16 years after the intervention commences.

A summary of BCA results is listed in Table 8 and table 9.

Table 8: Base Case BCA estimates (Lowest benefits)

Discount Rate	Mortality Avoided	Non fatal health risks	Productivity	Total Benefit	Costs	Benefit Cost Ratio	Net Benefit
3%	$ 350,658	$ 4,776,010	$ 321,609,674	$ 326,736,341	$169,121,492	1.93	$ 157,614,850
8%	$ 312,514	$ 4,248,062	$ 57,503,203	$ 62,063,779	$169,121,492	0.37	$ (107,057,713)
12%	$ 286,879	$ 3,895,925	$ 19,319,419	$ 23,502,223	$169,121,492	0.14	$ (145,619,269)

Table 9: Alternative Case BCA estimates (Highest benefits)

Discount Rate	Mortality Avoided	Non fatal health risks	Productivity	Total Benefit	Costs	Benefit Cost Ratio	Net Benefit
3%	$ 1,431,351	$ 6,393,583	$ 321,609,674	$ 329,434,608	$169,121,492	1.95	$ 160,313,116
8%	$ 1,275,652	$ 5,686,826	$ 57,503,203	$ 64,465,681	$169,121,492	0.38	$ (104,655,811)
12%	$ 1,171,013	$ 5,215,424	$ 19,319,419	$ 25,705,856	$169,121,492	0.15	$ (143,415,636)

Discussion

This paper applied economic evaluation to appraise the economic benefits of multi-sectoral nutrition programs in the socioeconomically challenged context of Nepal. The evaluation of cost-effectiveness ratio compared to Nepal's per capita Gross Domestic Product (GDP), showed that the estimate was significantly higher than 3x Nepal GDP per capita implying that the program was not cost-effective.

However, the Benefit-cost analysis revealed contradictory conclusion with a BCR comparable to most similar programs. This discrepancy suggests that the program may offer a good return on investment when considering the longer-term impacts of improving maternal and child health in the first 1000 days. This was the case because the BCA included potential future benefits like benefits from increased lifetime productivity, thus, overcoming this limitation of cost-effectiveness analysis. Furthermore, conducting a BCA in addition to the more common CEA evaluation enhances ease of comparing with interventions across sectors with an emphasis on overall well-being and not just on health. (23)

Our comprehensive benefit-cost analysis confirms the potential advantages of this approach, leveraging the effect of reducing stunting prevalence and consequent enhancements in economic productivity, along with the avoidance of premature mortality and non-fatal health risks like Diarrhea. Notably, the BCA estimations derived from this study align with results of similar interventions (refer Table 1). Additionally, it must be noted that this analysis did not include benefits from non-fatal health risks other than Diarrhea and several other potential benefits like benefits from improved dietary diversity due to limitations with the Lives Saved Tool. However, results were comparable to other such analyses despite this limitation. Critically, the study employed two distinct economic evaluation methodologies, which despite diverging implications, suggest a favorable return on investment.

The 2022 annual Suaahara II survey exhibited advancements concerning the mitigation of stunting and underweight conditions, although significant change in wasting rates has transpired since 2017. Notably, the incidence of stunting diminished from 28% in 2017 to 22% in 2022, while the prevalence of underweight cases has declined from 23% in 2017 to 20% in 2022, which is not a significant reduction. However, the prevalence of wasting exhibited constancy, maintaining a level of 9.9%. The most substantial enhancements in anthropometric indicators were observed among children aged 12-23 months, with stunting prevalence in this age group diminishing by 9 percentage points and underweight incidence decreasing by 6 percentage points from 2017 to 2022. (44) It is imperative, however, to acknowledge a pivotal issue that underestimates the results of the program: the program has yielded these results despite disruptions due the Covid-19 pandemic and the Russia-Ukraine war during the program period that could be expected to have reduced its impact significantly due to challenges with service delivery and agricultural supply chains during the 2016-2022 period.

In this analysis, we estimated the potential benefits from changes in coverage for breastfeeding, ANC and WASH indicators only, despite the findings that changes in coverage levels from baseline and endline with and without the intervention, were not significant. We used these changes in the Lives Saved tool to project potential benefits for use in the cost-effectiveness analysis and the BCA model. We did not capture significant improvements in dietary diversity, as the Lives Saved Tool is not developed to map those to diarrhea, stunting and deaths averted at this time. This approach, although hypothetical, underscores a gap within the current economic evaluation framework, particularly in the context of multifaceted nutrition-sensitive programs. This study underscores the necessity for an enhanced economic evaluation framework that encapsulates within its estimations of economic evaluations, the full spectrum of program coverage indicators.

Economic analysis of Suaahara II through an ex-ante cost effectiveness analysis demonstrated that some components of the SII program centered on Social and Behavioral Change Communication (SBCC) were cost-effective, significantly diverging from our results on cost-effectiveness. (45) This can be attributed to several differences in our respective approaches. Firstly, their cost estimates were based on unit costs

for SBCC interventions from literature that turned out to be significantly lower that than actual estimates for this program, thereby underestimating the incremental cost of the program and overestimating the overall program cost-effectiveness significantly. Secondly, their analysis was based on SBCC activities with an emphasis on breastfeeding and complementary feeding coverage indicators only and not the entire Suaahara II program and excluded ANC and WASH coverage improvements, unlike this analysis. Nevertheless, this analysis confirms the utility of the program as an effective investment for policy makers. (45)

Strengths and Limitations

This study possesses some notable strengths. It used data on intervention coverage from a program evaluation in control and intervention districts to hypothetically explore the impact of a multisectoral approach on stunting reduction and combined the potential benefits with actual costs of implementing a complex scaled up multisectoral nutrition program. This approach distinguishes it from most other such analyses to our knowledge, in estimating the cost-effectiveness of a multi-sectoral intervention rooted in empirical data. An additional robust facet of this paper is the application of a Benefit-cost analysis based on best recommended practices, underpinned by diverse data sources.

However, certain limitations should also be considered. First, the benefits were calculated from an impact evaluation showing improvements in coverage of many interventions, but limited impact on stunting. This approach had to be taken in the light of limited reported improvements in stunting outcomes attributed to disruptions in service delivery and food security due to the Covid-19 pandemic and the Russia-Ukraine war during the 2016-2022 period. Thus, this analysis looks at the cost-effectiveness and benefit costs of improving coverage through a scaled national program, and the net benefits are hypothetical, assuming that in fact the changes in coverage were significant. Second, the cost estimations of the program are based on a sample of 4 districts out of 44 participating districts. Although they represent diverse agroecological zones, they likely do not capture the diversity in economic costs across different setting in Nepal. Although these districts are representative for various regions in Nepal, the number of districts is low for an evaluation of this scale. Third, on the effectiveness estimates, while we estimate stunting outcomes based on intermediary program coverage indicators around breastfeeding, ANC and WASH using the Lives Saved Tool, there are limitations around testing historical changes with assumed stunting outcomes as a sensitivity analysis, due to limitation of the LiST tool with retrospective analyses.

Subsequently, despite the comprehensive benefit-cost analysis encompassing a wide array of advantages related to averted premature mortality, heightened lifelong economic productivity, and increased benefits from non-fatal health risks, certain potential benefits were not covered. Such exclusions were done because of lack of coverage of certain critical intermediary indicators such as dietary diversity related outcomes in the Lives Saved Tool (LiST) and the literature that could facilitate estimation of benefits from increased dietary diversity and other such benefits.

Conclusion

In conclusion, this paper presents empirical evidence based on the application of benefit cost analysis to estimate the returns on investment of a large scale multi-sectoral nutrition program. It further provides insights into current methodological limitations that hinder better quality economic evaluations in this domain. The evidence from this study indicates that the adoption of multi-sectoral nutrition programs at the country level, could represent a judicious allocation of financial resources within Nepal and similar settings. There is a need for future research to bridge gaps in methodological approaches to economic evaluation, thereby enabling more meaningful interpretations of the evidence when evaluating the cost-effectiveness of multi-sectoral interventions.

References:

1. UNICEF DATA [Internet]. [cited 2023 Mar 24]. Malnutrition in Children. Available from: https://data.unicef.org/topic/nutrition/malnutrition/

2. Wun J, Kemp C, Puett C, Bushnell D, Crocker J, Levin C. Measurement of benefits in economic evaluations of nutrition interventions in low- and middle-income countries: A systematic review. Matern Child Nutr. 2022 Feb 8;18(2):e13323.

3. Njuguna RG, Berkley JA, Jemutai J. Cost and cost-effectiveness analysis of treatment for child undernutrition in low- and middle-income countries: A systematic review. Wellcome Open Res. 2020;5:62.

4. Ramponi F, Tafesse W, Griffin S. Economic evaluation of interventions to address undernutrition: a systematic review. Health Policy Plan. 2021 May 1;36(4):533–41.

5. Shekar M, Dayton Eberwein J, Kakietek J. The costs of stunting in South Asia and the benefits of public investments in nutrition. Matern Child Nutr. 2016;12(S1):186–95.

6. Fiedler JL. The Nepal National Vitamin A Program: prototype to emulate or donor enclave? Health Policy Plan. 2000 Jun;15(2):145–56.

7. Thorne-Lyman AL, Parajuli K, Paudyal N, Chitekwe S, Shrestha R, Manandhar DL, et al. To see, hear, and live: 25 years of the vitamin A programme in Nepal. Matern Child Nutr. 2020 Feb 27;18(Suppl 1):e12954.

8. Nutrition | UNICEF Nepal [Internet]. [cited 2023 Mar 27]. Available from: https://www.unicef.org/nepal/nutrition

9. Chitekwe S, Torlesse H, Aguayo VM. Nutrition in Nepal: Three decades of commitment to children and women. Matern Child Nutr. 2021 Sep 15;18(Suppl 1):e13229.

10. Wun J, Kemp C, Puett C, Bushnell D, Crocker J, Levin C. Measurement of benefits in economic evaluations of nutrition interventions in low- and middle-income countries: A systematic review. Matern Child Nutr. 2022;18(2):e13323.

11. Sharma IK, Di Prima S, Essink D, Broerse JEW. Nutrition-Sensitive Agriculture: A Systematic Review of Impact Pathways to Nutrition Outcomes. Adv Nutr Bethesda Md. 2021 Feb 1;12(1):251–75.

12. Keats EC, Das JK, Salam RA, Lassi ZS, Imdad A, Black RE, et al. Effective interventions to address maternal and child malnutrition: an update of the evidence. Lancet Child Adolesc Health. 2021 May 1;5(5):367–84.

13. Qureshy LF, Alderman H, Rokx C, Pinto R, Wai-Poi M, Tandon A. Positive returns: cost-benefit analysis of a stunting intervention in Indonesia. J Dev Eff. 2013 Dec 1;5(4):447–65.

14. Trenouth L, Colbourn T, Fenn B, Pietzsch S, Myatt M, Puett C. The cost of preventing undernutrition: cost, cost-efficiency and cost-effectiveness of three cash-based interventions on nutrition outcomes in Dadu, Pakistan. Health Policy Plan. 2018 Jul 1;33(6):743–54.

15. Hoddinott J, Alderman H, Behrman JR, Haddad L, Horton S. The economic rationale for investing in stunting reduction. Matern Child Nutr. 2013;9(S2):69–82.

16. Wong B, Radin M. Benefit-Cost Analysis of a Package of Early Childhood Interventions to Improve Nutrition in Haiti. J Benefit-Cost Anal. 2019 ed;10(S1):154–84.

17. A G, CG K, A M, A T, M K, C L. Economic evaluation of an early childhood development center–based agriculture and nutrition intervention in Malawi. Food Secur. 2022 Feb 1;14(1):67–80.

18. Health costs and benefits from a pilot rural sanitation intervention in India | Request PDF [Internet]. [cited 2023 Aug 11]. Available from: https://www.researchgate.net/publication/328822230_Health_costs_and_benefits_from_a_pilot_rural_sanitation_intervention_in_India

19. Benefit–Cost Analysis of Community-Led Total Sanitation: Incorporating Results from Recent Evaluations | Journal of Benefit-Cost Analysis | Cambridge Core [Internet]. [cited 2023 Aug 11]. Available from: https://www.cambridge.org/core/journals/journal-of-benefit-cost-analysis/article/benefitcost-analysis-of-communityled-total-sanitation-incorporating-results-from-recent-evaluations/1DE9FBD02CE0C5FAFDF17CC784DC1806

20. Fl B, G P, S U. Cost-benefit analysis of a micronutrient supplementation and early childhood stimulation program in Nicaragua. Ann N Y Acad Sci [Internet]. 2014 Jan [cited 2023 Aug 11];1308. Available from: https://pubmed.ncbi.nlm.nih.gov/24571215/

21. Stegmuller AR, Self A, Litvin K, Roberton T. How is the Lives Saved Tool (LiST) used in the global health community? Results of a mixed-methods LiST user study. BMC Public Health. 2017 Nov 7;17(4):773.

22. Njuguna RG, Berkley JA, Jemutai J. Cost and cost-effectiveness analysis of treatment for child undernutrition in low- and middle-income countries: A systematic review. Wellcome Open Res. 2020 Oct 5;5:62.

23. Robinson LA, Hammitt JK, Cecchini M, Chalkidou K, Claxton K, Cropper ML, et al. Reference Case Guidelines for Benefit-Cost Analysis in Global Health and Development. SSRN Electron J [Internet]. 2019 [cited 2023 Mar 31]; Available from: https://www.ssrn.com/abstract=4015886

24. Choo, E., Kemp C, Sagun KC, Paudel U, Wun J, Cunningham K, Acharya P, Pandey P, & Levin C. The costs of Suaahara II, a complex scaled-up multisectoral nutrition program in Nepal. Maternal and Child Nutrition, Under review.

25. WHO [Internet]. World Health Organization; [cited 2023 Apr 3]. GHO | By category | Life tables by country - Nepal. Available from: https://apps.who.int/gho/data/view.main.LT62120?lang=en

26. World_Health_Organization-Disability_Weights_for_Diseases_and_Conditions_2004.pdf [Internet]. [cited 2023 Apr 3]. Available from: https://files.givewell.org/files/DWDA%202009/Interventions/voluntary_male_medical_circumcision/World_Health_Organization-Disability_Weights_for_Diseases_and_Conditions_2004.pdf

27. Olofin I, McDonald CM, Ezzati M, Flaxman S, Black RE, Fawzi WW, et al. Associations of Suboptimal Growth with All-Cause and Cause-Specific Mortality in Children under Five Years: A Pooled Analysis of Ten Prospective Studies. PLoS ONE. 2013 May 29;8(5):e64636.

28. Regional Model Life Tables and Stable Populations - 2nd Edition [Internet]. [cited 2023 Apr 3]. Available from: https://www.elsevier.com/books/regional-model-life-tables-and-stable-populations/coale/978-0-12-177080-8

29. Sweis NJ. Revisiting the value of a statistical life: an international approach during COVID-19. Risk Manage. 2022;24(3):259–72.

30. Robinson LA, Hammitt JK, O'Keeffe L. Valuing Mortality Risk Reductions in Global Benefit-Cost Analysis. J Benefit-Cost Anal. 2019;10(Suppl 1):15–50.

31. Life expectancy at birth (years) [Internet]. [cited 2023 Apr 27]. Available from: https://www.who.int/data/gho/data/indicators/indicator-details/GHO/life-expectancy-at-birth-(years)

32. Grajeda R, Behrman JR, Flores R, Maluccio JA, Martorell R, Stein AD. The Human Capital Study 2002–04: Tracking, data Collection, Coverage, and Attrition. Food Nutr Bull. 2005 Jun 1;26(2_suppl1):S15–24.

33. Nepal Average Monthly Household Income: Rural | Economic Indicators | CEIC [Internet]. [cited 2023 Apr 28]. Available from: https://www.ceicdata.com/en/nepal/household-budget-survey-average-monthly-household-income/average-monthly-household-income-rural

34. IMF [Internet]. [cited 2023 Apr 24]. Nepal and the IMF. Available from: https://www.imf.org/en/Countries/NPL

35. Wilkinson T, Sculpher MJ, Claxton K, Revill P, Briggs A, Cairns JA, et al. The International Decision Support Initiative Reference Case for Economic Evaluation: An Aid to Thought. Value Health. 2016 Dec 1;19(8):921–8.

36. Claxton K, Asaria M, Chansa C, Jamison J, Lomas J, Ochalek J, et al. Accounting for Timing when Assessing Health-Related Policies. J Benefit-Cost Anal. 2019 ed;10(S1):73–105.

37. World Bank Open Data [Internet]. [cited 2023 Apr 26]. World Bank Open Data. Available from: https://data.worldbank.org

38. Robinson LA, Hammitt JK. Valuing Nonfatal Health Risk Reductions in Global Benefit-Cost Analysis [Internet]. Rochester, NY; 2018 [cited 2023 Apr 27]. Available from: https://papers.ssrn.com/abstract=4013166

39. Guh S, Xingbao C, Poulos C, Qi Z, Jianwen C, von Seidlein L, et al. Comparison of cost-of-illness with willingness-to-pay estimates to avoid shigellosis: evidence from China. Health Policy Plan. 2008 Mar 1;23(2):125–36.

40. Global, regional, and national comparative risk assessment of 79 behavioural, environmental and occupational, and metabolic risks or clusters of risks, 1990–2015: a systematic analysis for the Global Burden of Disease Study 2015 - ScienceDirect [Internet]. [cited 2023 Apr 28]. Available from: https://www.sciencedirect.com/science/article/pii/S0140673616316798

41. Mishra R, Acharya A, Yadav AK, Shreewastav RK. Diarrhoea among Children Under Five Years of Age Residing in a Village Development Committee: A Descriptive Cross-sectional Study. JNMA J Nepal Med Assoc. 2022 May;60(249):425–9.

42. Shrestha M, Adhikari S, Manandhar N, Choulagai B, Pradhan B. Household Expenditure on Diarrhea Treatment among Under Five Children in Godawari Municipality of Nepal. J Nepal Health Res Counc. 2019 Nov 13;17:351–6.

43. Effect of a nutrition intervention during early childhood on economic productivity in Guatemalan adults - ScienceDirect [Internet]. [cited 2023 Apr 29]. Available from: https://www.sciencedirect.com/science/article/abs/pii/S0140673608602056?casa_token=K91Phm0Bb1MAAAAA:vPw1JSpvtLKpCbglQsJ46e7mRkUO6Dh41TfQZlmn-qreR19xgvMOBthiSwg43nNHKZ-uHNRY

44. PA00ZWFZ.pdf [Internet]. [cited 2023 Aug 16]. Available from: https://pdf.usaid.gov/pdf_docs/PA00ZWFZ.pdf

45. Avenir Health. The business case for social and behavior change for breastfeeding and complementary feeding [Internet]. Population Council; 2023 Feb [cited 2023 Aug 11]. Available from: https://knowledgecommons.popcouncil.org/focus_sexual-health-repro-choice/144