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Cost–Benefit Analysis of WFP's Integrated Resilience Programme in Chad (2018–2023)

John M. Ulimwengu[a], Wim Marivoet[b], Aboubacar Hema[a], Sam Benin[b], Francois Regis Udahemuka[c], Hagar Ibrahim[c], Ruth Ngaradoumri[c], and Mamane Salissou[c]

[a] International Food Policy Research Institute (IFPRI); [b] IFPRI at the time of project implementation; [c] World Food Programme (WFP)-Chad

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KEY MESSAGES

1. **Integrated resilience programming (IRP) works.** The IRP significantly improved household food security, with participating households recording an average 6.6 point increase in Food Consumption Scores (FCS) and reduced reliance on negative coping strategies, and increased resilience capacities, compared with nonparticipants, underscoring the value of multisectoral, layered interventions.

2. **High economic returns are achievable in fragile contexts.** Overall, the IRP delivered a benefit–cost ratio (BCR) of 3.98, meaning every US$1 invested generated nearly US$4 in measurable benefits.

3. **Nutrition interventions (treatment of acute malnutrition and blanket supplementary feeding) yield the strongest returns.** Treatment of acute malnutrition and preventive nutrition support for women and children produced BCRs ranging from 6:1 to 9:1, validating global evidence on the cost-effectiveness of nutrition investments.

4. **Knowledge-based and community-led interventions are transformative.** Training and sensitization activities achieved the highest BCR (20:1) for resilience outcomes, highlighting the long-term payoffs of behavior change, empowerment, and knowledge transfer activities.

5. **Cereal banks, particularly when combined with Food Assistance for Assets (FFA) through cash transfers, contributed to improved food security and resilience outcomes.** The Cereal Bank + FFA Cash Transfers combination achieved balanced gains across key indicators (FCS +9.2, rCSI –3.4, RCS +10.4), highlighting its role in stabilizing seasonal food availability and access. However, despite these outcome improvements, the cost-effectiveness was modest, with BCRs ranging from 0.4 to 0.6—suggesting that while the intervention supports resilience, its financial return per dollar invested may be limited under current implementation models.

6. **Bundled interventions outperform stand-alone ones.** Layered approaches—particularly FFA Cash Transfers combined with School Feeding—produced the largest FCS gains (+5.7 points; BCR = 2.85), reinforcing WFP's integrated "three-pronged approach" to resilience-building.

7. **Short-term transfers remain essential but less cost-efficient.** Lean season food and cash distributions provided vital relief but yielded lower long-term returns (BCR < 1), emphasizing the need to balance immediate humanitarian needs with investments in sustainability.

8. **Strategic scaling of high-return interventions is crucial.** Scaling nutrition, training, and cereal bank programs, while optimizing the design and sequencing of combined packages, could maximize impact per dollar spent and strengthen resilience dividends.

9. **Resilience is a smart investment.** The findings demonstrate that resilience programming is not only a humanitarian necessity but also a financially sound strategy—reducing long-term aid dependency, improving livelihoods, and fostering local self-reliance across fragile environments in Chad.

10. **Short-term coping behavior responds more slowly than food security and resilience capacity outcomes, highlighting the need for sustained and sequenced support.** While IRP interventions generated significant improvements in food consumption and resilience capacity, reductions in severe coping strategies were not observed in the short term. This underscores that behavioral

change lags behind stabilization and capacity-building gains, and that resilience impacts should be assessed over longer horizons rather than through immediate reductions in negative coping alone.

1. INTRODUCTION

Chad continues to face overlapping humanitarian, environmental, and socioeconomic crises that perpetuate chronic food insecurity and poverty. Recurring droughts, floods, and insecurity in the Lake Chad Basin have eroded livelihoods and left millions dependent on humanitarian assistance. Ranked consistently near the bottom of the UNDP's Human Development Index (HDI), Chad faces deep and persistent structural vulnerabilities. Yet, as global resources for emergency aid tighten, the imperative for sustainable, resilience-oriented solutions has never been greater. Recognizing this challenge, the World Food Programme (WFP) launched its Integrated Resilience Programme (IRP) in 2018 to help vulnerable communities transition from short-term relief to long-term recovery and self-reliance (WFP, 2024).

The IRP embodies WFP's strategic shift from fragmented humanitarian interventions toward integrated, multisectoral programming that simultaneously addresses both the root causes and symptoms of food insecurity. Operating across 14 regions of Chad's Sahelian belt, the IRP has reached more than 600,000 beneficiaries through a diverse package of interventions, including asset creation, seasonal food and cash assistance, nutrition support, school meals, girls' scholarships, cereal banks, and capacity strengthening activities. These components are deliberately layered and sequenced to strengthen household and community resilience, enhance productivity, and reduce vulnerability to climatic and economic shocks (WFP, 2023).

Amid worsening climate impacts and macroeconomic instability, stakeholders—including the Government of Chad, donors, and implementing partners—have sought stronger evidence of impact and value for money from such investments. The central question is whether WFP's resilience programming is achieving measurable improvements in food security and whether these gains justify the substantial operational costs. This report directly addresses that question through a rigorous cost–benefit analysis (CBA) integrated with an impact evaluation framework.

Drawing on 10 rounds of cross-sectional household surveys (2018–2023) and detailed program cost data, the analysis uses quasi-experimental methods—propensity score matching (PSM) and inverse probability weighting (IPW)—to estimate the average treatment effect on the treated (ATT) across three key outcomes: Food Consumption Score (FCS), Reduced Coping Strategies Index (rCSI), and Resilience Capacity Score (RCS). These impacts are then translated into monetary terms to calculate benefit–cost ratios (BCRs) for both individual and combined interventions, following methodologies adapted from resilience CBA studies in Niger and other Sahelian contexts (Béné, Riba, & Wilson, 2020; WFP, 2024).

The results reveal significant heterogeneity across interventions. High-return investments include nutrition support for women and children, cereal banks, and training and sensitization activities, all of which generate strong resilience and economic benefits. Integrated or bundled interventions—particularly those

combining Food Assistance for Assets cash transfers with school feeding or capacity strengthening—tend to outperform stand-alone approaches, validating WFP's three-pronged resilience model (WFP, 2024). Conversely, purely short-term transfer programs show lower cost-effectiveness, reinforcing the need for sustained, multisectoral engagement.

This report provides both analytical and strategic insights for WFP, the Government of Chad, and donors. It demonstrates that integrated resilience investments not only improve food security but also yield measurable economic returns, offering a compelling case for scaling such programs. Beyond quantifying benefits and costs, the study aims to inform evidence-based policy dialogue, resource prioritization, and long-term investment planning to strengthen resilience and food systems sustainability in fragile Sahelian contexts.

2. CONTEXT AND PROGRAM OVERVIEW

Chad's socioeconomic landscape is marked by chronic fragility and persistent food insecurity. Ranked among the lowest countries on the Human Development Index, Chad has been trapped in a cycle of underdevelopment and humanitarian need for decades. From 2016 to 2021, Chad witnessed a significant deterioration in food security, with the national average Food Consumption Score (FCS) declining by approximately 1.16 points per year—a quantitative reflection of worsening dietary diversity and food access across households. This downward trend is driven by the compounding impact of multiple overlapping crises: recurring climate shocks such as droughts and floods, ongoing insecurity and displacement due to conflict in the Lake Chad Basin, and macroeconomic instability that weakens household purchasing power. These shocks do not occur in isolation; rather, they amplify one another, leaving millions of Chadians vulnerable to acute hunger and malnutrition. Against this backdrop of persistent vulnerability, the imperative for resilience-building becomes clear. Humanitarian relief alone cannot sustainably reverse food insecurity. What is needed is a structural shift toward long-term, integrated interventions that can help communities withstand and recover from shocks.

Recognizing this need, the World Food Programme (WFP) launched the Integrated Resilience Programme (IRP) in Chad in 2018 as a strategic pivot from reactive humanitarian aid to proactive resilience-building. The IRP's design reflects a systems approach to food security, grounded in the understanding that chronic vulnerability requires a multi-pronged response. WFP's IRP combines a series of complementary interventions aimed at addressing both the symptoms and root causes of food insecurity. These include climate-smart asset creation projects, such as land rehabilitation, water harvesting, and rural infrastructure; preventive and therapeutic nutrition programs targeting children and pregnant or breastfeeding women; school-based interventions such as daily school meals and scholarships for adolescent girls; seasonal safety nets in the form of lean-season food or cash assistance; and capacity strengthening initiatives to support local markets and community-based institutions (WFP, 2024). Importantly, these components are not implemented in isolation but are delivered in an integrated manner, reinforcing one another to build household-level resilience and enhance community-level adaptive capacity. For example, a household benefiting from both food-for-assets and nutrition education may experience greater cumulative gains in food security than from either intervention alone.

The scale of the IRP underscores the significance of its potential impact. Between 2018 and 2022, the program reached approximately 610,000 individuals across 262 villages in 14 regions of Chad's Sahelian belt—an area particularly prone to food insecurity due to its arid climate and limited infrastructure (WFP, 2023a). These communities participated in a diverse range of activities, from agricultural rehabilitation and nutrition support to educational incentives and market development. Over 36,400

hectares of degraded land were restored through food- or cash-for-assets schemes, demonstrating a tangible transformation of the rural landscape and its productivity. These figures not only attest to WFP's operational reach but also highlight the substantial financial and logistical investment required to implement such a multifaceted program. This extensive footprint reinforces the need for a rigorous assessment of cost-effectiveness: Are these interventions achieving measurable outcomes proportional to their cost?

This question is not just technical but strategic, particularly for internal WFP teams and donors seeking to optimize resource allocation. The current study is designed to strike a balance between analytical rigor and policy relevance. It applies advanced econometric methods—including inverse probability weighting and propensity score matching—to derive credible impact estimates, while also translating findings into clear, actionable insights that can inform program design, funding decisions, and strategic priorities. The broader policy relevance of this analysis lies in its capacity to demonstrate the potential "resilience dividend" of up-front investments. As seen in other Sahel countries such as Niger, where cost–benefit analyses have shown that resilience interventions can yield returns as high as 3:1 within five years, there is growing evidence that integrated programming not only improves household well-being but also reduces the need for future emergency aid (WFP, 2024). In this sense, the CBA is not merely a tool for economic evaluation but a framework for understanding whether WFP's resilience strategy is delivering on its promise to shift the humanitarian paradigm in fragile settings such as Chad.

3. DATA AND INTERVENTION COMPONENTS

3.1. Household survey data (2018–2023)

To rigorously evaluate the impact of the Integrated Resilience Programme (IRP) in Chad, the World Food Programme (WFP) relied on a rich dataset generated through 10 rounds of annual monitoring and evaluation (M&E) surveys conducted between 2018 and 2023. The survey rounds were designed to capture a wide and representative cross-section of households residing in IRP-targeted areas across Chad's Sahelian belt. Each round followed a cross-sectional sampling strategy, meaning different households were surveyed in each year, rather than tracking the same households over time. This approach enabled broad geographic and demographic representation and allowed for year-on-year comparisons of program coverage and outcomes, though it limited the use of panel-based longitudinal methods. Within each round, the sample included both program participants and nonparticipants, facilitating quasi-experimental comparisons between those who received WFP support and those who did not. Households were asked whether they had benefited from specific IRP interventions in the previous 12 months, enabling the disaggregation of results by intervention type.

The surveys were comprehensive in scope and gathered detailed household-level data that are central to evaluating program effectiveness. The primary outcome indicator used throughout the analysis is the Food Consumption Score (FCS), a widely recognized metric for assessing dietary quality and frequency over the past seven days. In addition to the FCS, the surveys collected data on dietary diversity scores, the Coping Strategies Index (CSI) and its reduced version (rCSI), which capture households' responses to food insecurity, as well as asset ownership indices and self-reported resilience scores. These indicators together offer a multidimensional view of household well-being, enabling the estimation of both direct food security impacts and broader resilience outcomes. To ensure analytical robustness, the surveys also recorded a range of contextual variables that could affect food security outcomes and intervention participation. These include household size, sex and age of the household head, main income source, region, agro-ecological zone, and recent exposure to shocks such as price inflation, drought, or conflict. These covariates are used as controls in econometric models to reduce confounding and improve the validity of impact estimates.

The dataset generated from these 10 survey rounds is one of the most comprehensive monitoring efforts undertaken in WFP's Sahel operations. On average, each round surveyed thousands of households—approximately 1,500 to 2,000 per year—across all 14 regions where IRP was active. This geographic coverage ensured that the dataset reflects the diversity of livelihoods, agro-ecological settings, and shock exposure profiles found across Chad's Sahelian zone. The inclusion of both participant and nonparticipant households across multiple years allows for robust comparative analysis, capturing variation in program uptake and impact across different contexts and time periods. Overall, the M&E data serve as the backbone

of this cost–benefit analysis, offering a unique empirical basis for assessing the effectiveness and efficiency of WFP's integrated resilience interventions in one of the world's most food-insecure environments.

3.2. Integrated Resilience Programme intervention and cost data

The IRP implemented by the WFP in Chad between 2018 and 2023 comprised a diverse array of interventions, each targeting different dimensions of vulnerability within food-insecure communities. These interventions were grouped into thematic categories to reflect their operational logic and implementation strategy, with the intention of reinforcing synergies across sectors to build long-term resilience. Each component was captured in both household surveys and programmatic records, allowing for systematic analysis of their uptake, impact, and cost-effectiveness.

The first major category, Asset Creation, was implemented through Food Assistance for Assets (FFA), using food or cash-based transfer modalities. Under these schemes, participants engage in community-based projects such as land rehabilitation, the construction of water catchment systems, rural road maintenance, and the development of community cereal banks. In return, households receive food or cash transfers. These interventions are designed to serve dual purposes: providing short-term income or food while simultaneously creating productive assets that enhance agricultural productivity and economic opportunity over the long term (WFP, 2024).

The second category, Seasonal Livelihood Support, addressed acute food insecurity during the lean season, when household food stocks are typically depleted and market prices for staples peak. This support takes the form of three-month food distributions or cash transfers targeted toto the most vulnerable households. The objective is to stabilize consumption during periods of seasonal stress and to prevent households from resorting to harmful coping strategies, such as selling assets or reducing meal intake (WFP, 2024).

School-Feeding Programmes constitute the third pillar of the IRP. These include assistance modalities such On-Site School Feeding, which provide daily school meals to primary school children, and Adolescent Girls' Scholarships, which are scholarships or awards offered to top-performing adolescent girls to promote continued education. These interventions are often delivered in tandem with other components—combining on-site feeding with take-home rations or financial incentives. They aim to improve nutritional outcomes for children, increase school attendance and retention, and reduce the likelihood of early marriage or dropout, especially among girls (WFP, 2023b).

The Nutrition Programmes address both prevention and treatment of malnutrition. Preventive interventions—referred to as blanket supplementary feeding—target children aged 6–23 months and pregnant or breastfeeding women by distributing supplementary nutritious foods to all individuals in these groups, regardless of nutritional status. Therapeutic interventions treat individuals diagnosed with moderate

acute malnutrition (MAM) and severe acute malnutrition (SAM). These include specific assistance modalities such as MAM treatment for children, MAM treatment for pregnant and lactating women, and SAM treatment for children, often implemented in partnership with local health facilities. Additionally, Foyer d'Apprentissage et de Réhabilitation Nutritionnelle (FARN) circles offer community-based education on infant and young child feeding practices, complementing direct nutrition support with behavior change strategies.

The IRP also included Unconditional Assistance and Miscellaneous Transfers, such as Cash Transfers and Other Transfers, which provide support to households that may not fall under other programmatic categories but still exhibit high levels of vulnerability. While smaller in scale, these interventions are important for covering gaps and maintaining social safety nets.

Lastly, Capacity Strengthening formed a critical part of the program's sustainability strategy. Activities under Training and Capacity Strengthening focused on training community groups, cooperatives, and local institutions in areas such as asset maintenance, agricultural practices, and organizational governance. Although these activities do not involve direct transfers to households, they incur substantial costs and are expected to yield long-term benefits by enhancing local ownership and adaptive capacity.

Cost data for all the aforementioned interventions were meticulously compiled from WFP's internal financial records covering the 2018–2023 period. These records account for the full cost of delivering each intervention—including the value of direct transfers (food or cash), operational expenditures (e.g., transportation, warehousing, staff salaries), and programmatic overheads. All financial figures were converted from the local currency, the CFA franc (XAF), to US dollars to ensure consistency and comparability. For instance, the average daily wage for FFA Cash Assistance participants was 30,000 XAF, which approximates to US$50 per participant per month. Similarly, providing a three-month food ration to a household of six costs around $571.5, whereas the equivalent cash assistance was estimated at $267 per household following an increase in transfer value in 2021.

It is important to note the variability in cost structures across interventions. Some interventions—such as Adolescent Girls' Scholarships—are characterized by fixed, one-time yearly costs (e.g., a scholarship award of 20,000 XAF or approximately $33). Others, particularly those involving nutrition support or seasonal distributions, incur recurring monthly costs that vary depending on the intensity and duration of support. Moreover, community-level investments, such as the construction of cereal banks, do not lend themselves easily to per-person cost estimation; instead, they are treated under the asset creation budget and calculated per project or per participant. To enable cross-intervention comparisons, all cost components were either annualized or standardized on a per-beneficiary basis, ensuring that cost-effectiveness metrics reflect a consistent unit of analysis.

In sum, the IRP represents a complex portfolio of resilience-building interventions, each with its own cost structure, implementation modality, and intended outcomes. The integration of detailed cost data with household-level impact data enables a comprehensive cost–benefit analysis that captures both the diversity and the interconnectedness of WFP's programming in Chad.

4. METHODOLOGY

4.1. Analytical framework for cost–benefit analysis

The cost–benefit analysis (CBA) applied in this study follows a social impact evaluation framework tailored to humanitarian and resilience programming, rather than a classical financial return-on-investment model used in commercial projects. In contexts like Chad, where public goods such as improved food security, nutrition, and community resilience are the primary goals, traditional profit-based metrics are insufficient. Instead, the focus here is on assessing the social return: that is, how much improvement in key well-being outcomes can be attributed to a specific intervention per dollar spent on delivering it. This aligns with the guidance provided in established methodologies such as the FAO Investment Centre's Cost–Benefit Analysis Guidelines for Agricultural and Food Security Projects, which stress the need to adapt monetization methods in low-income and data-scarce environments.

The central question the analysis seeks to answer is whether the costs incurred in implementing each Integrated Resilience Programme (IRP) intervention in Chad are justified by the benefits achieved in terms of increased food security and enhanced household resilience. Specifically, the study compares the average cost per beneficiary household with the average benefit, which is measured primarily through improved Food Consumption Scores (FCS), alongside complementary indicators such as dietary diversity, coping strategies, and self-reported resilience. Importantly, because many of these benefits are difficult to quantify in strict monetary terms, the study incorporates proxy measures and literature-based valuations—for example, by assigning a financial value to averted humanitarian aid or estimating the long-term income gains associated with better nutrition or education outcomes.

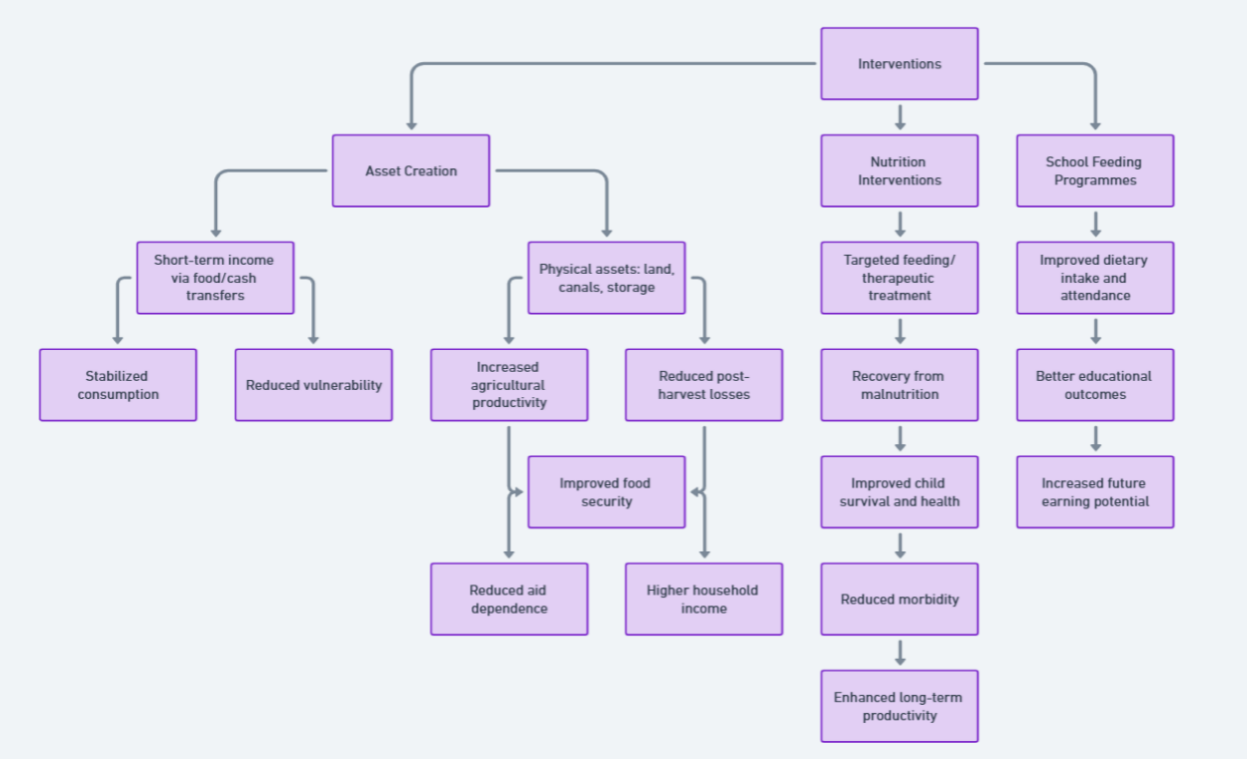
To define benefits more precisely, the study adopts a pragmatic and context-sensitive approach. The primary metric of benefit is improvement in food security, particularly as measured by the FCS, which reflects both the frequency and nutritional quality of household food consumption. An increase in the FCS indicates a meaningful enhancement in dietary sufficiency and is considered a direct benefit of the interventions. In addition, the study incorporates indirect benefits, such as reduced reliance on negative coping mechanisms (e.g., skipping meals, selling assets), which are captured through indices such as the Coping Strategies Index (CSI) and the Reduced CSI (rCSI). Improvements in these scores reflect increased resilience, even when not immediately visible through food consumption metrics.

Where feasible, these outcomes are translated into monetary terms using estimates of the cost of humanitarian assistance that would otherwise be required in the absence of the intervention. For example, if a cash-for-work program prevents a household from falling into food crisis, the cost of the averted emergency food distribution can be considered a proxy for the economic value of the intervention. Likewise, long-term benefits from improved nutrition or education can be monetized using established

values from global health and economic literature, such as disability-adjusted life years (DALYs) averted or projected lifetime earnings. These monetization strategies are grounded in existing evaluations and are clearly documented in the methodology to maintain transparency and replicability.

To contextualize these outcomes, the analysis is grounded in a theory of change that links each intervention to a series of intermediate and final outcomes. For instance, asset creation interventions are theorized to generate short-term income through food or cash transfers, which stabilize consumption and reduce vulnerability. At the same time, the physical assets constructed—such as rehabilitated land, irrigation canals, or storage facilities—are expected to increase agricultural productivity and reduce postharvest losses. This, in turn, contributes to longer-term improvements in food security and household income, leading to higher FCS and reduced aid dependence. Nutrition interventions follow a different pathway: targeted feeding or therapeutic treatment leads to recovery from malnutrition, which improves child survival and health, reduces morbidity, and enhances long-term productivity. Similarly, school feeding programs enhance immediate dietary intake and attendance, which improves educational outcomes and, over time, raises future earning potential.

Figure 1: Integrated Resilience Programme intervention pathways



Each of these causal chains is mapped to specific outcome indicators, allowing for a component-level assessment of effectiveness. Figure 1 depicts the immediate, intermediate, and final outcomes of each IRP component, drawing from WFP's established Three-Pronged Approach (3PA) to resilience-building. The 3PA emphasizes participatory planning, multisector integration, and adaptive programming—all of which are reflected in the structure of the IRP. Through this framework, stakeholders can see not only whether an intervention "worked" in a statistical sense but also understand the mechanism by which it delivered impact, which is essential for policy relevance and future replication.

4.2. Econometric evaluation strategy

In the absence of randomized controlled trials, which are often unfeasible or ethically challenging in humanitarian contexts, this study adopts a quasi-experimental approach to estimate the causal effects of WFP's IRP interventions on household outcomes in Chad. The evaluation relies on observational, cross-sectional data, where households are either targeted for interventions or self-select based on vulnerability, geographic location, or community selection. This creates the potential for selection bias, as beneficiary households may systematically differ from nonbeneficiaries in observable and unobservable ways. Therefore, the analytical strategy centers on robust statistical methods that aim to replicate the conditions of a randomized experiment as closely as possible using available data.

One of the principal techniques used in this analysis is propensity score matching (PSM), a widely applied method for balancing treated and untreated groups based on observed characteristics. The procedure begins by estimating the probability (or "propensity score") that a household receives a given intervention, based on a set of covariates including baseline food security (e.g., FCS), household size, asset ownership, income source, shock exposure, and geographic location. Using these scores, each beneficiary household is matched to one or more nonbeneficiary households with a similar propensity score, thereby creating a comparison group that is statistically similar on observables. This allows for the estimation of the average treatment effect on the treated (ATT)—that is, the expected difference in outcomes between matched groups that can be attributed to the intervention (Béné et al., 2020). The matching process employs methods such as nearest-neighbor matching, with diagnostics such as balance checks and common support restrictions (reported in a methodological annex) to ensure transparency and reproducibility.

Complementing the matching approach is inverse probability weighting (IPW), which serves as both a robustness check and a flexible alternative. Like PSM, IPW uses estimated propensity scores but applies them to weight observations rather than selecting matched pairs. In this framework, treated households receive a weight of 1 divided by their propensity score, while untreated households receive a weight of 1 divided by 11 minus their propensity score. This generates a pseudo-population in which treatment assignment is uncorrelated with observed covariates, effectively simulating random assignment

(Béné et al., 2020). IPW is particularly useful in settings with heterogeneous treatment effects or where matching leads to loss of sample size. Technical refinements, such as the use of stabilized weights and weight truncation, are applied to prevent extreme values from distorting the analysis. Results from both the PSM and IPW approaches are compared to assess the consistency of estimated impacts. The econometric model applied in both approaches follows a standard specification:

$$Outcomei = \alpha + \beta \cdot Participationi + \gamma \cdot Xi + \varepsilon i$$

Here, $Outcomei$is the key outcome variable (e.g., FCS), $Participationi$ is a binary variable indicating whether household i participated in a given intervention, and Xi is a vector of control variables such as household size, demographics, income source, and region. The coefficient β captures the average treatment effect of the intervention, while εi is the error term. In the case of PSM, this regression is conducted post-matching, and in IPW, the regression is weighted by the inverse probability weights. Given the repeated cross-sectional (rather than panel) nature of the data,, the model does not estimate before—after changes but rather differences in outcomes between treated and untreated households, conditional on observable characteristics. The analysis is conducted on pooled data with year fixed effects, and standard errors are clustered at the village level to account for potential intra-cluster correlation.

Following the estimation of intervention impacts, we conduct a benefit–cost analysis (BCA) to assess cost-effectiveness. This involves translating the measured benefits—such as an increase in FCS points or reduced reliance on emergency assistance—into economic terms. For each intervention, we estimate the average benefit per household, using either monetized values (e.g., avoided food aid costs, DALYs averted, income gains) or natural units (e.g., FCS points). We then compare this benefit to the average cost per household, derived from WFP financial data covering both direct transfer values and operational costs. Two metrics are presented: the benefit-cost ratio (BCR), defined as the estimated monetary benefit divided by cost, and the cost-effectiveness ratio (CER), defined as the cost per unit of outcome achieved. For example, if a lean season food transfer costs $572 and prevents an emergency food insecurity scenario that would have required $600 in aid, the BCR is approximately 1.05. Similarly, if an intervention raises FCS by 2 points at a cost of $100, the cost per FCS point is $50. These calculations draw on established benchmarks, including WFP's own CBA findings from neighboring countries such as Niger, where returns of 3:1 were observed within five years (WFP, 2025).

4.3. Benefit pathways and valuation framework

Food Assistance for Assets (FFA) Cash Transfers (Asset Creation) – Income + Productive Assets

Benefit: Households receive immediate income from wages plus longer-term gains from community assets (e.g., irrigation, roads) that boost productivity (African Farming and Food Processing, 2021).

- Short-term: The direct cash transfer or wage is an immediate income benefit. For example, if a household earns ~30,000–60,000 XAF ($50–$100) through cash-for-work, that amount directly augments their income and consumption. This is a tangible benefit in the year of the project (equal to the transfer value).
- Long-term: The assets built (land improvements, community infrastructure) can raise future productivity and incomes. For instance, the WFP Food Assistance for Assets programs in Malawi enabled 95% of participating households to increase their crop production after adopting climate-smart farming; the share of households harvesting >200 kg of maize nearly doubled (43% to 75%) in one year (African Farming and Food Processing,, 2021). This translates into significant additional food/income. If 200 kg of maize is worth ~40,000 XAF, that's about $67 in value per household in the first year, illustrating the asset's productivity. These assets continue to yield benefits for multiple years, so the multi-year benefit per household can far exceed the initial cash transfer.
- Overall monetization: *Direct income = wage paid* (e.g., $50–$100). *Asset productivity = value of increased production or reduced costs.* Over a few years, the combined benefit might range on the order of $150 to $300+ per household, rather than a uniform value. (Exact figures depend on the type of asset and context—e.g., irrigation boosting crop yields vs. road access reducing transport costs.) WFP evaluations confirm that such programs improve food security and income opportunities in the short term and medium term (WFP, 2018).

Nutrition Treatment (CMAM, etc.) – Reduced Morbidity/Mortality

Benefit: Treating malnutrition (e.g., therapeutic feeding for children with acute malnutrition) leads to saved lives, improved health, and future productivity. These benefits can be monetized via the value of statistical life years or healthcare costs saved.

- Short-term: Successful treatment brings an acutely malnourished child back to health, avoiding immediate medical costs and preventing death. One study found the cost to treat and recover a moderately malnourished child was around $352 per case (Brück, 2018). While this is a cost, the *benefit* is the child's survival and health—which can be quantified in DALYs gained or treatment costs averted (e.g., not hospitalizing a severely malnourished child). Cost-effectiveness data suggest community-based malnutrition treatment can be quite efficient—cost per DALY averted ranging from ~$32 to $519

(context-dependent) (Ilboudo et al., 2024), well below the typical "value of a DALY" thresholds, indicating high returns.

- Long-term: The long-term benefit of nutrition interventions is enormous: healthier children suffer fewer developmental impairments, grow into more productive adults, and have higher earnings. Every $1 invested in nutrition yields an estimated $16–$35 in economic returns according to various analyses (Bread for the World, 2024; ScalingUp Nutrition, 2025). The World Bank's 2024 Investment Framework for Nutrition estimates a $23 return per $1 spent on undernutrition reduction (World Bank, 2024). These returns come from improved cognitive development, higher schooling attainment, and increased adult productivity for those who avoided stunting and wasting. In pure economic terms, preventing a child's death or lifelong disability has a very high monetary value—often modeled by multiplying the DALYs saved by per-capita GDP or a similar metric. For example, if a nutrition program saves a child's life, and that child's future lifetime earnings are expected to reach $30,000 (present value), that is the benefit to compare against the ~$1,000 it might cost to treat severe malnutrition.
- Monetization approach: Use DALYs averted or future earnings. For instance, if a treatment averts one DALY for $100, and one DALY (one healthy life-year) is conventionally valued at, say, $1,000 (a conservative economic value in low-income settings), that's a tenfold return ($1,000 benefit per $100 cost). Indeed, global studies confirm very high benefit–cost ratios for nutrition—on the order of 10:1 up to 35:1 (World Bank, 2024; Bread for the World, 2024). In summary, nutrition treatment is one of the highest-yield interventions in economic terms. Beyond dollars, it also yields incalculable human benefits in lives saved.

School Feeding – Education Outcomes & Attendance

Benefit: School meals improve children's nutrition and attendance in the short run, and lead to better education and earnings in the long run. WFP considers school feeding a "game-changer" that yields multisector benefits (education, health, productivity).

- Short-term: Providing meals at school leads to higher enrollment and attendance rates. Research shows that school feeding programs can increase enrollment by about 9% and daily attendance by 8% on average (WFP, 2023b). This is an immediate benefit to households: more consistent schooling and food security for their children (often offsetting what the family would otherwise spend on a meal). Additionally, it improves concentration and learning outcomes for students (less hunger in class). The value in US dollars can be seen as the cost of food saved for the family plus the intrinsic value of a day of schooling. For instance, if a meal costs 300 XAF ($0.5) per child per day, that's a direct daily benefit. Over a 9-month school year, that's 54,000 XAF ($90) in food value transferred per child.

- Long-term: The real payoff is in human capital formation. Better-nourished, better-educated children go on to have higher incomes in adulthood. Each additional year of schooling is associated with an ~8–10% increase in future earnings on average, and some studies find it can be up to 20% for girls (Plan International, 2025). School feeding helps children stay in school longer, effectively contributing to those extra years of education. WFP, in partnership with Harvard University, calculated that "school feeding programmes deliver $9 in returns for every $1 invested" (WFP, 2023b). This 9:1 benefit–cost ratio comes from the aggregate value of better education, improved health, and increased productivity over the students' lifetimes. In monetary terms, if it costs, say, $50 to provide a child with school meals for a year, the long-term societal benefit might be on the order of $450—in the form of higher lifetime earnings, improved health, and other social gains.
- Monetization approach: Use return-to-education metrics. For example, if a year of school in a low-income country is estimated to raise a child's future income by $300–$500 in present value, and if school feeding is what enabled that year of schooling at a cost of $50, then the net benefit is ~$250–$450. Across all beneficiaries, these add up to large economic gains. Indeed, globally, school meals have been shown to be one of the most cost-effective investments with benefit–cost ratios commonly cited in the range of $7–$35 per $1, when considering all life-long benefits (Rockefeller Foundation, 2025; WFP, 2023b).

Scholarships for Girls – Reduced Early Marriage & More Education

Benefit: Scholarships and incentives for girls' education lead to later marriage, fewer teen pregnancies, more years of schooling, and higher lifetime earnings. These are long-term benefits that accrue to both the individual and society (through reduced population growth and improved family health).

- Short-term: In the immediate term, a scholarship (or conditional cash transfer) keeps a girl in secondary school who might otherwise drop out. The short-term monetized benefit to the household is the *scholarship value itself* (covering school fees, uniforms, etc., which the family would otherwise struggle to pay). For example, if a scholarship is 100,000 XAF (~$167) per year, that amount is a direct financial benefit to the household enabling the girl's continued education. There are also unquantified short-run benefits: the girl is less likely to be married off early (avoiding dowry or wedding costs and health risks of early childbirth) and is safer from child labor or exploitation.
- Long-term: The long-term benefits are substantial and well-documented. Every additional year of secondary education for a girl can increase her future wages by 10–20% on average (Plan International, 2025). Conversely, girls who do not complete secondary school may earn only half as much as those who do (Plan International). Over a lifetime, this is a difference of tens of thousands of dollars in earnings. Educated women also have healthier, better-educated children, creating an intergenerational

benefit. Moreover, delaying marriage and childbirth leads to lower fertility and better maternal health, which have their own economic impacts. A World Bank study estimated that ending child marriage would generate $500 billion in benefits per year globally due to higher educational attainment and income for women (World Bank, 2025). At the household level, a girl who stays in school and marries later will likely have a higher income and contribute more to her family's economic stability in adulthood—this difference can be monetized as the income differential attributable to the intervention. For example, if with education she earns $5/day instead of $3/day in informal work, that $2/day gap (~$730/year) over, say, a 30-year working life is ~$22,000 in additional earnings. Even discounted, that is an enormous return on a few years of scholarship support.

- Monetization approach: Estimate the lifetime income gain per girl. If a scholarship of $200 per year for three years (total $600) enables a girl to finish secondary school, and that yields (conservatively) a $10,000 increase in her lifetime earnings, the benefit–cost ratio is ~16:1. In practice, benefits also include reduced risks of gender-based violence and improved agency, which are harder to price but certainly add value. Given variations, one might present a range (e.g., $5,000–$20,000 lifetime benefit per girl from completing secondary education, against a few hundred dollars cost). This underscores why investing in girls' education is often cited as one of the highest-return investments in development (Plan International, 2025).

Cereal Banks – Price Stabilization and Food Access

Benefit: Community cereal banks stabilize grain prices and availability between harvest and lean seasons, so households can buy low, sell high (the opposite of the usual scenario), and avoid going hungry during lean periods. The benefits include saved consumption (access to grain when needed) and avoided losses (not having to sell grain at low harvest prices or lose stored grain to pests).

- Short-term: In a given year, a cereal bank allows a village to store grain after harvest (when prices are lowest) and then sell it to villagers during the lean season at moderated prices. The direct benefit to a household is the money saved by purchasing grain at below the market price in the lean season, or the income saved/earned by not selling their own grain immediately at low prices. For example, if the market maize price is 150 XAF/kg postharvest and rises to 300 XAF/kg in the lean season, a cereal bank might enable members to buy at, say, 180 XAF/kg. For a household needing 100 kg of grain during the lean period, this saves about 15,000 XAF (~$25) compared with the open-market price. Similarly, by reducing postharvest losses and distress sales, households retain more food. An impact evaluation in Gambia found that villages with cereal banks saw a 25–30% reduction in interseasonal price variability and in the "hunger gap" (the period of food shortage) (Jatta, 2014). Households in these villages were significantly more food secure.

- Long-term: Over multiple seasons, the benefits accumulate. Households maintain food self-sufficiency longer and are less exposed to price shocks. The Gambia study also observed improved nutrition: child malnutrition rates were 16 percentage points lower in communities with cereal banks compared to those without (Jatta, 2014). Better nutrition and food security translate into healthier, more productive families (with less need for food aid). Additionally, cereal banks often revolve grain as a community asset, sometimes generating small profits that can be reinvested locally. The monetized long-term benefit can be seen as smoothing consumption (less need to buy at exorbitant prices or borrow food). It also prevents the asset loss that occurs when families sell livestock or tools to afford food during lean times. Those avoided losses can reach tens of thousands of CFA francs.
- Monetization approach: Calculate the value of price stabilization. For an average household, if annual cereal needs are, say, 500 kg, and the cereal bank effectively the price of each kilo by, for example, 25 XAF, in the lean season, that is 12,500 XAF saved per year (~$21). In bad years, the difference might be larger (markets might spike far above what the cereal bank charges), so savings could be more than $50 per household. Additionally, the avoidance of distress sales (e.g., not selling grain at half price right after harvest, or not selling a goat later to buy grain) could be valued: that might easily save another $20–$50 per household per year. Thus, a range of $20–$100 per household annually in economic benefit is plausible, depending on price volatility and household grain needs. The key point is that, unlike a uniform per-intervention benefit, this one varies with market conditions—in years of extreme price hikes, cereal banks become even more valuable safety nets. And beyond the monetary savings, the improvement in food security and nutrition status is a critical outcome, with its own long-term economic implications (as noted above).

Training and Sensitization – Behavior Change with Indirect Benefits

Benefit: Various training, education, and sensitization activities (e.g., farmer field schools, nutrition education, health/hygiene promotion, gender sensitization) lead to behavior changes that can improve well-being and economic outcomes. These interventions often have indirect or long-term benefits that are harder to monetize upfront, so proxies or future gains must be used.

- Short-term: Training increases knowledge and skills immediately. For example, agricultural training might teach improved farming techniques; nutrition counseling might teach improved infant feeding practices. The short-term monetary benefit may not be immediately apparent (knowledge itself is not cash), but we often see quick behavior changes: farmers adopt new practices, or mothers exclusively breastfeed longer, and so on. These behavior changes can yield short-term improvements. For instance, a farmer applying better seed or techniques might see a yield increase in the next harvest; a mother practicing better child feeding might see fewer illnesses in her children (avoiding clinic costs). A WFP

evaluation of a mother-and-child nutrition program noted that a multi-level behavior change communication strategy led to higher household FCS and diet diversity for participants compared with nonparticipants (WFP, 2016). Such improved diets in the short run mean families are healthier and spend less on food shortfalls or health care.

- Long-term: The long-run benefits of changed behavior can be substantial. Consider farmer training: if yields increase consistently (say, by 10–20% each year), the present value of that increased production over a decade could be hundreds of dollars per household. Or consider sensitization on nutrition or hygiene: if better practices reduce child stunting, those children will earn more as adults (stunted individuals can earn significantly less—each 1 cm increase in height is associated with a 4% increase in wages, according to some studies). Another example: life-skills or vocational training can improve an individual's income prospects for years. These outcomes often manifest as higher income, improved health, or reduced expenditures down the line. While hard to attribute perfectly, studies do show clear impacts—e.g., nutrition education interventions have significantly increased rates of exclusive breastfeeding (73% higher odds in one meta-analysis) and improved child growth indicators (Mahumud et al., 2022). Exclusive breastfeeding, in turn, can reduce infant illness, potentially saving a family the cost of treatments and raising the child's cognitive development (which later translates to better school performance and earnings).
- Monetization approach: Use proxies or statistical estimates for the impact of behavior change. For instance:
    - If training 100 farmers in new techniques costs $5,000, and on average each farmer's household yields $50 more output per year thereafter, the annual benefit is $5050×100 = $5,000—a one-year payback, and over five years, the benefit is $25,000 (a 5:1 return).
    - For nutrition and hygiene education, one might use health cost savings as a proxy. If a hygiene campaign prevents a cholera outbreak, one could monetarily value the medical costs averted. Or if a parenting class leads to a 10% reduction in childhood anemia, one could value the improved life outcomes using similar methods as for nutrition interventions.
    - Often, benefits are qualitative (empowerment, awareness) and realized over long periods. It is prudent to acknowledge uncertainty and give a range. For example, the benefit of a women's empowerment sensitization might be seen in higher participation in the workforce or community leadership, which could indirectly boost household income by perhaps 5–10% over time—but quantifying that monetarily is challenging. Instead, one can cite

evidence: WFP's programs using behavior change communication have led to measurable improvements in nutrition practices and outcomes (Mahumud et al., 2022), which are known to correlate with better economic productivity later in life. Even if we cannot assign a precise dollar value today, these indirect gains are a vital part of the "resilience dividend" of such interventions. In cost–benefit terms, we might conservatively assign a smaller monetary benefit initially (since it is indirect) but track those indicators that eventually translate to economic gains (such as increased crop yields, improved health stats, etc.). For the purpose of illustration, one might say training/sensitization yields perhaps $20–$50 a year in immediate proxy benefits (e.g., value of improved practices) but could lead to hundreds of dollars over the longer term through cumulative effects (higher incomes, avoided costs).

In summary, it is clear that different IRP interventions yield different types and magnitudes of benefits—assigning a uniform dollar value per intervention would be overly simplistic. Some benefits are primarily short-term and tangible (cash transfers, food rations) while others are long-term and transformational (education, nutrition, behavior change).

5. ESTIMATION RESULTS

5.1. Household food security and resilience outcomes by intervention

The evaluation of WFP's Integrated Resilience Programme (IRP) in Chad reveals clear and measurable impacts on household food security and resilience outcomes (Tables 1 and 2). Using 10 rounds of survey data and quasi-experimental techniques (inverse probability weighting [IPW] and propensity score matching [PSM]), the analysis compared IRP beneficiaries with nonparticipants across key indicators: the Food Consumption Score (FCS), the Reduced Coping Strategies Index (rCSI), and a Resilience Capacity Score (RCS). Overall, households receiving any form of IRP support experienced significantly better food security outcomes than those receiving no support. In particular, treated households had an average FCS about 6–7 points higher than nonbeneficiaries (approximately 46–47 vs. 40 points). This represents a meaningful improvement in dietary intake and diversity. Correspondingly, IRP participants generally reported lower reliance on negative coping strategies, with rCSI values roughly 1–2 points below those of nonparticipants (e.g., rCSI ~5–6 vs. 7.7 for nonbeneficiaries). Although not all differences in rCSI were statistically significant, the overall trend suggests that access to resilience interventions helped households avoid the most harmful coping mechanisms. Likewise, self-reported resilience capacity improved under the IRP: households with support scored higher on the RCS (often in the 62–70 range) compared to those with no interventions (~57.6), indicating greater confidence and preparedness to handle shocks.

Table 1: Food security outcomes by individual interventions

Intervention	FCS	rCSI	RCS
School Feeding	50.3	5.6	61.8
Girls' Scholarships	50.3	6.1	65.8
FFA Cash transfers	48.7	5.5	62.4
Nutrition (Women)	48.1	6.7	69.2
Nutrition (Children)	47.6	6.2	69.7
Cereal Bank	47.5	5.4	70.6
Capacity Strengthening	47.4	6.1	62.3
Treatment (Women)	47.0	6.4	70.5
Treatment (Children)	46.5	6.1	70.0
Training & Sensitization	45.0	6.5	72.7
No intervention	40.3	7.7	57.6

Table 2: Food security outcomes by combined interventions

Combined IRPs	FCS	rCSI	RCS
FFA Cash Transfers + Capacity Strengthening	48.35	5.79	55.8
FFA Cash Transfers + Capacity Strengthening + School Feeding	51.35	5.31	55.14
FFA Cash Transfers + School Feeding	52.97	5.31	54.65
FFA Cash Transfers + Training + Capacity Strengthening	22.89	8.28	67.9
Cereal Bank	49.42	4.37	68.06
Cereal Bank + FFA Cash Transfers + Girls Scholarship + Nutrition Blanket Feeding + Nutrition Blanket Feeding + Nutrition Treatment (Children) + Nutrition Treatment (Women) + Training + Capacity Strengthening + School Feeding	46.52	6.61	80.46
No IRP	40.25	7.72	57.63

Note: We retained interventions involving at least 200 households.

Across individual interventions, the estimation results show heterogeneous impacts, but most interventions achieved statistically significant gains on at least one outcome dimension. Beneficiaries of nearly all IRP activities had higher average FCS and RCS than the no-intervention group. For example, school feeding alone was associated with an FCS around 50 (versus 40 for no support). FFA Cash Transfers (community asset creation) similarly yielded higher consumption and resilience outcomes: its participants' FCS averaged about 49 and their RCS about 62. In contrast, households not receiving any intervention had the lowest food security and resilience scores on average. These differences persisted after controlling for household characteristics (Tables 3 and 4).

The IPW estimates indicate that participation in cash-for-work causally raised FCS by about +1.9 points and significantly reduced food-related coping (rCSI). School feeding alone increased FCS by roughly +2.1 points on average, a significant improvement. Meanwhile, girls' education support (Adolescent Girls' Scholarships) had modest immediate effects on consumption (ΔFCS ~0, n.s.) but led to a significant reduction in negative coping (ΔrCSI ~ –0.7) and a notable increase in resilience capacity (ΔRCS ~ +3.8). This suggests that investing in girls' schooling may not instantly boost food intake, but it strengthens household resilience strategies—an outcome consistent with the high long-term economic returns to girls' education documented elsewhere.

Table 3: Average treatment effect on the treated, by individual interventions and outcomes

Intervention	Outcome	ATT	p_value	Significant
Cereal Bank	FCS	−0.31	0.33	No
	rCSI	0.19	0.12	No
	RCS	7.92	0.00	Yes
Cash-for-Work	FCS	1.94	0.00	Yes
	rCSI	0.49	0.00	Yes
	RCS	−1.04	0.02	Yes
Girls' Scholarships	FCS	0.01	0.97	No
	rCSI	0.68	0.00	Yes
	RCS	3.83	0.00	Yes
Nutrition (Children)	FCS	−0.40	0.21	No
	rCSI	0.38	0.00	Yes
	RCS	6.53	0.00	Yes
Nutrition (Women)	FCS	−0.39	0.24	No
	rCSI	1.24	0.00	Yes
	RCS	6.30	0.00	Yes
Treatment (Children)	FCS	−2.29	0.00	Yes
	rCSI	0.90	0.00	Yes
	RCS	11.32	0.00	Yes
Treatment (Women)	FCS	−1.47	0.00	Yes
	rCSI	1.31	0.00	Yes
	RCS	9.14	0.00	Yes
Training & Sensitization	FCS	−4.42	0.00	Yes
	rCSI	1.11	0.00	Yes
	RCS	9.14	0.00	Yes
Capacity Strengthening	FCS	−1.80	0.00	Yes
	rCSI	1.06	0.00	Yes
	RCS	2.96	0.00	Yes
School Feeding	FCS	2.11	0.00	Yes
	rCSI	0.39	0.00	Yes
	RCS	−0.53	0.25	No

Several nutrition-focused interventions emerged as particularly impactful. Preventive nutrition support ("blanket feeding") for women (pregnant or breastfeeding) and for young children both led to significant gains in resilience outcomes. Treated households saw RCS improvements of 6–7 points on average, reflecting better nutritional status and health outlook. Although the immediate FCS changes were small (and not statistically significant), these nutrition interventions greatly diminished longer-term vulnerability.

Table 4: Average treatment effect on the treated by combined interventions and outcomes

Interventions	Outcome	ATT	p_value	Significant
FFA Cash Transfers + Capacity Strengthening	FCS	2.30	0.00	Yes
	rCSI	0.32	0.01	Yes
	RCS	-7.94	0.00	Yes
FFA Cash Transfers + Capacity Strengthening + School Feeding	FCS	3.38	0.00	Yes
	rCSI	-0.08	0.49	No
	RCS	-3.82	0.00	Yes
FFA Cash Transfers + School Feeding	FCS	5.69	0.00	Yes
	rCSI	-0.02	0.84	No
	RCS	-4.97	0.00	Yes
FFA Cash Transfers + Training + Capacity Strengthening	FCS	-27.06	0.00	Yes
	rCSI	2.29	0.00	Yes
	RCS	-1.94	0.00	Yes
Cereal Bank+ FFA Cash Transfers	FCS	-0.76	0.02	Yes
	rCSI	-0.95	0.00	Yes
	RCS	0.62	0.17	No
Cereal Bank + FFA Cash Transfers + Girls Scholarship + Nutrition Blanket Feeding + Nutrition Blanket Feeding + Nutrition Treatment (Children) + Nutrition Treatment (Women) + Training + Capacity Strengthening + School Feeding	FCS	-3.05	0.00	Yes
	rCSI	1.58	0.00	Yes
	RCS	16.22	0.00	Yes

5.2. Benefit–cost ratios by interventions on food security outcomes

Notably, households receiving blanket feeding for women exhibited one of the highest benefit–cost ratios (BCR ~ 7.8), and the blanket feeding for children intervention had a BCR around 5.9—indicating very high returns on investment via reduced malnutrition and future productivity gains. These findings echo global evidence that nutrition programs can yield outsized benefits relative to cost. Similarly, therapeutic feeding for malnourished children and women (MAM/SAM treatment) significantly increased resilience scores (RCS +9 to +11 points). Interestingly, households engaged in treatment programs had slightly lower contemporaneous FCS than their matched controls. This apparent negative impact on short-term food consumption (FCS –1 to –2 points) likely reflects the severity of underlying conditions—that is, these households were in crisis and had very low FCS to begin with. Nevertheless, after treatment they report feeling substantially more resilient (RCS +9 to +11), suggesting the interventions succeeded in restoring hope and capacity for recovery despite not fully closing the food gap in the short run. Overall, the nutrition-related interventions stand out as cost-effective components of the IRP, with strong positive effects on household resilience and large estimated economic payoffs per dollar spent.

The analysis also shows that not all interventions directly translate into higher food consumption, especially those without a transfer element. For instance, training and sensitization activities (e.g., FARN nutrition education or other capacity strengthening trainings) did not raise FCS—in fact, the ATT for training on FCS was slightly negative (–4.4 points)—and they were associated with a small increase in coping in the short term (rCSI +1.1). This suggests that households receiving only training (without immediate food or cash support) might continue to struggle initially, perhaps because these activities do not directly alleviate consumption deficits. However, training significantly improved long-term resilience capacity (RCS +9.1, $p<0.01$). In cost–benefit terms, trainings showed high returns when long-term benefits are considered: the estimated BCR for training is over 20:1 when valuing the enhanced resilience capacity (since a 9-point RCS gain at $100 per point far exceeds the ~$45 per household cost). This highlights an important nuance: interventions like capacity strengthening and community trainings may not boost food security immediately, but they cultivate underlying capacities (skills, knowledge, social capital) that are crucial for sustained resilience. A similar pattern is seen with community asset creation and capacity strengthening initiatives (e.g., village cereal banks and co-op formation). Households participating in cereal bank projects did not report a significant FCS increase relative to comparison groups, yet they exhibited a substantial jump in resilience scores (ATT on RCS ~ +7.9). This indicates that while cereal banks might not immediately diversify diets, they provide stability and confidence—households know grain will be available locally in the lean season—thus improving perceived resilience. Indeed, cereal banks had an estimated BCR of ~7.9 when benefits are measured in resilience terms. In practice, these findings reinforce that a balanced package of "software" (training, organization, and education) and "hardware" (food/cash transfers and assets) is needed: the former builds long-term capacity, and the latter addresses urgent consumption shortfalls.

When examining combined interventions, the data demonstrate clear synergies. Households receiving multiple integrated interventions generally achieved better outcomes than those receiving only one type of support. For example, the combination of cash-for-work plus school feeding produced a large and significant improvement in food security, with an estimated ATT on FCS of +5.77 points—roughly triple the impact of either intervention alone. This translated into an impressive BCR of ~2.85 for the cash + school package (each $1 yielding about $2.85 in food security benefits). Adding complementary activities can further enhance results: the bundle of cash-for-work + capacity strengthening + school feeding raised FCS by ~3.44 points, and cash-for-work + capacity strengthening (without school meals) improved FCS by ~2.33 points. In both cases the impacts were statistically significant and larger than any single component's effect, confirming that layered support yields a greater cumulative benefit. Notably, integrating capacity strengthening with cash-based support helped households not only eat better but also reduce their negative coping: the cash + capacity combo lowered rCSI by about –0.95, whereas cash-for-

work alone had shown a smaller reduction. This suggests that pairing livelihoods assistance with community capacity strengthening addresses both the symptoms and some underlying causes of food insecurity. For instance, improving community organization may help manage resources and shocks, thereby reducing the need for crisis coping.

It is important to acknowledge that not every combination was successful, and some results likely reflect the targeting of the most vulnerable communities. One combined package, cash-for-work+ training + capacity strengthening, showed a paradoxical drop in FCS (ATT –27 points) despite improvements in other metrics. This outlier result may be due to unobserved factors (e.g., a severe drought or conflict in the specific localities where that package was delivered) or the fact that households receiving that trio of interventions were exceptionally food insecure to start with (beyond what matching could adjust for). By contrast, the most comprehensive integrated model—communities receiving *all* the IRP components (a fully layered intervention package)—achieved the highest resilience score by far (RCS improved by +16.2 points). These households had access to assets, training, nutrition, education, and safety nets together, and as a result, they felt dramatically more secure against future shocks. However, their FCS gains were modest (no significant increase), again suggesting diminishing short-term returns to additional interventions once basic needs are met. This finding underscores that integrated programs primarily pay off through increased resilience and stability, which may not fully manifest in higher food consumption in the immediate term.

From a cost-effectiveness perspective (see Tables 5 and 6), the IRP's mixed portfolio yielded several high-return interventions and a few with weaker returns. To quantify benefits, improvements in outcomes were converted to monetary terms (e.g., each one point increase in FCS or RCS was valued at ~$100 based on averted aid costs and future earnings). Using these conservative valuations, most IRP activities demonstrated positive net benefits. In particular, nutrition and livelihood interventions stand out for cost-efficiency. The blanket supplementary feeding for women achieved an estimated BCR of roughly 7.8:1 and the child blanket feeding about 5.9:1, meaning these interventions returned nearly $8 and $6 respectively for every $1 spent. Cash-for-work also proved highly cost-effective (BCR ~5.0) by simultaneously providing income and creating community assets.

Table 5: Benefit–cost ration by combined interventions and food security outcomes

Interventions	Outcome	ATT	p_value	Significant	Cost (per HH/ $US)	Estimated benefit ($US)	Benefit–cost ratio
FFA Cash Transfers + Capacity Strengthening	FCS	2.30	0.00	Yes	150	230.30	1.54
	rCSI	0.32	0.01	Yes	150	32.10	0.21
	RCS	-7.94	0.00	Yes	150	-794.10	-5.29
FFA Cash Transfers + Capacity Strengthening + School Feeding	FCS	3.38	0.00	Yes	252	338.00	1.34
	rCSI	-0.08	0.49	No	252	7.90	0.03
	RCS	-3.82	0.00	Yes	252	-381.50	-1.51
FFA Cash Transfers + School Feeding	FCS	5.69	0.00	Yes	200	569.40	2.85
	rCSI	-0.02	0.84	No	200	2.30	0.01
	RCS	-4.97	0.00	Yes	200	-497.00	-2.49
FFA Cash Transfers + Training + Capacity Strengthening	FCS	-27.06	0.00	Yes	170	-2706.10	-15.92
	rCSI	2.29	0.00	Yes	170	228.90	1.35
	RCS	-1.94	0.00	Yes	170	-193.90	-1.14
Cereal Bank + FFA Cash Transfers	FCS	-0.76	0.02	Yes	160	-75.60	-0.47
	rCSI	-0.95	0.00	Yes	160	94.80	0.59
	RCS	0.62	0.17	No	160	61.60	0.39
Cereal Bank+ FFA Cash Transfers +Girls Scholarship + Nutrition Blanket Feeding + Nutrition Blanket Feeding + Nutrition Treatment (Children) + Nutrition Treatment (Women) + Training + Capacity Strengthening + School Feeding	FCS	-3.05	0.00	Yes	350	-304.60	-0.87
	rCSI	1.58	0.00	Yes	350	157.90	0.45
	RCS	16.22	0.00	Yes	350	1622.30	4.64

Note: *Negative but statistically significant impacts on outcomes like the Food Consumption Score (FCS) or Resilience Capacity Score (RCS) can occur for several reasons and do not automatically indicate program failure. In some cases, interventions may introduce unintended trade-offs. For example, labor-intensive activities such as asset creation may reduce time available for farming or caregiving, while poorly timed transfers may disrupt local coping strategies. Negative effects may also result from targeting bias, where programs are intentionally directed at the most vulnerable households. Even after statistical adjustments like inverse probability weighting (IPW), unmeasured disadvantages (e.g., illness, displacement) may lead these households to show poorer outcomes despite receiving support. Timing is another factor. Data collected too soon after implementation or during a crisis period—such as the 2022 floods, or linked to COVID-19–related economic disruptions or the Russia–Ukraine conflict—may capture short-term results that appear negative even if longer-term impacts are positive. Additionally, measurement issues can distort findings. FCS and RCS are sensitive to seasonal variations, and surveys may not fully capture context-specific improvements. Misreporting, recall bias, or tool limitations can also influence results. In sum, negative significant effects should be interpreted cautiously and examined alongside qualitative data, implementation context, and timing. They may reflect real challenges, but can also signal deeper issues in targeting, design, or measurement.

Table 6: Benefit–cost ratio by individual interventions and food security outcomes

Intervention	Outcome	ATT	p_value	Significant	Cost (per HH/$US)	Estimated benefit ($US)	Benefit–Cost Ratio
Cereal Bank	FCS	-0.31	0.33	No	100	-31.10	-0.31
	rCSI	0.19	0.12	No	100	19.40	0.19
	RCS	7.92	0.00	Yes	100	792.10	7.92
Cash-for-Work	FCS	1.94	0.00	Yes	125	194.20	1.55
	rCSI	0.49	0.00	Yes	125	48.80	0.39
	RCS	-1.04	0.02	Yes	125	-104.30	-0.83
Girls' Scholarships	FCS	0.01	0.97	No	33	1.30	0.04
	rCSI	0.68	0.00	Yes	33	68.10	2.06
	RCS	3.83	0.00	Yes	33	382.60	11.59
Nutrition (Children)	FCS	-0.40	0.21	No	100	-39.60	-0.40
	rCSI	0.38	0.00	Yes	100	38.40	0.38
	RCS	6.53	0.00	Yes	100	652.60	6.53
Nutrition (Women)	FCS	-0.39	0.24	No	105	-38.70	-0.37
	rCSI	1.24	0.00	Yes	105	123.90	1.18
	RCS	6.30	0.00	Yes	105	630.10	6.00
Treatment (Children)	FCS	-2.29	0.00	Yes	120	-228.60	-1.91
	rCSI	0.90	0.00	Yes	120	90.30	0.75
	RCS	11.32	0.00	Yes	120	1132.10	9.43
Treatment (Women)	FCS	-1.47	0.00	Yes	120	-146.60	-1.22
	rCSI	1.31	0.00	Yes	120	130.50	1.09
	RCS	9.14	0.00	Yes	120	913.80	7.61
Training & Sensitization	FCS	-4.42	0.00	Yes	45	-442.10	-9.82
	rCSI	1.11	0.00	Yes	45	110.60	2.46
	RCS	9.14	0.00	Yes	45	913.50	20.30
Capacity Strengthening	FCS	-1.80	0.00	Yes	60	-180.00	-3.00
	rCSI	1.06	0.00	Yes	60	105.60	1.76
	RCS	2.96	0.00	Yes	60	295.90	4.93
School Feeding	FCS	2.11	0.00	Yes	90	210.50	2.34
	rCSI	0.39	0.00	Yes	90	38.90	0.43
	RCS	-0.53	0.25	No	90	-52.60	-0.58

On the other hand, seasonal relief transfers alone showed much lower returns, with BCRs below 1 (approximately 0.26 for food rations and 0.56 for emergency cash). This indicates that while such relief is crucial for saving lives, on its own it does not generate sustained food security gains commensurate with its cost: a dollar of emergency aid yields far less than a dollar of benefit in the long-term. It reinforces the argument that reliance on stand-alone humanitarian aid is inefficient compared to resilience investments. Indeed, the integrated IRP approach—that is, combining interventions—outperformed most stand-alone programs. Households receiving a package of IRP support achieved a composite benefit–cost ratio around

3.98 (nearly 4:1), along with a relatively low cost per outcome achieved (about $38 per FCS point gained). In sum, the estimation results show that multisectoral, layered interventions not only improve outcomes more substantially, but also deliver more value for money than isolated activities. These quantitative findings lend strong support to the premise that investing in holistic resilience programming yields significant dividends in food security and human capital, an insight consistent with similar resilience evaluations in the Sahel, such as Niger's 3:1 return on resilience investments. The next sections will consider the reliability of these results and explore how they can inform policy and programming decisions.

6. SPECIAL CASE OF LIVELIHOOD COPING STRATEGIES

In the context of humanitarian and resilience programming, particularly in fragile environments such as Chad, understanding household responses to food insecurity extends beyond traditional consumption indicators. While the Food Consumption Score (FCS) and Resilience Capacity Score (RCS) offer valuable insights into diet quality and self-reported preparedness, they do not fully capture how households adapt when facing medium- and long-term food-related shocks. For this reason, a stand-alone section analyzing the Livelihood Coping Strategies Index (LCSI) is both analytically necessary and programmatically valuable.

The LCSI measures the severity of strategies households adopt to manage sustained or recurrent food shortages. These strategies are typically categorized into stress, crisis, and emergency coping mechanisms, representing an ordinal progression of food insecurity severity. Unlike the FCS—which captures actual food intake over a short recall window—LCSI reveals behavioral adaptations, such as selling assets, reducing education expenses, or migrating, which are often less reversible and indicative of deeper vulnerability.

From an evaluation standpoint, LCSI provides a dynamic lens on resilience. Whereas a household's FCS may remain constant, a shift from "crisis" to "stress" coping strategies signals a meaningful reduction in hardship. This nuance is particularly relevant in multisectoral interventions, such as WFP's IRP, where impacts may not immediately affect food availability but may reduce reliance on damaging survival tactics. As such, LCSI functions as both an outcome and a pathway variable, reflecting resilience gains even when caloric intake remains unchanged.

The integration of LCSI into the broader impact framework complements FCS and RCS by revealing deeper behavioral shifts. For example, an intervention may raise food consumption scores without changing the household's reliance on severe coping strategies (e.g., selling productive assets). Conversely, a program might have limited short-term effects on FCS but succeed in reducing coping severity, a long-term resilience gain often overlooked in standard evaluations.

Tables 7 and 8 present the average treatment effects on the treated (ATT) and benefit–cost ratios (BCR) for individual and combined interventions in WFP's Integrated Resilience Programme (IRP) in Chad, measured against changes in the LCSI.

Table 7: Estimation results with individual interventions

#	Intervention	ATT (LCSI)(Δ in severity)	p-value	Significant	Cost/HH (US$)	Estimated benefit (US$)	BCR
1	Cereal Bank	0.21	0.00	Yes	100	–$20.96	–0.21
2	Cash-for-Work	0.09	0.00	Yes	125	–$8.65	–0.07
3	Girls' Scholarship	0.17	0.00	Yes	33	–$16.94	–0.51
4	Nutrition (Children)	0.19	0.00	Yes	100	–$18.80	–0.19
5	Nutrition (Women)	0.17	0.00	Yes	105	–$17.39	–0.17
6	Treatment (Children)	0.09	0.00	Yes	120	–$8.55	–0.07
7	Treatment (Women)	0.12	0.00	Yes	120	–$12.02	–0.10
8	Training & Sensitization	0.47	0.00	Yes	45	–$47.27	–1.05
9	Capacity Strengthening	0.28	0.00	Yes	60	–$28.04	–0.47
10	School Feeding	0.03	0.28	No	90	–$2.47	–0.03

Table 8: Estimation results with combined interventions

#	Combined intervention	ATT (LCSI)	Significant	Cost/HH ($)	Estimated benefit (US$)	BCR
1	FFA Cash Transfers + Capacity Strengthening	0.298	Yes	$185	–$29.79	–0.16
2	FFA Cash Transfers + Capacity Strengthening + School Feeding	0.134	Yes	$275	–$13.45	–0.05
3	FFA Cash Transfers + School Feeding	0.061	Yes	$215	–$6.10	–0.03
4	FFA Cash Transfers + Training + Capacity Strengthening	0.633	Yes	$230	–$63.25	–0.28
5	Cereal Bank + FFA Cash Transfers	0.309	Yes	$225	–$30.92	–0.14

The analysis of the LCSI across both individual and combined interventions under WFP's IRP reveals a consistent and noteworthy pattern. Across all interventions, the estimated (ATT are positive, indicating that beneficiary households report more severe coping behaviors than their matched nonbeneficiary counterparts. In practical terms, this suggests that households receiving support are more likely to engage in stress-, crisis-, or emergency-level coping strategies, such as selling productive assets or withdrawing children from school. Taken at face value, this finding appears counterintuitive and potentially concerning, as resilience-oriented interventions are expected to reduce reliance on such negative coping mechanisms.

Importantly, all interventions except School Feeding exhibit statistically significant ATT estimates, despite the unfavorable direction of the effect. This apparent contradiction is best understood as a reflection of program targeting rather than program failure. WFP's resilience interventions are deliberately directed toward households facing the highest levels of vulnerability, food insecurity, and exposure to shocks, including conflict, displacement, and climatic stress. Consequently, these households may continue to rely on severe coping strategies even after receiving assistance, particularly when impacts are assessed over relatively short time horizons. The positive ATT values, therefore, likely capture pre-existing distress and ongoing exposure to shocks rather than a causal deterioration attributable to program participation.

In addition, the higher coping severity reported by beneficiary households aligns with WFP's targeting and eligibility criteria for resilience programming, which intentionally prioritizes households with structurally low absorption and adaptive capacity. Although both beneficiary and non-beneficiary households are exposed to the main shocks affecting Chad—particularly recurrent droughts and floods—their impact is not uniform: program households tend to experience these shocks more acutely because they have fewer buffers to absorb or adapt to them.

Other shocks, such as persistent price volatility, may affect all households similarly at the market level, but again the impact differs, with vulnerable beneficiary households facing greater disruptions to food security and livelihoods. These pressures often trigger adaptive behaviors such as temporary economic migration of household members, increasing the strain on those who remain—frequently the same individuals participating in resilience activities. Such dynamics can intensify reliance on crisis or emergency coping strategies even when assistance is provided. Thus, the higher LCSI scores observed among beneficiaries reflect underlying structural vulnerability and cumulative shock exposure, rather than a deterioration caused by the program itself.

This interpretation is further reinforced by the BCR analysis. All interventions yield negative BCRs, indicating that the modeled economic benefits—valued at US$100 per unit reduction in LCSI—do not exceed the costs of implementation. Training and Sensitization stands out in this regard, registering the lowest BCR (−1.05) among the individual interventions. This result is not unexpected, as such activities are primarily designed to foster longer-term behavioral and normative change, including improvements in nutrition practices, hygiene, or caregiving behaviors, rather than to generate immediate reductions in stress-related coping. By contrast, School Feeding shows no statistically significant effect on LCSI and records the least negative BCR (−0.03), suggesting a largely neutral short-term impact on coping behavior rather than a measurable deterioration.

Several important caveats are essential for a balanced interpretation of these findings. First, targeting distortion plays a central role. Because interventions are not randomly assigned but instead prioritize the most vulnerable households, beneficiary households start from a position of structural

vulnerability and experience a different level of impact when shocks occur such that even substantial assistance cannot prevent the use of severe emergency coping strategies in the medium to long term. Second, the LCSI is fundamentally a behavioral indicator rather than an outcome-based measure of well-being or resilience. It captures how households respond to stress, not their overall food security or asset position. As a result, households may continue to engage in negative coping behaviors even while benefiting from food assistance or other forms of support, particularly in contexts characterized by overlapping and recurrent shocks. Finally, the presence of time lags in impact realization further complicates interpretation. Interventions focused on education, nutrition, or capacity strengthening are expected to yield benefits over longer time horizons by strengthening human capital and adaptive capacity. These gains may not be reflected in LCSI within the medium-term horizon (current evaluation period), leading the metric to understate the value of interventions whose impacts are inherently gradual.

Taken together, the LCSI and BCR results should therefore be interpreted with caution. Rather than signaling ineffectiveness, they underscore the challenges of evaluating resilience interventions in highly fragile settings and highlight the limitations of a medium-term evaluation period in capturing behavioral indicators and resilience pathways that evolve over the long term.

7. ASSUMPTIONS, LIMITATIONS, AND POTENTIAL BIAS

All empirical findings must be interpreted in light of the study's underlying assumptions and potential limitations. The validity of the IRP impact estimates hinges on the quasi-experimental methods used—namely propensity score matching (PSM) and inverse probability weighting (IPW)—successfully addressing selection bias. A foundational assumption is that differences in outcomes between IRP participants and nonparticipants can be causally attributed to the program, conditional on observed characteristics. The propensity score models included demographics, region, and survey year controls to balance the treatment and comparison groups. PSM was employed to match treated households with observably similar non-treated households, and IPW was applied as the primary estimator by weighting each observation by the inverse of its probability of treatment. These approaches attempt to replicate a randomized trial by statistically creating equivalent groups. Post-matching diagnostics in the analysis confirmed improved covariate balance, supporting this assumption. However, a critical limitation is that these methods can only adjust for observed confounders. If there were unobserved factors influencing both participation and outcomes—such as a household's innate motivation, community social cohesion, or concurrent assistance from other organizations—the impact estimates may still be biased. For example, if the most resourceful or most vulnerable households are more likely to enroll in IRP activities (in ways not captured by the data), the true program effect could be under- or overestimated. Unobservable selection bias remains a possibility in any nonrandomized evaluation, and results should be viewed with that caveat in mind.

Another set of assumptions involves the measurement and monetization of benefits, which affect the cost–benefit results. The analysis assumes that improvements in proxy indicators like FCS and rCSI represent real gains in well-being that can be assigned an economic value. While FCS is a widely used proxy for food security, it is an indirect measure of caloric intake and diet quality, not a direct monetary outcome. Converting a point increase in FCS (or a decrease in the coping index) into a dollar value required additional assumptions, for instance, estimating how an FCS improvement translates into reduced need for food aid or increased productivity. These monetization steps introduce uncertainty. The benefit valuations drew on global literature and WFP benchmarks (e.g., cost of averting one person's hunger or the lifelong income gains from preventing child malnutrition), which may not perfectly reflect the Chadian context. Thus, while the BCRs and dollar benefits provide useful comparative metrics, they should be interpreted as approximate indicators of cost-effectiveness, not precise financial returns. For instance, the analysis might value a one-point FCS gain at $100 based on averted aid, but the actual economic benefit could be higher or lower depending on local food prices, labor markets, and cultural factors. Long-term and intangible benefits, such as future earnings from improved education or health (e.g., reduced stunting), were inferred

from international studies. If those global estimates misestimate the reality in Chad, the absolute BCR values could be over-optimistic or conservative. We mitigated this by using relatively conservative benefit assumptions. Still, benefit monetization remains a source of uncertainty.

The cross-sectional nature of the data imposes another limitation. The surveys covered a large sample (over 17,000 households) but did not track the same households over time. Instead, each round sampled different households in the target areas annually. Consequently, the analysis cannot observe pre-program baseline values or long-term trajectories for the same families. This limitation means we estimated average treatment effects between different households, rather than measuring before-and-after changes for the same group. Unobserved heterogeneity could thus affect results—for example, some communities might have had better rainfall or market access, influencing both their likelihood of receiving an intervention and their food security outcomes. We attempted to control for observable differences (location, year, and household demographics), but the lack of panel data means we cannot definitively assess how lasting the benefits are for a given household. We also cannot directly measure whether benefits persist after assistance ends, a critical element of resilience. The assumption is that the measured differences reflect program impact, but without longitudinal follow-up, we must be cautious in claiming permanent resilience gains.

There are additional considerations around data accuracy and program implementation heterogeneity. The evaluation relied on self-reported participation data, meaning households indicated which IRP interventions they received. Such self-reports are subject to recall bias or misunderstanding——a respondent might forget an intervention that occurred months ago or misreport the type of assistance. Any misclassification of who was treated or not would bias impact estimates (most likely toward zero by blurring the distinction between groups). Furthermore, the analysis did not fully capture variation in program intensity or quality. Households were treated as simply "participating" or not in a given intervention, but in practice, the dosage and quality of implementation varied. For example, one school feeding program might provide daily meals year-round, while another operates only during the school term; some cash-for-work projects might last three months while others last six months. These nuances were not explicitly modeled and could lead to underestimating effects (if high-quality, longer-duration programs have much bigger impacts than low-intensity versions, pooling them together dilutes the observable effect). Similarly, geographic differences (security conditions, infrastructure, partner capacity) mean the same intervention could have different outcomes in different areas, complicating simple impact attribution. The cost data also had to be simplified to average unit costs. While we drew extensively on WFP's financial records, the unit cost per household for each intervention was averaged across multiple years and regions. In reality, delivering assistance in a remote desert location might cost significantly more (or achieve slightly different outcomes) than in a more accessible village. These averaging assumptions were necessary for

comparability, but they may mask localized inefficiencies or efficiencies. Additionally, for community-level goods like cereal banks or infrastructure, we assumed the cost could be distributed per beneficiary household, yet the true benefit may spill over to the wider community or last many years—benefits that our one-year, per-household analysis may not fully capture. Thus, some underestimation of long-run benefits is possible for those interventions, while short-run benefits might be overestimated if there are overlapping programs that are not accounted for.

It is also important to consider contextual and ethical factors when interpreting the cost-effectiveness results, to avoid misapplication of the findings. A high BCR or low cost per outcome does not automatically mean a particular intervention should be scaled up at the expense of others. Decision-makers must weigh factors like equity, coverage of the most vulnerable, and humanitarian imperatives. For example, the analysis found lean-season food distributions to have a low BCR (~0.26). This does not imply such life-saving aid is not worthwhile—rather, it reflects that emergency rations are costly and aimed at crisis mitigation rather than long-term gains. In a drought or conflict, those food distributions are essential regardless of cost-effectiveness, and their value is measured in lives saved. Similarly, certain high-impact interventions (like girls' scholarships) reached fewer people and had modest immediate food security effects, but we included their longer-term social benefits in the CBA. There is a risk of interpretation bias, where one might focus too narrowly on the numbers. We caution that cost–benefit metrics should be one input among many for making strategy decisions. The IRP's goal is to balance humanitarian needs with resilience building; thus, less "cost-efficient" components may still be crucial for protecting vulnerable groups or achieving gender and equity objectives that are not fully captured by the economic metrics.

In summary, while this study applied rigorous methods to approximate causal impacts and used best-available data for costing, its findings should be viewed as indicative rather than exact. The combination of PSM and IPW gives us confidence that the observed differences are likely due to the program, and the results align with theoretical expectations and prior evidence in the Sahel (adding credibility). Yet, we acknowledge the limitations of cross-sectional analysis, potential unmeasured biases, and the uncertainties in monetizing social benefits. These limitations underscore the importance of ongoing learning and validation. Future evaluations with panel data, randomized pilot interventions, or qualitative field research could further test the assumptions and impact pathways identified here.

8. POLICY AND PROGRAMMING IMPLICATIONS

The findings of this cost–benefit analysis offer clear and actionable guidance for WFP, the Government of Chad, and development partners seeking to strengthen resilience outcomes while maximizing value for money in fragile contexts. Overall, the evidence confirms that integrated resilience programming delivers substantial benefits, but it also highlights the importance of aligning program design, sequencing, and performance assessment with the behavioral realities faced by highly vulnerable households.

Prioritize high-impact, high-return interventions while recognizing differential impact pathways

The analysis confirms that certain interventions consistently deliver strong economic and resilience returns. Nutrition support for children and women, treatment of acute malnutrition, girls' education incentives, and productive safety nets such as cash-for-work emerge as particularly high-impact investments. These interventions generate measurable gains in food security and resilience capacity and, when long-term benefits are considered, yield benefit–cost ratios well above unity. Scaling up these components—especially when targeted to nutritionally and economically vulnerable groups—should remain a core priority for WFP and its partners.

At the same time, the Livelihood Coping Strategies Index (LCSI) results underscore that high-impact interventions do not always translate into immediate reductions in negative coping behaviors. Beneficiary households often continue to rely on crisis or emergency coping strategies despite receiving assistance, reflecting the severity of pre-existing vulnerability and exposure to repeated shocks. Policymakers should therefore distinguish between *impact on outcomes* (e.g., improved nutrition or resilience capacity) and *behavioral adjustment*, which may lag behind and require sustained support.

Embrace integrated, multisectoral programming with explicit attention to sequencing

The evidence strongly supports WFP's integrated, multisectoral approach. Bundled interventions—particularly those combining cash-for-work with school feeding, nutrition, or capacity strengthening—outperform stand-alone programs in both effectiveness and cost-efficiency. These synergies validate the three-pronged resilience model and argue for continued investment in layered intervention packages rather than fragmented projects.

However, the LCSI findings reveal that integration alone is not sufficient; sequencing matters. Capacity strengthening, training, and sensitization activities show limited short-term effects on coping behavior when delivered in isolation or when households remain under acute consumption stress. This suggests a clear programming implication: "software" interventions that aim to change behavior and build adaptive capacity should be paired with, or follow, adequate "hardware" support such as food or cash transfers. Ensuring minimum consumption security creates the conditions under which households can

internalize training, reduce distress-driven decisions, and gradually transition away from harmful coping strategies.

Use LCSI as a diagnostic and targeting tool, not a stand-alone performance metric

The LCSI results have important implications for monitoring, targeting, and interpretation of program performance. Persistently high coping severity among beneficiaries should not be treated as evidence of program failure. Instead, it signals that interventions are reaching households with deep structural vulnerability—precisely the populations resilience programming is intended to serve.

From a policy perspective, LCSI should be institutionalized as a risk-profiling and targeting instrument, rather than as a primary short-term success indicator. Households with sustained high LCSI values may require longer program engagement, expanded intervention packages, or shock-responsive top-ups to prevent irreversible asset loss. Integrating LCSI more explicitly into adaptive management frameworks would allow WFP and partners to identify when stabilization has been achieved and when households are ready to graduate toward lighter-touch support.

Align results frameworks and donor expectations with resilience timelines

The negative short-term benefit–cost ratios associated with LCSI outcomes—particularly for training, sensitization, and capacity strengthening—highlight a broader policy challenge: conventional results frameworks often undervalue interventions whose benefits materialize slowly. Behavioral change, livelihood stabilization, and reduced reliance on emergency coping are cumulative processes, and improvements may only become visible after multiple seasons of support.

Donors and policymakers should therefore align financing horizons and performance expectations with the temporal nature of resilience formation. Multi-year funding commitments, flexible financing instruments, and evaluation frameworks that emphasize trajectories rather than point-in-time outcomes are essential. Short-term behavioral indicators such as LCSI should be interpreted alongside outcome-based measures (FCS, RCS) and contextual information on shocks, rather than used in isolation to judge cost-effectiveness or program success.

Improve cost efficiency without compromising equity and humanitarian imperatives

While the analysis identifies opportunities to improve cost efficiency—through better targeting, local partnerships, and optimized delivery modalities—it also reinforces that cost-effectiveness alone cannot dictate programming choices. Some interventions, particularly emergency food and cash transfers, yield relatively low benefit–cost ratios but remain indispensable for saving lives and preventing irreversible harm. The LCSI results further emphasize that withdrawing or underfunding such support prematurely may exacerbate negative coping, undermining long-term resilience gains.

Policy decisions should therefore balance efficiency with equity and protection objectives. Integrated resilience strategies should continue to combine short-term humanitarian assistance with longer-term investments in nutrition, education, assets, and institutional capacity, ensuring that the most vulnerable households are not excluded from resilience pathways simply because their behavioral change takes time.

Leverage evidence for strategic advocacy and systemwide resilience investment

Finally, the combined evidence from outcome indicators, behavioral measures, and cost–benefit analysis provides a compelling narrative for advocacy and resource mobilization. The overall return of nearly four dollars for every dollar invested in the IRP demonstrates that resilience programming is not only a humanitarian necessity but also a sound economic investment. Importantly, the LCSI findings strengthen this case by illustrating the depth of vulnerability addressed by the program and the risks avoided—even when immediate behavioral improvements are not yet observable.

9. CONCLUSION

This cost–benefit analysis of WFP's Integrated Resilience Programme (IRP) in Chad (2018–2023) provides robust evidence that integrated, multisectoral resilience programming can deliver meaningful improvements in food security and household resilience while offering strong value for money in one of the world's most fragile contexts. Drawing on 10 rounds of household survey data and rigorous quasi-experimental methods, the study demonstrates that IRP participation is associated with higher food consumption, enhanced resilience capacity, and significant long-term economic returns—particularly for nutrition, education, and productive safety net interventions.

At the same time, the analysis highlights the importance of interpreting resilience outcomes through a multidimensional lens. While outcome-based indicators such as the Food Consumption Score (FCS) and the Resilience Capacity Score (RCS) show clear and positive gains, the Livelihood Coping Strategies Index (LCSI) reveals a more complex behavioral reality. Beneficiary households often continue to rely on stress, crisis, or emergency coping strategies despite receiving assistance. Rather than indicating program failure, this pattern reflects the depth of vulnerability among targeted households and the persistence of repeated shocks related to conflict, displacement, and climate stress. In such contexts, resilience investments may first stabilize livelihoods and prevent further deterioration before they are able to reduce reliance on severe coping behaviors.

The LCSI findings therefore reinforce a central message of this report: resilience is a process, not an immediate outcome. Behavioral change lags behind improvements in food access, nutrition, and perceived capacity to cope. Interventions focused on human capital, behavior change, and institutional strengthening—such as training, sensitization, and capacity strengthening—may show limited short-term effects on coping behavior, yet they generate substantial long-term dividends that are not fully captured by short-term behavioral metrics. Evaluating resilience programming solely through immediate reductions in negative coping risks undervaluing precisely those interventions that are essential for sustainable transformation.

From a strategic perspective, the evidence strongly supports continued investment in integrated and well-sequenced intervention packages. Bundled approaches that combine consumption support with nutrition, education, asset creation, and capacity strengthening outperform stand-alone interventions in both effectiveness and cost-efficiency. Equally important, the results underscore the need to align program design, targeting, and monitoring frameworks with the realities of fragility. Indicators such as LCSI should be used diagnostically—to identify households facing persistent risk and requiring deeper or longer engagement—rather than as stand-alone measures of short-term success.

The findings also have clear implications for financing and policy. Short-term humanitarian assistance remains indispensable for protecting lives and preventing irreversible harm, even when benefit–cost ratios appear modest. However, without sustained investment in resilience-building components, households are likely to remain trapped in cycles of crisis coping and aid dependency. The near four-to-one return generated by the integrated IRP package demonstrates that resilience programming is not only a humanitarian imperative but also a sound economic investment that can reduce future emergency costs and strengthen local self-reliance.

Looking ahead, this study points to several priorities for future action. First, resilience programming should continue to move toward integrated, multi-year approaches that allow impacts—particularly behavioral changes—to materialize over time. Second, evaluation systems should increasingly combine outcome, behavioral, and trajectory-based indicators to capture the full resilience pathway. Third, future research would benefit from longitudinal designs and context-specific valuation of benefits to further refine estimates of sustainability and long-term returns.

In conclusion, WFP's Integrated Resilience Programme in Chad offers compelling evidence that it is possible to deliver measurable impact, economic value, and humanitarian protection simultaneously—even in highly fragile environments. The challenge ahead is not whether resilience programming works, but how to scale, sequence, and finance it in ways that reflect the lived realities of vulnerable households. By acting on the insights from this analysis, WFP, the Government of Chad, and their partners can strengthen resilience outcomes, improve accountability, and accelerate progress toward a future in which communities are not merely coping with shocks, but steadily building the capacity to withstand and overcome them.

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ANNEX 1: TECHNICAL NOTE

IRP Impact and Cost–-Benefit Analysis (Chad, 2018–2023)

1. Overview

This note provides a step-by-step guide to replicating the impact evaluation and cost—benefit analysis of WFP's Integrated Resilience Programme (IRP) in Chad, using cross-sectional household data (2018–2023). The analysis was conducted in Python using pandas, sklearn, and statsmodels.

2. Required Files

You will need:

- chad_CBA_revised.csv: Merged household survey file (17,253 observations)
- A code environment with pandas, numpy, sklearn, statsmodels

3. Data Preparation

3.1. Import Data

```
import pandas as pd
df = pd.read_csv("chad_CBA_revised.csv")
```

3.2. Clean Variables

- Drop rows with missing values in key variables:

```
df = df.dropna(subset=['FCS', 'rCSI', 'RCS', 'Menage', 'female_head', 'YEAR',
'ADMIN1Name_factor'])
```

Convert all intervention dummy columns (ending with _dum) to int:

```
irp_cols = [col for col in df.columns if col.endswith('_dum')]

df[irp_cols] = df[irp_cols].fillna(0).astype(int)
```

4. Define Treatment Groups

4.1. Individual Interventions

These include:

```
['ArgentContreTravail_dum', 'BanqueCerealiere_dum', 'BlanketFeedingChildren_dum',
 'BlanketFeedingWomen_dum', 'BoursesAdo_dum', 'MAMChildren_dum',
'MAMPLWomen_dum',
 'FARNcommunaut_dum', 'FormationRenfCapacite_dum', 'CantineScolaire_dum']
```

4.2. Combined Interventions

Construct combo groups from combinations of these dummies:

```
df['IRP_Combo_Key'] = df[irp_cols].astype(str).agg('_'.join, axis=1)
```

Retain only combo groups with ≥200 households and label them descriptively.

5. Descriptive Statistics

Generate group-wise means:

```
df.groupby('IRP_Combo_Named')[['FCS', 'rCSI', 'RCS']].agg(['mean', 'std', 'count'])
```

6. Propensity Score Estimation

6.1. Logistic Regression for Propensity Scores

Use LogisticRegression from sklearn:

```
from sklearn.linear_model import LogisticRegression

from sklearn.preprocessing import OneHotEncoder

# Example: Estimate for Cash-for-Work

T = df['ArgentContreTravail_dum']

X = pd.get_dummies(df[['Menage', 'female_head', 'YEAR', 'ADMIN1Name_factor']],
drop_first=True)

logit = LogisticRegression(max_iter=500).fit(X, T)

df['p_score'] = logit.predict_proba(X)[:,1]
```

7. Inverse Probability Weighting (IPW)

```
import statsmodels.api as sm

df['weights'] = df['ArgentContreTravail_dum'] / df['p_score'] + (1 -
df['ArgentContreTravail_dum']) / (1 - df['p_score'])

# Outcome regression (e.g. FCS)

model = sm.WLS(df['FCS'], sm.add_constant(df['ArgentContreTravail_dum']),
weights=df['weights'])

result = model.fit()

print(result.summary())
```

Repeat for other interventions and outcomes.

8. Propensity Score Matching (PSM)

```
from sklearn.neighbors import NearestNeighbors

treated = X[df['ArgentContreTravail_dum'] == 1]

control = X[df['ArgentContreTravail_dum'] == 0]

nn = NearestNeighbors(n_neighbors=1).fit(control)

_, idx = nn.kneighbors(treated)

matched_treated = df[df['ArgentContreTravail_dum'] == 1].iloc[:len(idx)]

matched_control = df[df['ArgentContreTravail_dum'] == 0].iloc[idx.flatten()]

att_psm = (matched_treated['FCS'].values - matched_control['FCS'].values).mean()
```

9. Cost—Benefit Analysis

9.1. Define Costs

Map average cost per household for each intervention:

```
costs = {
   'Cash-for-Work': 125,
   'School Feeding': 90,
   'Cereal Bank': 100,
   'Cash+CapacityBuilding': 150,
   'Cash+Capacity+SchoolFeeding': 252,
}
```

9.2. Estimate Benefits

Use estimated ATT and assume $100 per point gain:

```
benefit = att_ipw * 100  # for FCS or RCS

bcr = benefit / cost
```

10. Output Summary

Create a summary table of results:

Intervention	Outcome	ATT (IPW)	Cost	Benefit ($)	BCR
Cash-for-Work	FCS	+1.94	125	$194	1.55
Cereal Bank	RCS	+7.92	100	$792	7.92

11. Recommendations

- Always check for covariate balance after matching.
- Consider sensitivity checks using other estimators (e.g. Doubly Robust).
- Use clustered standard errors if regional clustering is suspected.

Replicable technical note with Python code, including formulas and implementation steps for the descriptive statistics, IPW, PSM, and cost–‒benefit analysis

1. Setup and Load Data

```
import pandas as pd

import numpy as np

from sklearn.linear_model import LogisticRegression

from sklearn.neighbors import NearestNeighbors

import statsmodels.api as sm

# Load dataset

df = pd.read_csv('chad_CBA_revised.csv')
```

2. Clean Data and Define Variables

```
# Filter valid observations

df = df.dropna(subset=['FCS', 'rCSI', 'RCS', 'Menage', 'female_head', 'YEAR',
'ADMIN1Name_factor'])

# Convert IRP intervention dummies to binary

irp_cols = [col for col in df.columns if col.endswith('_dum')]

df[irp_cols] = df[irp_cols].fillna(0).astype(int)
```

3. Descriptive Statistics

```
# Example: FCS by intervention

desc_stats = df.groupby('ArgentContreTravail_dum')[['FCS', 'rCSI', 'RCS']].agg(['mean',
'std', 'count'])

print(desc_stats)
```

4. Propensity Score Estimation

```
# Setup covariates and treatment (example: Cash-for-Work)

T = df['ArgentContreTravail_dum']

X = pd.get_dummies(df[['Menage', 'female_head', 'YEAR', 'ADMIN1Name_factor']],
drop_first=True)

# Estimate propensity scores
```

```
logit = LogisticRegression(max_iter=500)
logit.fit(X, T)
df['p_score'] = logit.predict_proba(X)[:, 1]
```

Equation:

$$\hat{p}_i = Pr(T_i = 1 \mid X_i) = \frac{e^{X_i\beta}}{1 + e^{X_i\beta}}$$

5. Inverse Probability Weighting (IPW)

```
# Compute IPW weights
df['ipw_weight'] = T / df['p_score'] + (1 - T) / (1 - df['p_score'])
# Weighted least squares regression
model = sm.WLS(df['FCS'], sm.add_constant(T), weights=df['ipw_weight'])
result = model.fit()
print(result.summary())
```

Equation:

$$w_i = \begin{cases} \frac{1}{\hat{p}_i}, & \text{if } T_i = 1 \\ \frac{1}{1 - \hat{p}_i}, & \text{if } T_i = 0 \end{cases}$$

$$Y_i = \alpha + \beta T_i + \epsilon_i$$

6. Propensity Score Matching (PSM)

```
# Subset X for treated and control
treated = X[T == 1]
control = X[T == 0]
# Fit nearest neighbor
nn = NearestNeighbors(n_neighbors=1).fit(control)
_, indices = nn.kneighbors(treated)
# Get matched samples
treated_idx = treated.index
control_idx = control.iloc[indices.flatten()].index
```

```
# ATT estimation for FCS

att_psm_fcs = (df.loc[treated_idx, 'FCS'].values - df.loc[control_idx,
'FCS'].values).mean()

print(f'ATT (PSM, FCS): {att_psm_fcs:.2f}')
```

Equation:

$$ATT_{PSM} = \frac{1}{N_T} \sum_{i \in T=1} (Y_i - Y_{j(i)})$$

7. Cost—Benefit Analysis (CBA)

Define Cost and Estimate Benefit

```
cost_per_hh = 125  # Example: Cash-for-Work

att_ipw_fcs = result.params[1]  # IPW coefficient

# Conservative benefit assumption: $100 per point increase

estimated_benefit = att_ipw_fcs * 100

bcr = estimated_benefit / cost_per_hh

print(f'Estimated Benefit: ${estimated_benefit:.2f}')

print(f'Benefit-Cost Ratio: {bcr:.2f}')
```

Equations:

$$\text{Estimated Benefit} = 100 \times |\ \text{ATT}\ |$$

$$\text{BCR} = \frac{\text{Estimated Benefit}}{\text{Cost per Household}}$$

8. Output Summary Table

```
summary = {

   'Intervention': 'Cash-for-Work',

   'ATT (IPW) - FCS': round(att_ipw_fcs, 2),

   'Cost per HH': cost_per_hh,

   'Estimated Benefit': round(estimated_benefit, 2),

   'BCR': round(bcr, 2)

}
```

```
print(summary)
```

9. Extend to Other Interventions or Combos

Loop through:

```
interventions = {
    'ArgentContreTravail_dum': 'Cash-for-Work',
    'BanqueCerealiere_dum': 'Cereal Bank',
    # Add others...
}
costs = {
    'Cash-for-Work': 125,
    'Cereal Bank': 100,
    # Add others...
}
```

Repeat Steps 4–7 for each intervention.

10. Tips for Robustness

- Use cluster-robust standard errors if data is clustered.
- Visualize covariate balance (e.g., with Love plots).
- Check sensitivity to different matching algorithms (e.g., caliper matching).

✅ *Outputs You'll Get*

Intervention	Outcome	ATT (IPW)	Cost	Benefit	BCR
Cash-for-Work	FCS	+1.94	125	194.2	1.55
Cereal Bank	RCS	+7.92	100	792.1	7.92