Sustain Sudan
Impact Report 2025



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Executive summary

The war in Sudan has disrupted food production and supply chains, threatening the livelihoods of millions since 15 April 2023. The Sustain Sudan project was designed to contribute towards restoring local food production by increasing fertilizer and improved seed supply and facilitating increased access and use by farmers. These goals are pursued using a market-based approach that supports private sector–led fertilizer and seed imports, local seed production, and distribution. This is coupled with demand – and supply – side financing and strengthened advisories to improve input use efficiency. Since its inception in July 2025, the project intervened in three main ways.

First, the project supported four private sector partner agrodealers (General Energy, WAS Trading Co Limited, CTC Group, and Nutri Crop) with input sourcing. This included identification of suppliers, contracting, and shipping arrangements. Second, the project intervened to strengthen last-mile distribution and supported the discharge of inputs at port Sudan, bagging, and transportation to various last mile points. The project provided logistical and security support as needed to facilitate distribution through five models: integrated supply, managed schemes, commercial bank sales, microfinance sales, and retail agrodealers. Lastly, the project used innovative finance models to crowd-in private sector investments to re-establish agricultural input supply chains. On the supply side, the project used letters of credit, grants and credit guarantees among other instruments to unlock structural liquidity constraints and enable international fertilizer suppliers to trade. Parallel demand-side channels were employed, each tailored to a distinct farmer segment. The project incentivized the Agricultural Bank of Sudan (ABS) that deployed government-backed credit to lend project supported fertilizers to irrigation farmers in major irrigation schemes including New Halfa. In addition, the project provided a funded loan facility to the Al Ebdaa Microfinance Institution, which onward lent to targeted smallholder farmers. Farmers who accessed project supported inputs are considered beneficiaries.

Through these interventions, and working closely with four Sudanese agrodealers, the project facilitated the importation of 48,500 metric tons (MT) of fertilizers (diammonium

phosphate (DAP), Urea-46, and ammonium sulfate (AS)) and 5,200 MT of seed potato into Sudan for the 2025 winter season. This fertilizer quantity imported with support from the Sustain Sudan project accounted for approximately 86% of total national 2025 winter season fertilizer imports given depressed imports at the time. Whereas the project-supported inputs reached 11 out of 18 States in Sudan, this assessment was conducted specifically in Kassala, Khartoum and River Nile States. Kassala State hosts the New Halfa Scheme where 12,500 MT of project-linked fertilizers (approximately 25%) were distributed through ABS, enabling the reopening of credit lines to smallholders after years of inaction since the start of the war. Khartoum and River Nile States were the loci for Irish potato production activities during the 2025 winter season, where the project supported the distribution of 4,000 MT of fertilizer and 5,200 MT of seed potato. This report assesses the extent to which these interventions improved crop yield, farmer incomes, and food security outcomes. We also estimate the number of farmers reached, assess the project contributions to wheat and potato production, and model the projected additional food production contribution to closing the food deficit.

The assessment combined project beneficiary monitoring from 8,000 farmers, potato yield cut assessments representative of about 100 acres and a detailed wheat household survey of 490 farmers including 316 project beneficiaries and 174 non-beneficiaries as control group. We find statistically significant differences between project beneficiaries and non-beneficiaries in terms of wheat and potato yields, and food security outcomes. Wheat yields among project beneficiaries were on average 596 kg/ha or 27% higher than for non-beneficiaries. This difference is statistically significant. Since non-beneficiaries also used fertilizer as is common for winter wheat production in Sudan, we also compared beneficiary yields to those under traditional systems. The project beneficiary wheat yields were 1,189kg/ha or 74% higher than the average wheat yields with limited fertilizer use under traditional production systems.[1] This last comparison has not been used for further impact

[1] https://www.afdb.org/en/success-stories/farmers-cultivate-wheat-and-hope-avert-food-crisis-sudan-87898 (Accessed 22 May 2025)

calculations but is relevant going forward as the fertilizer supply to the control group through WFP is not scalable due to budget constraints.

Beneficiaries had a three-fold potato yield gain (18.8 t/ha compared to 6.3 t/ha among non-beneficiaries) mainly because beneficiaries received both improved seed and fertilizers. This comparison is relevant because WAS Agrico, the value chain manager, would not have been able to source any inputs without the support and de-risking provided by Sustain Sudan. All (100%) of the beneficiaries were food secure compared to 42% among non-beneficiaries. In addition, project beneficiaries had about USD 526 more annual household income than non-beneficiaries, but the statistical significance dissipates after controlling for other variables in a multivariate regression framework. Among beneficiaries, female-headed households benefited more than male-headed households. The positive effects are expected given that the project beneficiaries used higher quantities and better quality of fertilizers than non-beneficiaries, and a higher proportion accessed credit and complementary advisory and extension services. The yield gains are much higher without fertilizer use in the non-beneficiary sample.

Overall, the project contributed substantially to national wheat and Irish potato production during the 2025 winter season in Sudan. The project directly reached an estimated 101,144 farmers and made large and significant contributions to national crop production. In terms of wheat, project interventions contributed to about 101% of the national production and covered about 126% of the total area under wheat during the 2024/2025 season. We used the 2024/2025 data for comparison as the most recent available national statistics. This increased production has extended the recovery trends in agriculture production systems in Sudan in the last few years. For example, wheat production increased by 130% between 2023/2024 and 2024/2025. The potato interventions contributed about 65% of the national annual production and covered 40% of the total area under potato production relative to the 2024/2025 statistics. These overall reach and production results are a testament of the significant contributions of the Sustain Sudan project to local food production during the 2025 winter season in Sudan.

The project comprised USD 6.3 million in financial investment, including USD 4.7 million in financial incentives (finance, de-risking and price support) facilitating 53,700 MT of inputs (fertilizer and seed potato). This investment covered only a small portion of the total input cost; farmers and importers paid the remaining 90%+ at market prices. The average investment per ton of inputs was USD 117, and the donor cost per additional ton of net food produced was USD 9.6. In comparison, direct food aid costs USD 1,000–1,300 per ton delivered. As such, the Sustain Sudan project investment of about of USD 117 per ton of input is 8 – 11 times lower than direct donor funded fertilizer purchase, and the USD 9.6 per ton of additional food is 104 – 156 times lower than food aid. These figures indicate that a market-based approach can be used to maximize donor return on investment; they do not claim that the total economic cost of producing a ton of grain is USD 9.6.

The collapse of agricultural finance is a critical bottleneck for the recovery of agriculture in Sudan. The Agriculture Bank of Sudan ceased operations from April 2023 to November 2025, and commercial banks halted agricultural lending. The Sustain Sudan project explores the options to establish a EUR 90 million "finance facility" de-risking fund with EUR 10 million first loss from donors, which is deemed imperative to unlock credit, facilitate and sustain agricultural recovery.

The positive results from this assessment demonstrate the impact of a market-led agricultural intervention in an active conflict setting. The project played a significant catalytic role in de-risking private sector and facilitated imports through various financing mechanisms both on the demand and supply sides. Another pathway the project facilitated increased farmer access to fertilizer is through its contribution to lowering fertilizer prices at the time the imports arrived in Sudan. These results demonstrate that the Sustain Sudan project contributed to the positive outcomes of the 2025 winter season. Future studies can develop long-term and statistically representative panel surveys to capture impacts over time and to estimate the reach of interventions. The table below provides a succinct summary of the key results.

Altogether, the additional food produced because of our interventions in winter 2025 equaled 34% of the national food gap (in weight) and 29.4% of the gap (in kCal). These calculations are based on the actual measured yields and on a few conservative assumptions (wheat yields set against a control group also using fertilizers; total production corrected for 30% exports and for Food Loss and Waste along the chain). We believe therefore that these results provide strong proof of concept for the market-based approach.

Indicator	**Result 2025**	**Method**	**Stat. sign.**	**Comments**
Fertilizer imported	48,500 Mt	Measured 100%	Y	
Seed potato imp.	5,200 Mt	Measured 100%	Y	
Agrodealers	4	Measured 100%	Y	
Suppliers	3	Measured 100%	Y	
Fin. Institutions	3	Measured 100%	Y	
Distribution mod.	5	Measured 100%	Y	
Beneficiaries	101,144	Calculated		
Wheat avg. farm size	2.1 ha	Measured mngd. scheme	Y	
Potato avg. farm size	2.2 ha	Literature		
Wheat area	197,131 ha	Calculated		
Potato area	16,000 ha	Calculated		
Wheat yield	2.79t/ha, +/+ 27%	Sampling	Y	WFP control group
Wheat yield	+/+ 74%	Calculated		Industry average
Potato yield	18.8t/ha, +/+ 198%	Sampling	Y	Mean differences
Wheat income	+/+ USD 526/ha	HH survey		Mean differences
Potato income	+/+ USD 7,500/ha	HH survey		Mean differences
Wheat food security	100% (+/+ %)	HH Survey	Y	Farmers food sec.
Potato food security	100% (+/+ 48%)	HH Survey	Y	Farmers food sec.
Wheat Δ production	497,558 Mt	Calculated		
Potato Δ production	259,200 Mt	Calculated		
Food gap red. net	34%	Calculated weight		30% export, FLW
Food gap red. net	29.4%	Calculated kCal		30% export, FLW
Urea price delta	-/- 45%	IFPRI/CIMMYT data		During sales
DAP price delta	-/- 12%	IFPRI/CIMMYT data		During sales

Table of Contents

Executive summary ..... *i*

List of Tables ..... *viii*

List of Figures ..... *ix*

1. Introduction *1*

2. The Sustain Sudan project inventions: what, why and how? *3*

3. Methodology *6*

3.1 Study area **6**

3.2 Data sources **6**

3.2.1 Beneficiary monitoring data 7

3.2.2 Irish potato yield cut assessment procedures. 7

3.2.3 Household survey data 8

3.3 Data analysis **9**

3.3.1 Estimating project reach and contributions to wheat and potato production 11

3.3.2 Projected impact analytical framework 11

4. Results *13*

4.1 Crops grown during the 2025 winter season. **13**

4.2 Potato yield performance **13**

4.3 Gross income from potato production **14**

4.4 Overall potato intervention impact **15**

4.5 Wheat survey results **16**

4.5.1 Household demographics and farm characteristics 16

4.5.2 Input use and correlates of input use and outcomes 18

4.5.3 Benefits of the Sustain Sudan project among beneficiaries. 21

4.5.4 Mean outcomes comparison by beneficiaries 23

4.5.5 Wheat yields across beneficiaries and gender 24

4.5.6 Household income across beneficiaries and gender **25**

4.6 Impacts of project interventions on food security and welfare **26**

4.7 Project reach and contributions to crop production **28**

4.8 Projected impacts on net food production **30**

4.8.1 2025 winter season net food production based on survey data **30**

4.8.2 Contribution to closing the national food deficit **30**

4.8.3 Cost-effectiveness analysis **31**

4.8.4 Projected scale-up for context (2026–2027) 32

4.9 Project effects on fertilizer prices 33

5. Discussion 35

6. Limitations 39

7. Conclusion and implications 40

Acknowledgments 45

References 46

Annexes: Project Impact model 48

List of Tables

Table 1: Household demographics and farm characteristics of wheat farmers. 17
Table 2: Balance test of variables between beneficiaries and non-beneficiaries. 18
Table 3: T-test comparison of mean differences between the treatment and control groups. 24
Table 4: Augmented inverse-probability weighted regression adjustment results of project participation on wheat yield, household income, and food security. 27
Table 5: Estimated overall project reach and contributions to food production during the 2025 winter season. 29
Table 6: Project contributions to net food production during the 2025 winter season..... 30
Table 7: Cost effectiveness of the Sustain Sudan investments for the 2025 winter season 31

List of Figures

Figure 1: Extent of reach of the Sustain Sudan project during the 2025 winter season. 6
Figure 2: Crop types grown by project beneficiaries during the 2025 winter season. 13
Figure 3: Potato yield performance across inner, middle, and outer sections of center-pivot fields under improved seed intervention and non-beneficiary control conditions. 14
Figure 4: Gross income (US$/ha) from potato production under improved seed intervention and non-beneficiary control conditions. 15
Figure 5: Average potato yield (left panel) and average gross income (right panel) comparison between beneficiary and non-beneficiary farmers. 16
Figure 6: DAP fertilizer application rates by project beneficiaries and non-beneficiaries. .. 19
Figure 7: Urea fertilizer application rates by project beneficiaries and non-beneficiaries... 20
Figure 8: Responsiveness of wheat yield to DAP (panel A) and Urea (panel B). 21
Figure 9: Types of benefits realized from project participation. 22
Figure 10: Types of advisories received by beneficiary status. 23
Figure 11: Average wheat yields by beneficiary type and gender. 25
Figure 12: Household income by beneficiary type and gender. 26
Figure 13: Fertilizer price trends between January 2025 and January 2026. 34

1. Introduction

Sudan is facing an unprecedented humanitarian crisis, with millions of people affected by acute food insecurity due to the ongoing civil war (FAO, 2024; UNICEF, 2025). The war has disrupted farming systems and supply chains and crippled agricultural production leading to the largest food supply gaps ever experienced in recent years. Estimates suggest that Sudan required about 8.4 million metric tons of cereals in 2025, while domestic production reached only around 6.7 million metric tons (FAO, 2025a). This led to a "food gap" of an estimated 1.9 million MT, including a food gap in cereals of an estimated 1.7 million MT.

The Sustain Sudan project was designed to contribute towards addressing this crisis. This is a market-based agricultural project that leverages a strong, resilient, and active private sector. The goal of the project is to reduce hunger in Sudan by supporting local food production. This goal is pursued through strategic and market-based investments to (i) increase the volume of quality fertilizer supplies to the country, (ii) improve the accessibility of fertilizer for smallholder farmers through structured demand – and supply – side financing, (iii) increase access to technical assistance for smallholders, and (iv) increase the availability and affordability of seeds and crop protection products to support productivity growth.

Since its inception in July 2025, the project has facilitated the importation of 48,500 MT of fertilizers, including urea-46, diammonium phosphate (DAP), and ammonium sulfate (AS) through four partner Sudanese agrodealers, General Energy, WAS Trading Co Limited, CTC Group, and Nutri Crop. The fertilizer breakdown includes 39,650 MT of urea, 8,350 MT of DAP, and 500 MT of AS. These quantities represent approximately 10% of Sudan's total annual urea imports, 7% DAP imports, and 3% AS imports during the pre-war period. As of 2025, the fertilizer volumes imported under the Sustain Sudan project accounted for approximately 86% of total national annual fertilizer imports, considering the post-war collapsed import levels. The Sustain Sudan project facilitated import volumes represent a substantial intervention in a highly constrained agricultural input market. In addition, the project facilitated the importation and distribution of 5,200 MT of seed potato.

These inputs were strategically distributed across multiple market segments to reach last-mile farmers in key production areas, including Gezira, White Nile, Sennar, Gedarif, Port Sudan, River Nile, Northern, Khartoum, Darfur, and Kassala States. Overall, the project-supported inputs reached 11 out of 18 of the States in Sudan (Figure 1). By improving the availability and accessibility of fertilizer in these regions, complemented with the use of improved seeds and farmer advisories, the project aimed to stabilize input supply chains, support crop productivity, and enhance the resilience of farming systems amid ongoing economic and climatic challenges.

This report assesses the extent to which this large-scale importation of inputs and targeted distribution through the private sector agrodealer networks translated into tangible livelihood improvements particularly among smallholder farmers in the project's intervention areas. The assessment focused on three main outcomes: crop productivity, income, and food security outcomes. We also estimate the project reach and contributions to wheat and Irish potato production in Sudan.

Additionally, the report models the project impact to quantify the additional food production generated by the 2025 winter season inputs, assess the contribution to closing the national deficit, and demonstrate why the "high allocation to staple food crops" scenario is the most realistic and impactful planning assumption for Sudan.

2. The Sustain Sudan project inventions: what, why and how?

The intervention logic for the Sudan project is premised on the fact that if farmers access improved inputs to boost soil fertility, coupled with good advisories and crop protection, then, the demand for, correct use and adoption of improved inputs will increase. This will lead to increased crop productivity, food security, and higher incomes. In pursuit of these outcomes, the project intervenes in three primary areas to restore local food production in Sudan.

1) **Input sourcing support:** The war in Sudan and the resulting macroeconomic instability destabilized and cut off the country from the international payment systems, limiting international transactions. This led to the withdrawal of international fertilizer and seed suppliers from the country. It also led agrodealers in Sudan to reduce and divert their working capital at risk, leading to significantly lower volumes of imported farm inputs. Through its sourcing interventions, the project restored international suppliers' confidence and facilitated fertilizer and seed imports into Sudan. This was done through the issuance of letters of credit, grants and credit guarantees, while helping partner Sudanese agrodealers to identify credible suppliers and negotiate fair prices and shipping costs.
2) **Strengthening last-mile distribution:** The project worked with four Sudanese agrodealers to ensure the discharge of inputs at port Sudan, bagging, and transportation to various last mile points. The project provided logistical and security support as needed. These inputs were distributed through five main channels.
    i. **Integrated supply chain model:** The project provided impact-linked guarantee financing to enable an agrodealer to import seed and fertilizer timely. These inputs were coupled with extension and advisories services for end user farmers. The guarantee expired uncalled, absolving the project of any risk. This partnership delivered 4,000 MT fertilizer (2,000 urea, 2,000 DAP) and 5,200 MT certified seed potato across River Nile, Khartoum, and Northern States.
    ii. **Managed schemes model; re-activating public finance infrastructure:** The project supported fertilizer imports supplied via General Energy enabled the

Agricultural Bank of Sudan (ABS) to resume financing in irrigation schemes, including the New Halfa Scheme. This revived a critical credit line for Sudan's agricultural sector that had been dormant since the onset of the war. Through this model, 12,500 MT of project supported fertilizers were delivered through ABS along with critical farmer advisory services.

iii. **Commercial bank sales model; unlocking private sector liquidity:** During the reporting period, the project was in discussions with the United Capital Bank (UCB) for a cash-backed, first-loss guarantee to de-risk agricultural lending. UCB will provide the liquidity, allowing on lending in Sudanese Pounds, while the project will hold the guarantee funds in USD. This facility will be activated in the 2026 summer season.

iv. **Microfinance sales model:** The project provided USD 152,000 grant to Al Ebdaa Microfinance Institution, which on-lent to smallholder farmers under seasonal repayment terms. Al Ebdaa deployed the funds through its branch network in River Nile, Northern, Kassala, and Gezira states, using its group lending methodology to distribute 200 MT of urea fertilizer.

v. **Retail agrodealer network model:** The model required no direct financial risk from the project as it was based on bank inventory financing and trade credit guarantees to enable hub dealers to extend 30–60 days credit terms to retailers, creating a sustainable, subsidy-free commercial pipeline. This supplier-credit model delivered 18,800 MT of fertilizer: 4,850 MT through CTC and 13,950 MT through General Energy. This channel also includes direct sales by hub agrodealers to farmers.

3) **Access to innovative finance:** This is a critical intervention area for the Sustain Sudan project that plays a catalytic role in crowding in private sector investments to re-establish agricultural input supply chains. Both supply – and demand – side financing options are used.

   a. **Supply side finance options:** The project deployed innovative financing instruments including letters of credit and credit guarantees to unlock structural

liquidity constraints and enable international fertilizer suppliers to release stock, facilitating trade even prior to full payments. These financing mechanisms helped to secure the imported inputs during the 2025 winter season. All the imports required a combination of direct project-backed supplier credit and advance cash payment to secure supplier commitment.

b. **Demand-side finance options:** The project activated three parallel demand-side channels, each tailored to a distinct farmer segment. The project incentivized ABS that deployed the Government of Sudan-backed credit to large-scale irrigation farmers. ABS bore all credit and currency risk, distributing 12,500 MT of project supported Urea fertilizer to farmers in major irrigation schemes including New Halfa. Medium to large farmers with access to banking services will be catered for through credit facilities from the United Capital Bank (UCB). To unlock this credit line, the project deploys a first loss guarantee mechanism (cash-backed, up to 78% coverage) and UCB provided 100% of lending liquidity. For smallholder farmers, the project provided a fully funded facility to the Al Ebdaa microfinance institution, which on-lent to targeted smallholder farmers under terms aligned with seasonal repayment capacity.

Overall, more than 20,000 MT of fertilizer, over half of the project facilitated inputs during the 2025 winter season reached farmers through credit-enabled channels. Smallholders demonstrated creditworthiness under active conflict conditions, directly contradicting market assumptions.

3. Methodology

3.1 Study area

Out of the 11 States reached by inputs supported by the Sustain Sudan project during the 2025 winter production season, this initial assessment focuses on Kassala, Khartoum and River States. This deliberate focus allowed the study to concentrate on locations where interventions were most concentrated, and where it was both practical and feasible to collect data to assess project impacts.

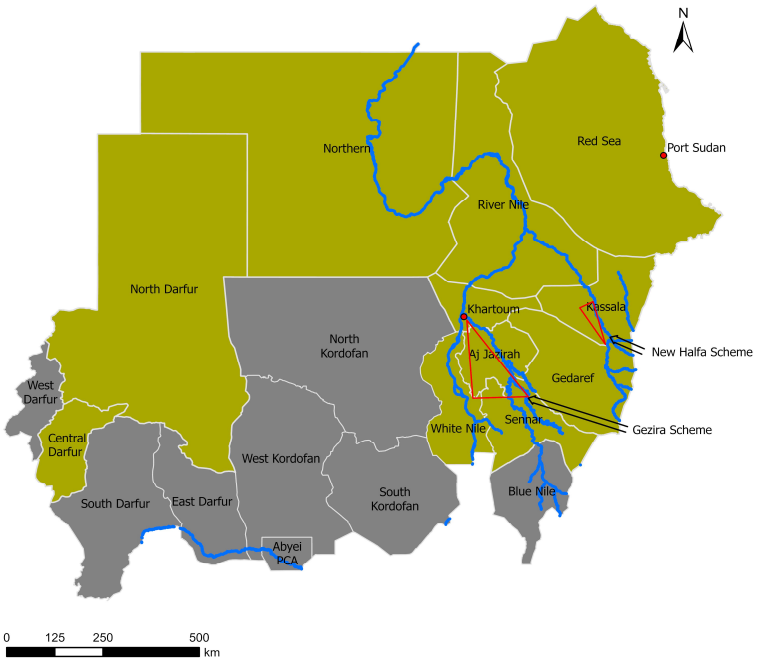


Figure 1: Extent of reach of the Sustain Sudan project during the 2025 winter season.
Notes: States in green represent those reached by the Sustain Sudan project

3.2 Data sources

This study uses data from three main sources to assess the outcomes of the Sustain Sudan Project interventions during the 2025 winter season. These include beneficiary monitoring data, yield cut assessments for potato, and survey data. Additional secondary

price data were drawn from the IFPRI Sudan price monitoring dashboard.[2] These were complemented with literature review.

3.2.1 Beneficiary monitoring data

We use a large database with about 8,000 beneficiaries from the New Halfa Scheme that contains details about input access/use and production for the 2025 winter season. These data were collected from project beneficiaries under the new Halfa Scheme. The focus is on input access and use, without production and harvest details.

3.2.2 Irish potato yield cut assessment procedures.

A potato yield cut assessment was conducted for the 2025 winter irrigated season in Khartoum and River Nile States, to evaluate the agronomic and economic performance of improved seed potato interventions. The assessment comprised four beneficiaries, with farms seeded using improved seed potato and one non-beneficiary control site cultivated using a local potato variety. The beneficiary sites included Almarkhiat, Kilo 67, and Kilo 60 in Khartoum State, and Shendi in River Nile State. The non-beneficiary control site was in Almarkhiat, Khartoum State.

Each assessment unit covered about 20 acres, resulting in a total sampled area of approximately 100 acres across all locations. Yield sampling was undertaken along center-pivot irrigation systems with an approximate radius of 360 meters (m). To account for potential spatial variation in crop performance, sampling points were stratified into three zones: inner, middle, and outer sections along the pivot radius. The inner sampling point was established approximately 10-15 m from the beginning of the pivot to minimize edge effects associated with pivot tracks. The middle sampling point was located at approximately 134 m along the pivot radius, while the outer sampling point was positioned approximately 344 m from the pivot origin.

At each sampling point, a minimum of two subsamples were collected randomly. Each subsample consisted of a 1 m linear section measured along a potato ridge. All plants

[2] https://sudan.ifpri.info/essential-commodities-prices-and-availability-monitor/

within the measured section were carefully uprooted, and tubers were manually cleaned to remove attached soil without washing prior to weighing. Fresh tuber weight was recorded immediately using a calibrated field scale. The potato crop was established at an inter-row spacing of 0.9 m; therefore, each subsample represented a sampling area of 0.9 m^2.

Fresh tuber yield was subsequently converted and expressed in tons per hectare (t/ha) based on the sampled area. In addition, gross monetary value (US$/ha) was estimated by multiplying the calculated tuber yield by the prevailing market price of potato during April 2026, estimated at US$600 per ton.

3.2.3 Household survey data

The assessment targeted to collect household survey data from Kassala, Khartoum and River Nile States. These States were purposively selected as they were key project intervention areas during the 2025 winter season. Kassala State hosts the New Halfa Scheme where 12,500 MT of project-linked fertilizer were distributed through the Agricultural Bank of Sudan (ABS). This intervention enabled ABS to reopen credit lines to smallholders after years of inaction since the start of the war. Khartoum and River Nile were the loci for Irish potato production activities during the 2025 winter season, where the Sustain Sudan project supported the distribution of 4,000 MT of fertilizer and 5,200 MT of seed potato. Given the ongoing conflict situation, sufficient household survey data were only collected from the New Halfa Scheme at the time of reporting while data collection was still ongoing in Khartoum and River Nile States. As such, we only report on survey data from Kassala for wheat production and use the yield cut results for potato from Khartoum and River Nile States.

3.2.3.1 Sampling and sample size determination

Within Kassala, the survey targeted New Halfa Scheme as the primary intervention site. We randomly selected five blocks that received project supported inputs in the New Halfa Scheme, and households in these blocks were randomly selected using lists from scheme administrators. To generate statistically representative estimates, we used the

Cochran formula to determine the minimum required sample size (Cochran, 1977). This formula is defined as:

$$n_0 = [Z^2 pq]/e^2 \qquad [1]$$

where n_0 is the minimum required sample size; Z is the z-score for the desired confidence level (1.96 for 95% confidence); e is the margin of error or level of precision, at 5%; p is the estimated reach, i.e., proportion of the rural population reached estimated at (30%, 0.3), q is 0.7 (1 – p). The statistically representative beneficiary sample size for New Halfa was 514, of which 316 households were interviewed, representing 61%. The target sample for non-beneficiaries was 250, of which 174 were interviewed, representing 70%.

Non-beneficiaries within the scheme were selected following similar approaches, but from blocks that did not receive any project supported inputs. Data was collected through face-to-face interviews by well-trained enumerators using a semi-structured questionnaire programmed in the KoBo Toolbox with inbuilt validation logics to minimize data errors. Field work was conducted between 10 April and 10 May 2026. Ongoing data collection is led by the international data collection firm, GeoPoll, which uses Computer-Assisted Telephone Interviewing (CATI) as the primary method for collecting data. CATI is effective in maintaining data quality and consistency, and allows instant validation of responses, while standardizing the survey process across locations. Combining the three sources facilitated a quick turnaround given the active conflict situation and the fact that harvest was still ongoing at the time of the writing in April 2026. Suffice to mention that the selected samples are not representative of the project reach but are meant to provide a deep synopsis of the project impact in selected intervention areas.

3.3 Data analysis

Both descriptive and quantitative data analysis approaches were used in the analysis. The descriptive statistics are presented using tables and graphs, with comparisons made between the between beneficiaries and non-beneficiaries. Simple mean comparisons using t-statistics are applied to test for statistically significant differences in outcomes between beneficiaries and non-beneficiaries, providing a valid approach to demonstrate

project impacts. The quantitative analysis used the potential outcomes framework where the central idea is to estimate outcomes of project beneficiaries compared to non-beneficiaries. The main challenge is defining a credible counterfactual i.e.; the outcomes of project beneficiaries had they not been beneficiaries. If we define a treatment variable as *T = 1*, for a household that benefited from the project, and *T=0* for non-beneficiaries; we can compute the average treatment effect (ATE) as the difference between treated and untreated outcomes. Formally, the ATE is defined as

$$ATE = E[Y(1) - Y(0)] = E[Y(1)] - E[Y(0)] = E[Y|T = 1] - E[Y|T = 0] \quad (2)$$

where $T = \{0,1\}$, $Y(1)$ is the outcome for project beneficiaries and $Y(0)$ is the outcome for non-beneficiaries. Since the main interest is on the effects of the project on beneficiaries, we can restrict the analysis to this segment, and define the average treatment effect on the treated (ATET) as

$$ATET = E[Y(1)|T = 1] = E[Y(0)|T = 1]. \quad (3)$$

$E[Y(0)|T = 1]$ captures the expected outcomes or the counterfactual outcomes for non-beneficiaries had they benefited from the project. The counterfactual is key for causal identification. We estimated the ATET for crop yield, household income and food security outcomes using the Inverse Probability Weighted Regression Adjustment (IPWRA) approach. Crop yield captures average productivity per ha; income is the annual total from all sources in nominal USD value and food security is a categorical variable capturing if a household had no food shortages during the past one year from the date of the survey.

Even if the Sustain Sudan project is market-based, there is a chance that participation is non-random, which can bias the ATET estimates. To address this potential

endogeneity issue, we instrument project participation with distance to the main market. We test and show that this instrumental variable is positively correlated with project participation but does not directly affect outcomes. This is logical since the Sustain Sudan project is a market-based approach, suggesting that proximity to the main market increases the chances of accessing project supported inputs.

3.3.1 Estimating project reach and contributions to wheat and potato production

We use data on input application rates per hectare from the household survey, the yield cut assessment and literature to estimate area (covered) under production, total production and the reach, i.e., the total number of farmers estimated to be using the project supported inputs for wheat and potatoes as follows.

$$Area_i\ (ha) = fert\ quantity_i\ (kg)\ /\frac{fert_i}{kg/ha}, \qquad (4)$$

where $area$ is total area covered in ha for crop i; $fert\ quantity$ is the total quantity of fertilizer made available for crop $i$by the project; and $fert$ (kg/ha) is the average total fertilizer use per farmer per ha for crop i from the surveys.

$$prod\ (kg)_i = Area_i\ (ha)\ X\ yield_i\ (kg/ha), \qquad (5)$$

$prod\ (kg)$ is total production for crop i, yield is average production per ha for crop i.

$$Reach\ (n)_i = Area_i\ (ha)\ /cult_i\ (ha), \qquad (6)$$

$Reach\ (n)$is the number of farmers reached; $cult$ is average area under cultivation per farmer for crop i.

3.3.2 Projected impact analytical framework

To determine the projected impact on national net food production, we use a bottom-up, scenario-based approach. This allows us to convert fertilizer volumes into additional net food production after accounting for post-harvest losses. The model treats winter (irrigated) and summer (rain-fed) seasons separately due to different yield responses. For 2025 winter season, we use measured yields from project beneficiaries. The key steps include (i) determining fertilizer allocated to food crops; (ii) converting that to fertilized area

using crop-specific application rates; (iii) applying measured yield increases, and lastly, (iv) deducting post-harvest losses. This assessment uses three scenarios to capture the trade-offs between export cash crops (sesame, groundnuts) and staple food crops (sorghum, millet, wheat, potatoes). Scenario one export-oriented where 70% of the fertilizer is used on cash crops and 30% on food crops. The second scenario is balanced with 50% of the fertilizer used for each of cash crop and food crops. The third scenario is focused on local food production and allocates 70% of the fertilizer on food crops and 30% on cash crops.

The food-focused scenario is the most realistic for Sudan. Sudan imports wheat and exports little; potatoes are consumed fresh locally. Since the war began, agricultural exports have collapsed by over 80% and logistics remain disrupted. Thus, almost all increased wheat and potato production will reach domestic consumers. This scenario is also the most humanitarian and operationally realistic; we present the others only for comparison.

4. Results

4.1 Crops grown during the 2025 winter season.

Project monitoring data shows that wheat was the main crop grown by 61% of beneficiaries during the 2025 winter season. Other important crops include onion, chickpeas and other vegetables grown by over 10% of the beneficiaries (Figure 2). Irish potatoes were grown by about 5% of the project beneficiaries. We limit the detailed analysis to wheat and Irish potatoes for which sufficient data are available.

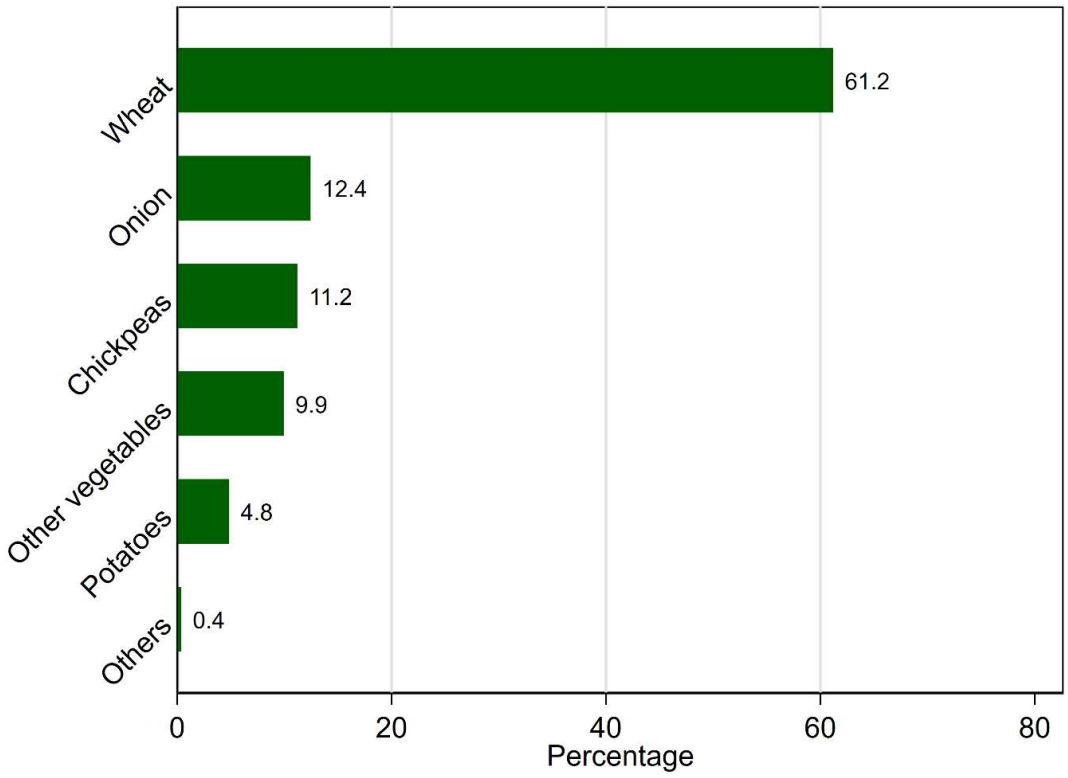


Figure 2: Crop types grown by project beneficiaries during the 2025 winter season.
Source: Monitoring beneficiary data

4.2 Potato yield performance

The improved seed potato intervention resulted in substantially higher potato yields across all beneficiary sites compared with the non-beneficiary control site (Figure 3).

Average yield among beneficiary farmers ranged from 15 to 24 MT/ha, while the non-beneficiary farmer who used a local potato variety achieved an average yield of only 6 MT/ha.

Among the beneficiary sites, Almarkhiat recorded the highest average yield (24 MT/ha), followed by Shendi (19 MT/ha), Kilo 60 (17 MT/ha), and Kilo 67 (15 MT/ha). Yield performance remained relatively stable across the inner, middle, and outer sections of the pivot, indicating that water was not limiting production across the fields. In contrast, yields at the non-beneficiary site remained consistently low across all sampling sections.

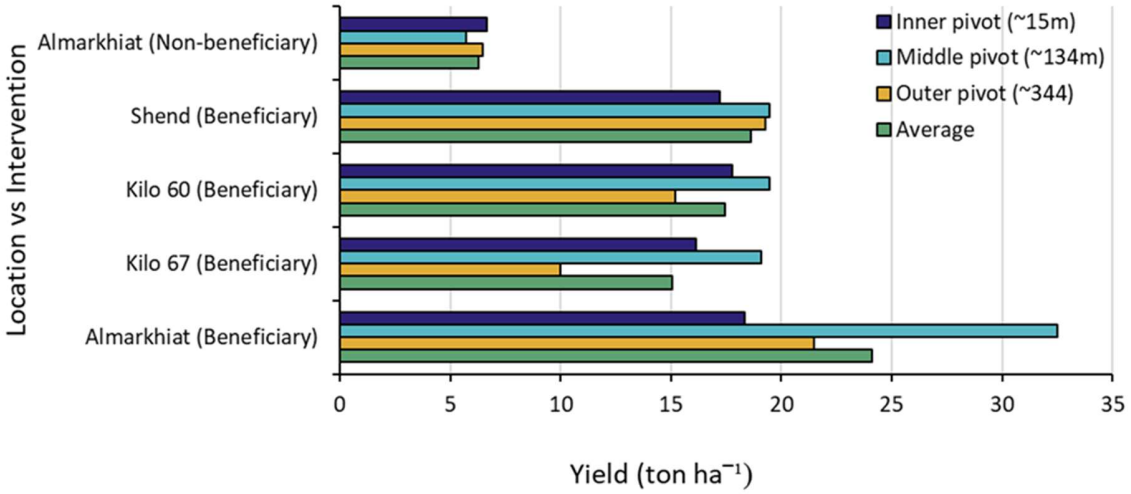


Figure 3: Potato yield performance across inner, middle, and outer sections of center-pivot fields under improved seed intervention and non-beneficiary control conditions.
Source: 2026 potato yield cut survey

4.3 Gross income from potato production

The increase in potato yield translated directly into higher gross income for beneficiary farmers (Figure 4). Gross income among beneficiary sites ranged from approximately US$9,037 to US$14,467 per hectare, compared with US$3,774 per hectare recorded at the non-beneficiary site. The highest gross income was recorded at Almarkhiat (beneficiary), where returns exceeded US$14,000/ha. Shendi and Kilo 60 also achieved strong economic returns of more than US$10,000/ha. Even the lowest-performing

beneficiary site generated more than double the gross income obtained at the non-beneficiary site.

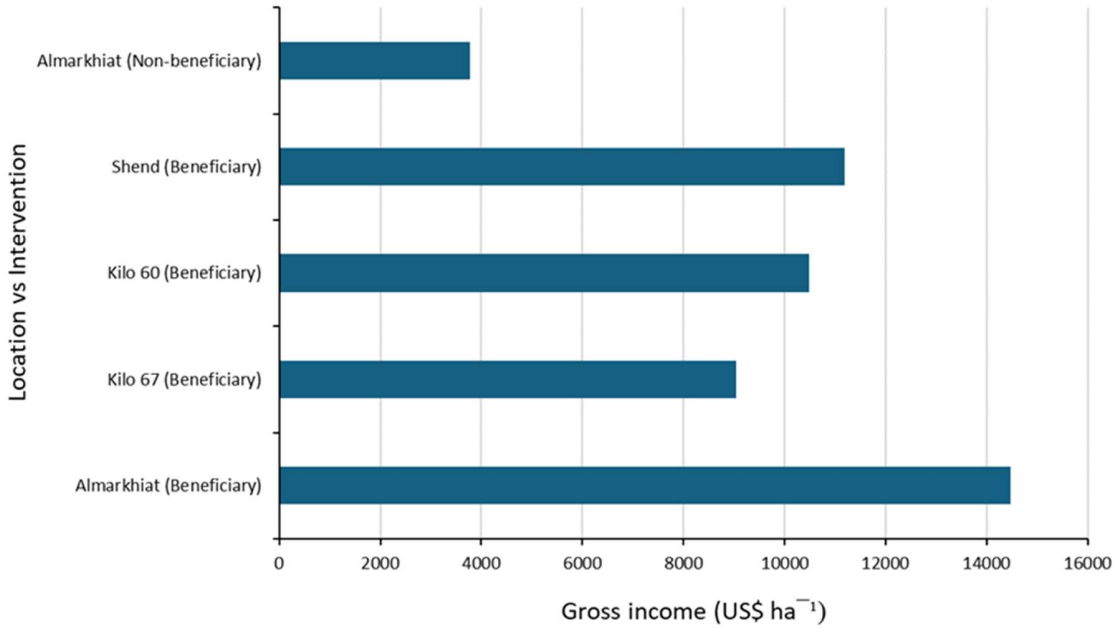


Figure 4: Gross income (US$/ha) from potato production under improved seed intervention and non-beneficiary control conditions.

Source: 2026 potato yield cut survey

4.4 Overall potato intervention impact

When averaged across all beneficiary sites, potato yield reached approximately 18.8 t/ha compared with 6.3 MT/ha at the non-beneficiary site, representing an average yield gain of approximately 12.5 MT/ha (Figure 5). Similarly, average gross income among beneficiary farmers exceeded US$11,000/ha, while the non-beneficiary farmer generated approximately US$3,774/ha. This represents an average additional gross income of more than US$7,500/ha associated with the improved seed intervention (Figure 5).

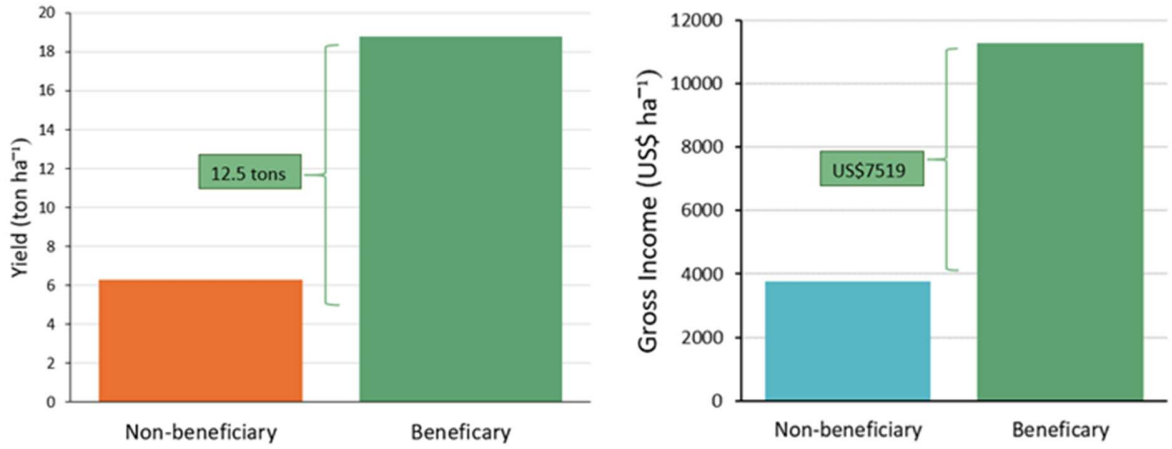


Figure 5: Average potato yield (left panel) and average gross income (right panel) comparison between beneficiary and non-beneficiary farmers.
Source: 2026 potato yield cut survey

4.5 Wheat survey results

4.5.1 Household demographics and farm characteristics

Because the wheat results are based on a detailed household survey, we start by presenting demographic characteristics of the sample. Overall, the wheat farmers that benefited from the project and those that did not are very comparable with no statistically significant differences in key variables (Tables 1 and 2). Project beneficiary household heads were aged 54 years on average compared to 55 years among non-beneficiaries (Table 1). Project beneficiaries applied slightly higher amounts of fertilizer per ha and were more educated compared to non-beneficiaries. Male headed households dominate both beneficiaries and non-beneficiaries.

Table 1: Household demographics and farm characteristics of wheat farmers.

	Beneficiary (n=316)		Non-beneficiary (n=174)		Total (n=490)	
	Mean	**SD**	**Mean**	**SD**	**Mean**	**SD**
Outcome variables						
Wheat yield (kg/ha)	2789.00	496.70	2192.76	559.57	2577.27	592.69
Household income (USD/year)	2704.59	1598.40	2178.52	1602.31	2517.78	1617.90
Household is food secure (%)	100.00	0.00	41.95	49.49	79.39	40.49
Control variables						
Household head age (years)	54.42	11.75	55.42	11.36	54.78	11.61
Female-headed household (%)	2.53	15.73	2.87	16.75	2.65	16.09
Primary education (%)	35.44	47.91	33.91	47.48	34.90	47.71
Secondary education (%)	35.76	48.01	32.18	46.85	34.49	47.58
Tertiary education (%)	3.48	18.36	2.87	16.75	3.27	17.79
No education (%)	25.32	43.55	31.03	46.40	27.35	44.62
Single (%)	10.44	30.63	9.77	29.78	10.20	30.30
Divorced (%)	0.63	7.94	0.00	0.00	0.41	6.38
Marital status: Married (%)	88.92	31.43	90.23	29.78	89.39	30.83
Distance to nearest market (km)	34.29	19.63	36.41	18.95	35.04	19.40
Seed quantity applied (kg/ha)	142.88	0.30	142.88	0.29	142.88	0.30
Basal fertilizer applied (kg/ha)	118.92	6.34	111.95	27.96	116.45	17.71
Top dressing fertilizer applied (kg/ha)	197.41	17.66	187.41	18.06	193.86	18.41

Source: Winter season household survey

Another important aspect in impact assessment is the need to check how well the project beneficiaries compare to the non-beneficiaries at baseline. Because we use cross sectional data without baseline data, we report the balance tests for all variables that could and could not be affected by the intervention (Table 2). As expected, there are no statistically significant differences between beneficiaries and non-beneficiaries for all variables not affected by the intervention. Only fertilizer application rates were higher for beneficiaries. This is not unexpected given that the project mainly facilitated access to fertilizer in the New Halfa Scheme.

Table 2: Balance test of variables between beneficiaries and non-beneficiaries.

	Non-beneficiary		Beneficiary		Pairwise t-test
Variable	N	Mean/(SE)	N	Mean/(SE)	Mean difference
Age of household head	174	55.42	316	54.424	0.995
Female household head	174	0.029	316	0.025	0.003
Primary education completed	174	0.339	316	0.354	-0.015
Secondary education completed	174	0.322	316	0.358	-0.036
Tertiary education completed	174	0.029	316	0.035	-0.006
No education	174	0.31	316	0.253	0.057
Married	174	0.902	316	0.889	0.013
Distance to market	174	36.408	316	34.294	2.114
Seed (kg/ha)	174	142.879	316	142.881	-0.002
DAP fertilizer (kg/ha)	174	111.954	316	118.92	-6.966***
Urea fertilizer (kg/ha)	174	187.411	316	197.408	-9.997***

*Significance: *p < 0.1; **p < 0.05; ***p < 0.01*

Source: 2026 Winter season household survey

4.5.2 Input use and correlates of input use and outcomes

Project beneficiaries used on average 119kg/ha of DAP compared to 112kg/ha among non-beneficiaries (Figure 6). Similarly, beneficiaries used more Urea at about 197 kg/ha compared to 187 kg/ha among non-beneficiaries (Figure 7). The differences in DAP and Urea use are statistically significant, showing that project beneficiaries used significantly larger quantities. For both inputs, female headed households used larger quantities compared to the male headed households among beneficiaries and non-beneficiaries. This should be taken with caution because of the small sample sizes for female headed households.

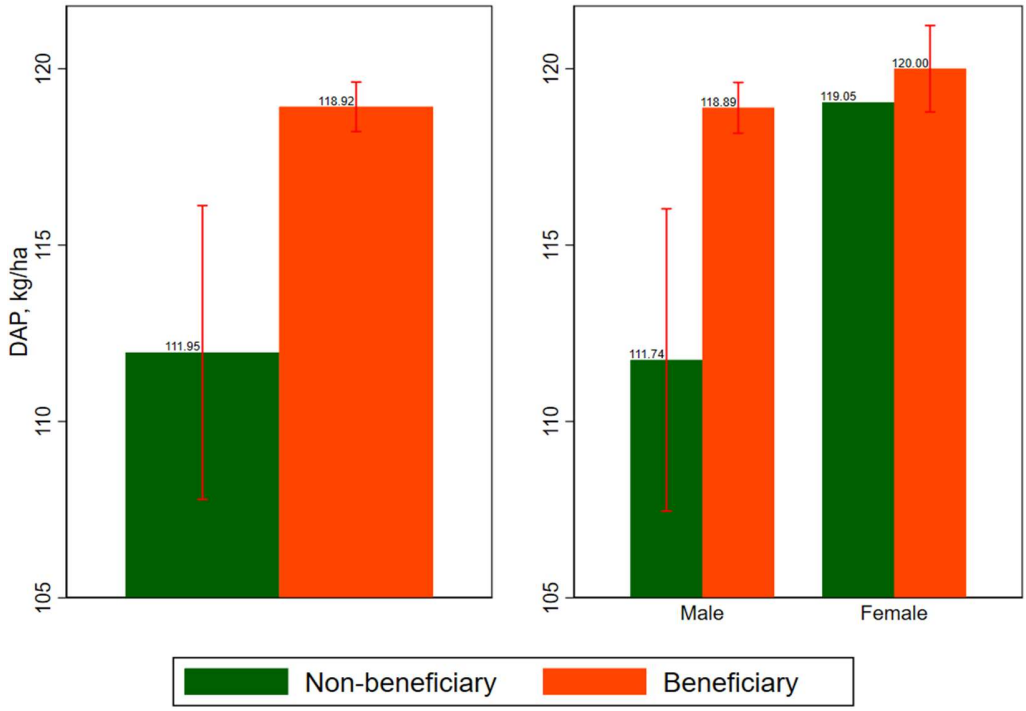


Figure 6: DAP fertilizer application rates by project beneficiaries and non-beneficiaries.

Source: 2026 Winter season household survey

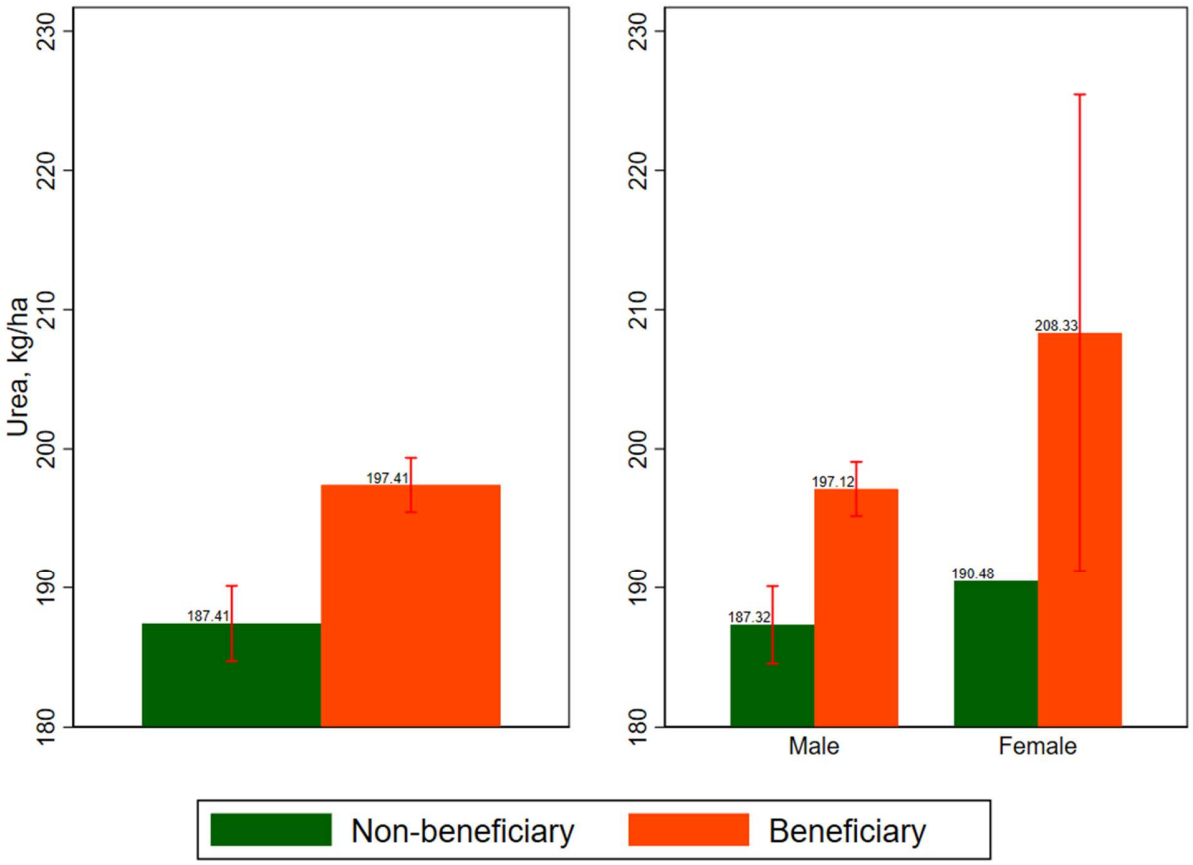


Figure 7: Urea fertilizer application rates by project beneficiaries and non-beneficiaries.

Source: 2026 Winter season household survey

A bivariate analysis shows that wheat yield is positively correlated to the quantities of both DAP and Urea (Figure 8). In both instances, the higher the fertilizer use, the higher the wheat yield. Of course, there are likely thresholds beyond which diminishing returns set in and there are several other factors that may affect wheat yields that are not accounted for in this analysis. As such, these results should be interpreted as correlational.

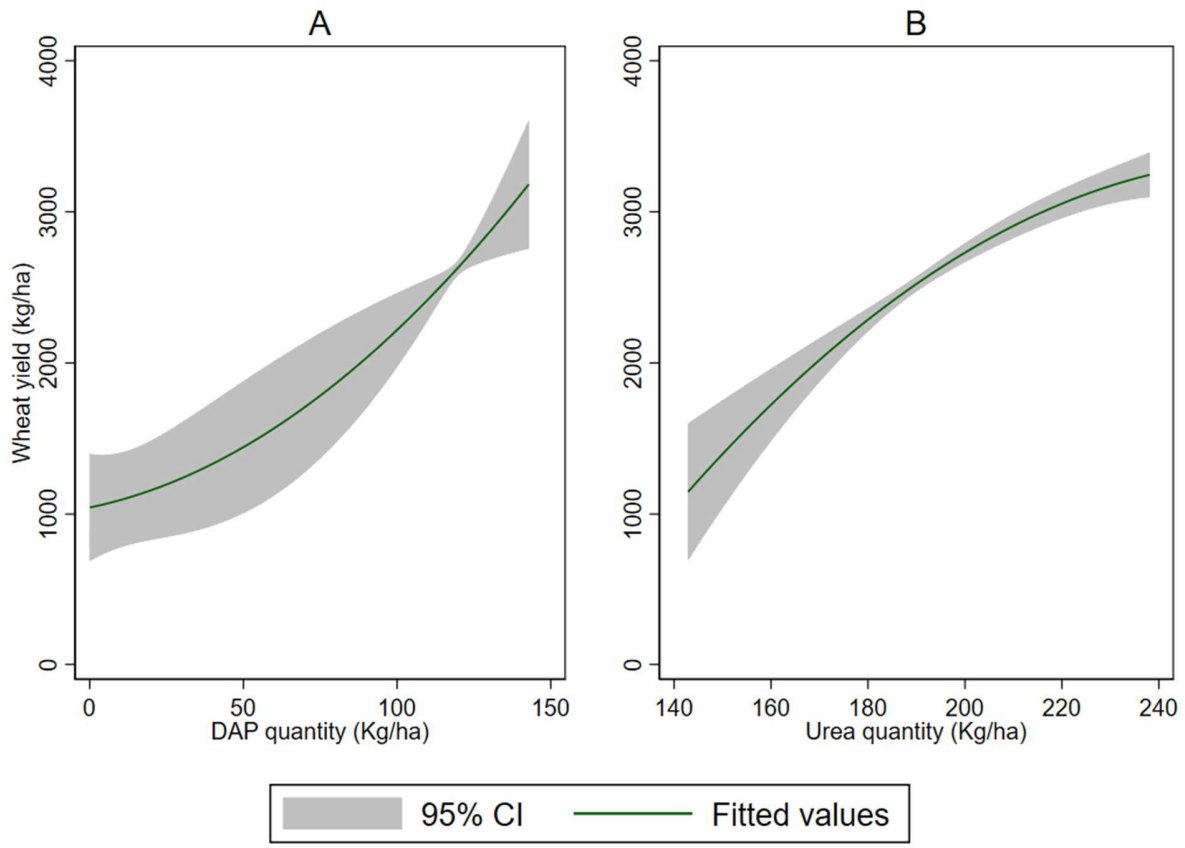


Figure 8: Responsiveness of wheat yield to DAP (panel A) and Urea (panel B).
Source: 2026 Winter season household survey

4.5.3 Benefits of the Sustain Sudan project among beneficiaries.

Project beneficiaries reported several benefits. The common ones mentioned by at least 75% of the beneficiaries surveyed include improved farming practices, pest control and management, access to improved seeds (likely linked to improved access to finance) and higher yields (Figure 9). However, very few reported access soil fertility and fertilizer use advisories.

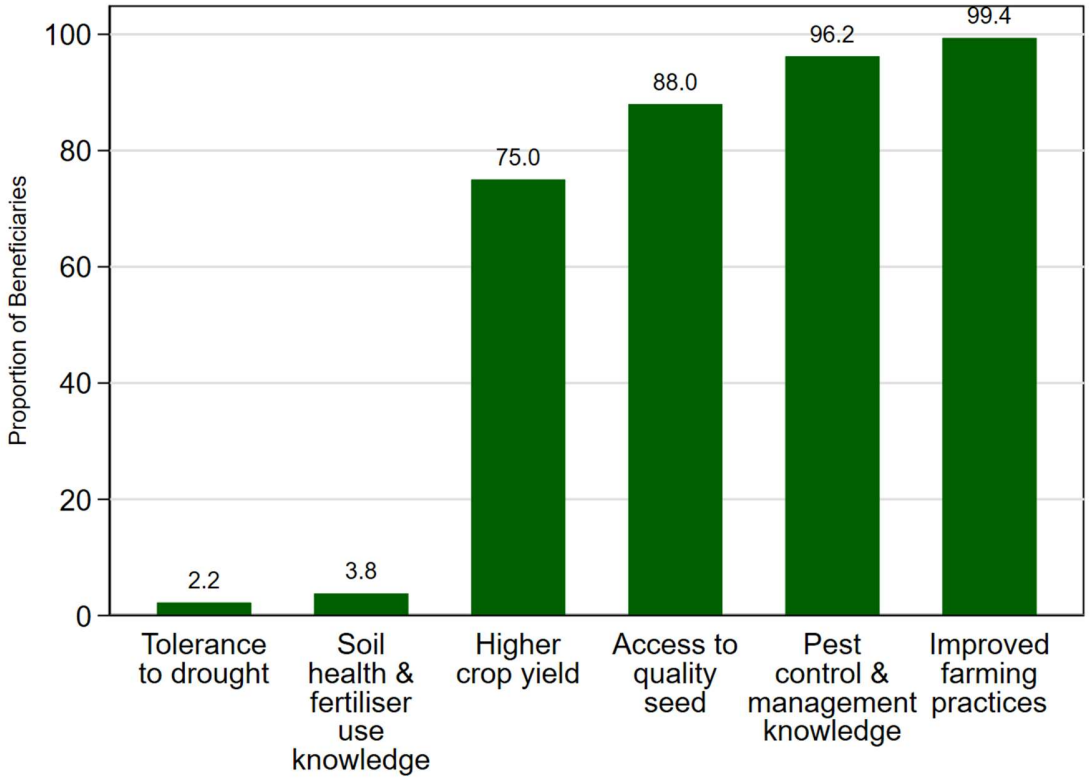


Figure 9: Types of benefits realized from project participation.

Source: 2026 Winter season household survey

These positive benefits are likely linked to various advisories received by project beneficiaries. Most of them mentioned receiving advisories on agronomy, access to finance, mechanization, and crop protection (Figure 10). A slightly larger proportion of project beneficiaries received agronomy and crop protection advisories compared to non-beneficiaries.

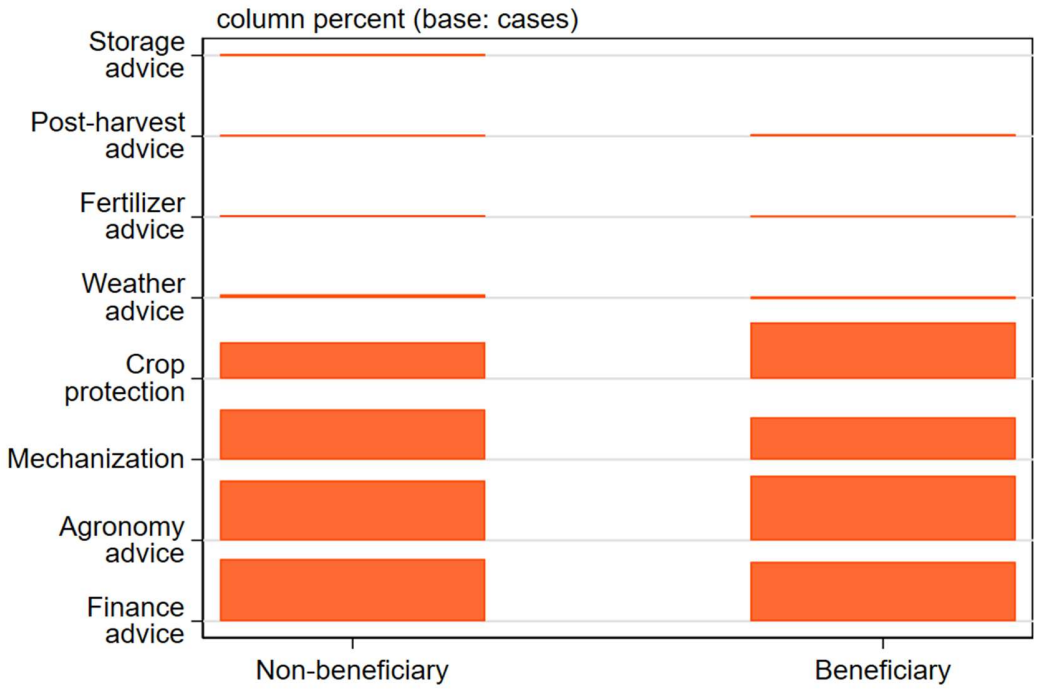


Figure 10: Types of advisories received by beneficiary status.

Source: 2026 Winter season household survey

4.5.4 Mean outcomes comparison by beneficiaries

We find statistically significant differences between project beneficiaries and non-beneficiaries in terms of wheat yield, income, and food security outcomes (Table 3). Wheat yields among project beneficiaries were on average 596 kg/ha or 27% higher than for non-beneficiaries. This difference is statistically significant. Since non-beneficiaries also used nearly comparable fertilizer rates, we compared our estimated beneficiary wheat yields to yields in traditional farming systems where fertilizer use is limited. The project beneficiary wheat yields were 1,189 kg/ha or 74% higher than the average wheat yields (1,600 kg/ha) with limited fertilizer use under traditional production systems.[3] Equally, project beneficiaries

[3] https://www.afdb.org/en/success-stories/farmers-cultivate-wheat-and-hope-avert-food-crisis-sudan-87898 (Accessed 22 May 2025)

had about USD 526 more annual household income, and 58% more beneficiaries were food secure compared to non-beneficiaries.

Table 3: T-test comparison of mean differences between the treatment and control groups.

	Non-beneficiary (1)		Beneficiary (2)		Mean difference (1)– (2)	T-value
Variables	**N**	**Mean**	**N**	**Mean**		
Wheat yield (kg/ha)	174	2193	316	2789	-596.2	-12.149***
Annual household income (USD/year)	174	2179	316	2705	-526.1	-3.483***
Food Secure (%)	174	41.95	316	100	-58.05	-20.867***

*Significance: *p < 0.1; **p < 0.05; ***p < 0.01*

4.5.5 Wheat yields across beneficiaries and gender

Figure 11 presents the graphical representation of wheat yield disaggregated by beneficiary status and gender of the household head. Male-headed households achieved higher yields than female-headed households among non-beneficiaries. However, female-headed households achieved higher yields than male-headed households among beneficiaries. In fact, comparisons within gendered households show that beneficiary female-headed households achieved 855kg/ha higher yields than beneficiary female-headed households. This yield gain is higher than the 590kg/ha difference between beneficiary and non-beneficiary male-headed households, suggesting that female-headed households benefited more from the project. These results should be interpreted with caution due to the small sample size of female-headed households.

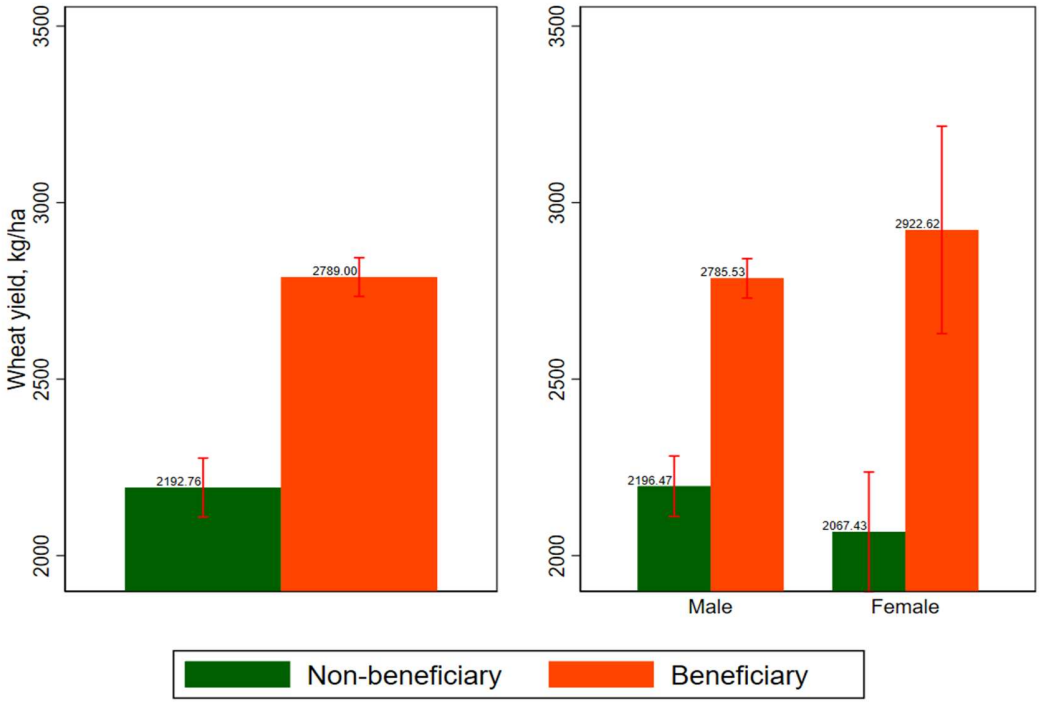


Figure 11: Average wheat yields by beneficiary type and gender.
Source: 2026 Winter Season household survey

4.5.6 Household income across beneficiaries and gender

We present the distribution of household annual income by beneficiary and gender of household head in Figure 12. Male headed households have higher annual income than female headed households among non-beneficiaries, but female-headed households have higher incomes among beneficiaries. These income differences are not statistically significant, shown by overlapping error bars. Nonetheless, as with the yield results, this suggests that female-headed households benefited more from the project. Again, the female headed household subsample is small, requiring caution in interpreting the results.

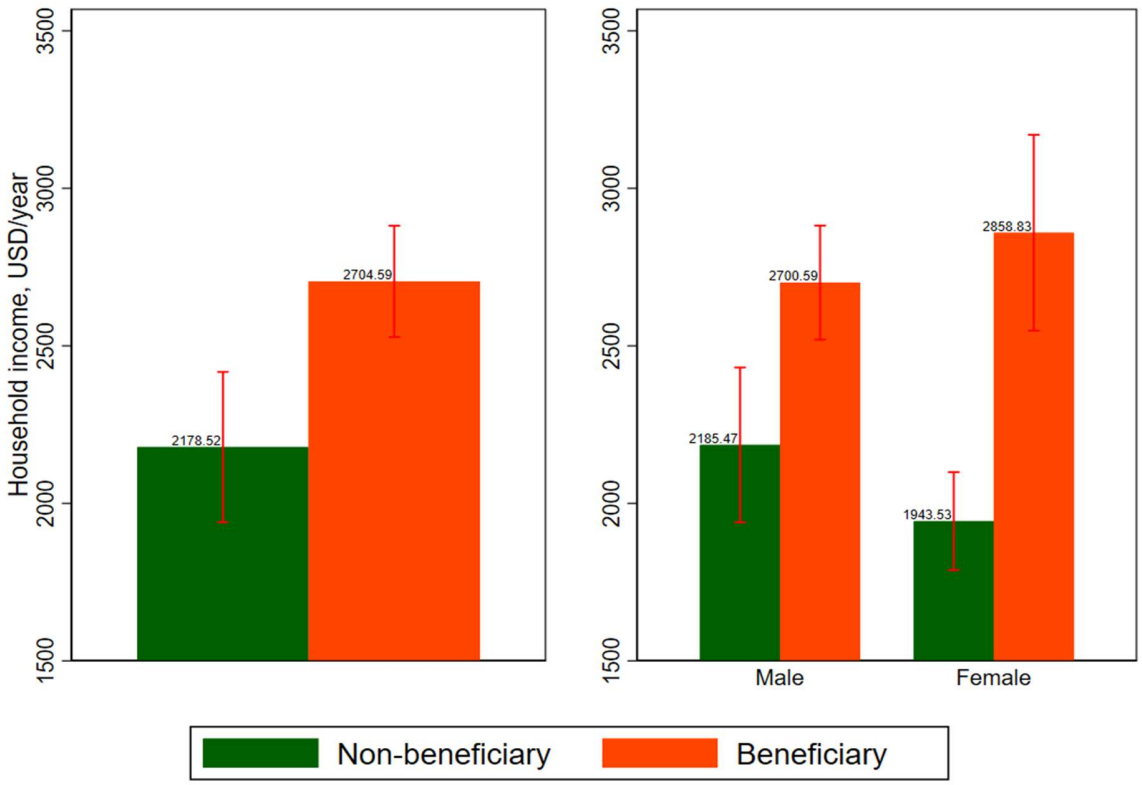


Figure 12: Household income by beneficiary type and gender.

Source: 2026 Winter Season household survey

The foregoing results should be interpreted as correlational as they do not control for other factors that may affect outcomes. The next section presents the fully econometric results.

4.6 Impacts of project interventions on food security and welfare

We employed the Inverse Probability Weighted Regression Adjustment (IPWRA) procedure to analyze the causal impacts of being a project beneficiary on household livelihood and welfare outcomes measured using wheat yield, income, and food security. After controlling for several confounders and potential endogeneity bias, the coefficient of 444.85 in Table 4 shows that the Sustain Sudan project participants had on average, about 445 kg/ha higher wheat yield compared to non-participants. This difference might be attributed to the inputs, credit, and advisories which the participants received through the

project interventions and supported wheat production which translated to increased productivity.

Additionally, the 0.527 coefficient shows that project participation was associated with better food security outcomes, i.e., project participants had a 53% higher chance of being food secure, compared to non-participation. One possible pathway in which participating in the project might have increased food security is that those who participated in the project had access to diverse food categories due to the increased yield. Thus, although the survey was done during the harvesting period, food security measures captured the household food security situation over the last 12 months prior to the survey date. Another possible pathway is that some project beneficiaries accessed loans from supported microfinance intuitions and could have used this money to buy food.

From these regression results, we can conclude that participating in the project increased wheat yields and improved household food security. We do not find statistically significant results indicating that project participation increased household income because the coefficient of 103.357 in Table 4 was not statistically significant. This is mainly because the survey was conducted just after harvest before most farmers sold any produce. As such, the income effects would only be realized in subsequent periods.

Table 4: Augmented inverse-probability weighted regression adjustment results of project participation on wheat yield, household income, and food security.

	Coefficient	St. Error	Z	[95% conf. interval]	
(A) Wheat yield effects					
ATET	444.848	56.128	7.93***	334.839	554.857
(B) Income effects					
ATET	103.357	427.303	0.24	-734.142	940.857
(C) Food Security effects					
ATET	0.527	0.079	6.61***	0.369	0.679

Note: Yield and income are continuous variables, while food security is a dummy variable (1 = food secure household, 0 = otherwise). *Significance; *p < 0.1; **p < 0.05; ***p < 0.01*

4.7 Project reach and contributions to crop production

Using the project facilitated input total volumes and average productivity, area planted and input use rates from the surveys, we report the estimated project reach and contributions to wheat and potato production during the 2025 winter season (Table 5). We assume that all the fertilizer was mainly used on two main field crops, wheat and potato, during the 2025 winter season based on the input distribution data. In addition, winter wheat production is 100% rainfed and in irrigation schemes, with each farmer cultivating on average 2.1 ha or 5 feddans. Overall, we estimate that 93,872 wheat farmers accessed project supported fertilizer to produce 497,558 MT on 197,131 ha (Table 5). In addition, 7,273 farmers used project supported potato seed and fertilizers to produce 259,200 MT on 16,000 ha.

Table 5: Estimated overall project reach and contributions to food production during the 2025 winter season.

Crop	Seed rate (kg/ha)	Fertilizer rate, median (kg/ha)	Total seed available from the project (kg)	Total fertilizer available from the project (kg)	Average area cultivated per farmer (ha)	Median yield (kg/ha)	Total area cultivated (ha)	Total production (MT)	Reach (number of farmers)	Comment
Wheat - DAP	150	119	-	5,850,000	2.1	2,524	49,160	124,079	23,409	Also used 1.63 Urea/ kg DAP
Wheat - Urea	150	190		28,114,500	2.1	2,524	147,971	373,479	70,462	Nets out 1.63*DAP equivalent
Potato - DAP	2500*	125*	-	2,000,000	2.2*	16,200	16,000	259,200	7,273	Assume all area used Urea given low Urea supply
Potato - Urea	2500*	250*		2,000,000	2.2*	16,200			-	Covered under DAP
Potato - seed	2500*	-	5,200,000		2.2*	16,200			-	Covered under DAP
Sub total	***Wheat***						***197,131***	***497,558***	***93,872***	
	Potato						***16,000***	***259,200***	***7,273***	
Grand total							**213,131**	**756,758**	**101,144**	

Notes: * obtained from literature, the rest are from the surveys, all are used to compute total area cultivated, production and reach.

4.8 Projected impacts on net food production

4.8.1 2025 winter season net food production based on survey data

Using survey data on actual input application rates, area cultivated, and farmer reach, the 2025 winter season inputs generated substantial gross and net food production after post-harvest losses (Table 6).

Table 6: Project contributions to net food production during the 2025 winter season

Crop	Area cultivated (ha)	Gross production (MT)	**Net production (MT)** after accounting for post-harvest loss
Wheat	197,131	497,558	433,373
Potatoes	16,000	259,200	220,320
Total	213,131	756,758	653,693

The total net production of 653,693 MT represents the additional food available for human consumption after accounting for post-harvest losses of 12.9% for wheat and 15% for potatoes. The project reached an estimated 101,144 farmers (93,872 wheat farmers and 7,273 potato farmers). For comparison, under the export-oriented scenario the same inputs would have produced only 382,612 MT, and under the balanced scenario 618,330 MT using modelled assumptions, but these scenarios are highly unlikely given the collapse of food exports during the war.

4.8.2 Contribution to closing the national food deficit

Sudan's annual national food deficit in 2025 is estimated at 1.9 million MT, of which 1.7 million MT cereals. Using actual 2025 winter season production data from the Sustain Sudan Project, additional net wheat output reached 433,373 MT, while additional net potato output reached 220,320 MT. This implies that Sustain Sudan's additional output of 653,693 MT covers 34% of the food gap in terms of weight.

Because potatoes provide only 30% of the caloric value of wheat per unit weight (a standard conversion reflecting lower energy density), the caloric contribution of potatoes calculated by multiplying potato quantity by 0.3, yielding an equivalent of 66,096 MT of

cereal. Adding the direct wheat contribution (433,373 MT) gives a total cereal-equivalent caloric contribution of 499,469 MT from the 2025 winter season alone.

This amount closes 29.4% of the 1.7 million MT cereals caloric deficit in a single season. In other words, the 2025 winter season wheat and potato harvests supplied nearly one-third of the cereal-based energy required to close Sudan's annual food gap, without accounting for additional contributions from summer crops or other food sources.

4.8.3 Cost-effectiveness analysis

Sustain Sudan invested USD 6.3 million to facilitate the import and distribution of 53,700 MT of inputs (48,500 MT of fertilizer and 5,200 MT of seed potato). These investments included financial incentives in the form of finance, de-risking and price support. Yet, these incentives covered only a small portion of the total input cost; farmers and importers paid the remaining 90%+ at market prices. From a donor perspective, the average investment per ton of inputs was USD 117 (Table 7).

Using survey data, the donor cost per additional ton of net food produced (after post-harvest losses) equals USD 9.6, which is calculated as USD 6.3 million divided by 653,693 MT.

Table 7: Cost effectiveness of the Sustain Sudan investments for the 2025 winter season

Intervention	Cost per ton (USD)	What is delivered
Direct food aid	1,000 to 1,500	1 ton of food
Direct fertilizer purchase/distribution	1,000 to 1,300	1 ton of fertilizer
Sustain Sudan fertilizer facilitation	117	1 ton of fertilizer facilitated (partial cost; farmers/importers pay the rest)
Resulting food production	9.6	1 additional ton of grain produced (total economic cost is higher, but donor contribution is this amount)

Comparisons with other intervention approaches adds two nuances. First, on a donor cost per ton of fertilizer basis, the project's investment of **USD 117** is **8 – 11 times lower** than the USD 1,000–1,300 required for direct donor funded fertilizer handouts. Second, on a

donor cost per ton of food, the project's cost of **USD 9.6** is **104 – 156 times lower** than the cost of delivering an equivalent ton of food aid.

These figures represent extraordinary donor return on investment. They do not claim that the total economic cost of producing a ton of grain is USD 9.6; rather, they show how donor resources can leverage private investment to generate larger food volumes in a more sustainable manner at a fraction of the direct aid cost, while simultaneously rebuilding local agricultural systems.

4.8.4 Projected scale-up for context (2026–2027)

This section explores the Sustain Sudan project's net food production for 2026 to 2027 based on phased input targets. The project directs a food-focused allocation of 70 percent of total fertilizer to staple food crops (sorghum, millet, wheat) each season. The remaining 30 percent goes to export crops such as sesame, groundnuts, and horticultural produce; these figures do not count toward net food production for local food security. The 2025 winter season actual production provides a reference.

Two scenarios reflect different total fertilizer volumes in 2027; Sustain Sudan apply the 70 percent allocation to each season's total to derive fertilizer to staples.

- Scenario 1 – Optimistic (Initial Project Target) assumes total fertilizer in 2027 of 130,000 metric tons in summer and 70,000 metric tons in winter, giving 200,000 metric tons. This corresponds to 91,000 metric tons (summer) and 49,000 metric tons (winter) of fertilizer to staple food crops, reflecting normal market conditions.
- Scenario 2 – Pessimistic (War-Impacted) assumes total fertilizer in 2027 of 84,500 metric tons in summer and 45,500 metric tons in winter, totaling 130,000 metric tons. Fertilizer to staples becomes 59,150 metric tons (summer) and 31,850 metric tons (winter). Continued conflict involving the USA, Israel, and Iran disrupts global fertilizer supply and raises costs, which accounts for this scenario.

Both scenarios use identical 2026 volumes: 2026 Summer total fertilizer 40,000 metric tons (28,000 metric tons to staples, 12,000 metric tons for export crops); 2026 Winter

total fertilizer 50,000 metric tons (35,000 metric tons to staples, 15,000 metric tons for export crops), plus 10,000 metric tons of seed potato.

Scenario 1 generates 6.59 million metric tons of net food over 2026 to 2027. Adding winter 2025 actual production (0.654 million metric tons) yields a three-year cumulative of 7.25 million metric tons. This represents an average annual deficit reduction of 2.42 million MT, or 127% of the national food deficit of 1.9 million MT per year. Scenario 2 generates 4.99 million metric tons over 2026 to 2027. The three-year cumulative reaches 5.64 million metric tons, closing 99 percent of the deficit, a marginal shortfall of about 19,000 metric tons per year, which demonstrates strong resilience despite a 35 percent reduction in 2027 fertilizer.

For each season, 70% of total fertilizer allocated to staple food crops; the remaining 30% allocated for export crops (e.g., sesame, groundnuts, and horticulture) and excluded from net food production figures. For summer seasons, the project assumes a 50% yield increase over baseline for fertilized sorghum and millet, equivalent to 37.3 MT of net grain per MT of fertilizer applied to staples. For winter seasons, the same farmer yields as winter 2025 apply (wheat 2.79 t/ha, potato 18.8 t/ha), giving 24.3 MT of net grain per MT of fertilizer plus a fixed 55,900 MT from 10,000 MT of seed potato. All calculations assume normal rainfall, adequate security, and full functioning of the proposed Finance Facility. For Scenario 2 only, prolonged US-Israel-Iran war reduces global fertilizer availability and raises prices, limiting 2027 total fertilizer to 130,000 MT. Actual results may vary depending on agronomic conditions, input-to-food price ratios, and conflict dynamics

4.9 Project effects on fertilizer prices

Since the Sustain Sudan project imported nearly 86% of the national fertilizer volume during the 2025 winter season, the project could have facilitated increased access by farmers through its contribution to lowering the fertilizer prices. We assessed this contribution using data from the IFPRI Sudan essential commodities monitor. In general, fertilizer prices remained volatile nationally between February 2025 and January 2026, with DAP and Urea prices increasing by 27% and 55%, respectively (Figure 13). We observe similar price trends in the key project intervention states. However, we note that both DAP

and Urea prices declined by approximately 45% and 12%, respectively, between late September 2025 and early October 2025 at national level and the same pattern is evident across the key States. This period coincides with an increase in fertilizer supply owing to the large volume facilitated by the Sustain Sudan project and a period of low demand at end of the summer season. This decline in fertilizer prices is suggestive of a positive contribution of the project to lowering fertilizer prices in the country.

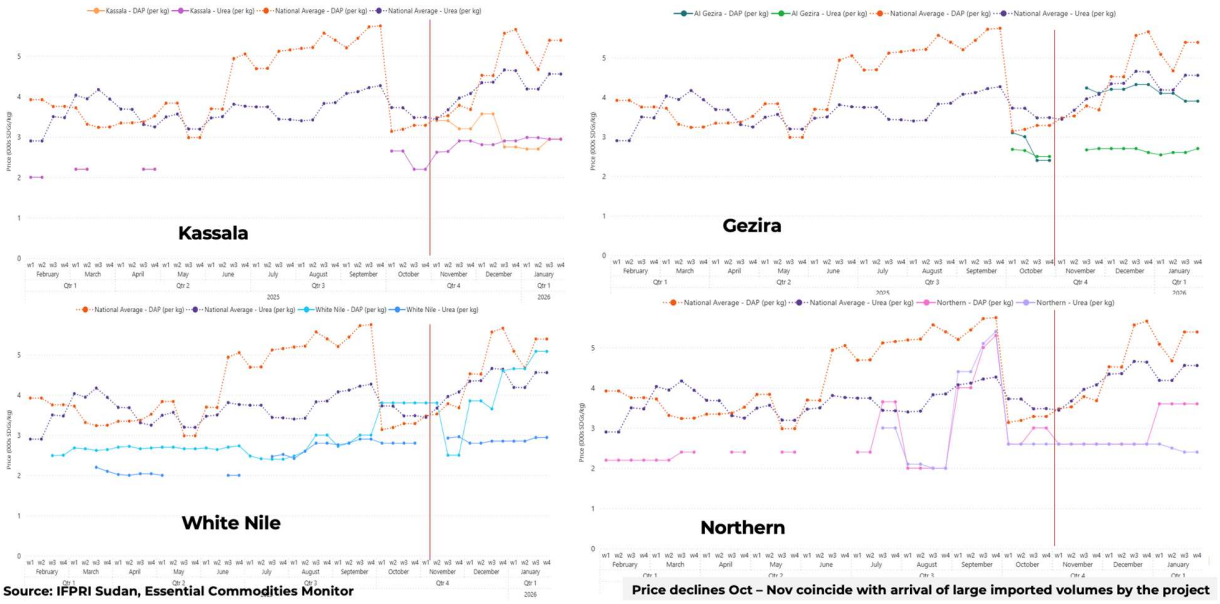


Figure 13: Fertilizer price trends between January 2025 and January 2026.
Source: IFPRI Sudan essential commodities monitor.

5. Discussion

We measured livelihood outcomes using crop yields (i.e., for wheat and potato), household income, and food security status. Beneficiaries achieved an average wheat yield of 2.8 MT/ha, while non-beneficiaries achieved 2.2 MT/ha. These figures align with average yields reported in the literature, which indicate an average irrigated wheat yield of approximately 2.5 MT/ha (FAO, 2025). Potato yields averaged about 18.8 MT/ha among beneficiaries, compared to 6.3 MT/ha among non-beneficiaries. These results fall within the range reported even before conflict in Sudan of 8 to 25 MT/ha, as documented by Simpson et al., (2021). Project beneficiaries applied more DAP (119 kg/ha vs 112 kg/ha) and urea fertilizers (197 kg/ha vs 187 kg/ha) than non-beneficiaries. These application rates are in line with FAO, (2006) reported application rates of 190 kg/ha of urea for wheat. The differences in input use are statistically significant, and the baseline balance test shows that variables not influenced by the project were statistically insignificant, indicating no meaningful differences between beneficiaries and non-beneficiaries at baseline. Therefore, the observed improvements in fertilizer application rates may be attributed to the project support.

We hypothesized that participation in the project influences household livelihood outcomes. Our results show that Sustain Sudan project participation significantly increased wheat yields by 27% among beneficiary households compared to non-beneficiaries. These findings align with FAO, (2025), which reports that low yields in both irrigated and rainfed systems largely result from limited access to improved seeds, fertilizer, credit, and limited use of improved agronomic practices. These factors are also key determinants of the persistent wheat yield gaps in Sudan (Ibrahim et al, 2024). Similarly access to improved seeds, fertilizer and advisories were key drivers of the higher potato yields among beneficiaries. These factors are key constraints to potato production in Sudan (Simpson et al, 2021). Therefore, the observed increase in wheat and potato yields among project beneficiaries likely reflects the project success in addressing common production constraints through enhancing access to inputs and the provision of technical support.

Despite the conflict, farmers with relatively stable access to irrigation infrastructure and agricultural services including inputs performed better. Our findings show that project interventions had a positive impact, consistent with Dorosh et al., (2026), who argue that wheat productivity in Sudan depends heavily on well-functioning irrigated systems and timely access to production inputs. The same argument applies to Irish potato production in Sudan (Simpson et al, 2021). This evidence suggests that project-supported access to improved inputs, finance and advisory services can play a stabilizing role, even under crisis. The project also indirectly facilitated increased fertilizer use by its contribution to lower prices owing to the large, imported volumes.

We find that recipients were more food secure than non-beneficiaries, consistent with broader evidence from Sudan. FAO, (2025) and Nigus et al., (2025) report that conflict-induced displacement and market disruptions have worsened food insecurity in the country. As such, even little to moderate improvements in crop yields can substantially enhance food access. However, we observe insignificant effects on income, aligning with Dorosh et al. (2026), who note that ongoing conflict has caused severe market disruptions, transport constraints, and price instability. These factors likely weaken the translation of production gains into realized household income. This suggests that while productivity gains may occur in the short term, income effects depend on well-functioning output markets and may only materialize over time.

The project contributed substantially to national wheat and Irish potato production. In addition to reaching a combined 101,144 farmers, the project made large and significant contributions to national crop production. In terms of wheat, project interventions contributed to about 101% of the national 490,320 MT production and covered about 126% of the total 155, 800 ha of area under wheat during the 2024/2025 season (FAO, 2025b). We used the 2024/2025 data for comparison as the most recent available national statistics. This increased production extends the recovery trends in agriculture production systems in Sudan in the last few years. For example, wheat production increased by 130% between 2023/2024 and 2024/2025 (FAO, 2025b). The potato interventions contributed about 65% of the national 400,000 MT annual production and covered 40% of the total 40,000 ha of area

under potato production relative to the 2024/2025 statistics (Simpson et al 2021). These overall reach and production results are a testament of the significant contributions of the Sustain Sudan project to local food production during the 2025 winter season in Sudan.

In our impact forecast model, analysts might argue that farmers will divert fertilizer to higher value cash crops such as sesame or groundnuts to maximize profits. However, several factors make the food focused scenario more realistic for Sudan. First, Sudan imports wheat and exports insignificant amounts. Potatoes reach consumers fresh locally and do not constitute a major export crop. Second, the war has collapsed export logistics and foreign exchange markets, making cash crop production and exports highly risky. Third, the project can use vouchers, credit guarantees, and input tracking to ensure that fertilizer reaches staple food crops. Fourth, with 25 million food insecure people, humanitarian aid must prioritize direct food availability. Even under a balanced scenario (50 percent food), the project would have covered only 33 percent of the deficit in 2025. The food focused scenario more than doubles that impact.

Beyond direct food availability, the project generates important secondary benefits. Increased local supply helps stabilize or lower grain prices, improving access for all consumers, not just project beneficiaries. Farmers who sell surplus staples or who use the 30 percent share of fertilizer on cash crops see higher incomes, which in turn improves their purchasing power for other essential goods. Potato production adds vitamin rich food to local diets, enhancing dietary diversity. Furthermore, the demonstration effect of successful input use encourages other farmers to adopt improved practices, potentially multiplying the impact beyond direct beneficiaries.

The single largest threat is the collapse of agricultural finance. Without the proposed Finance Facility, farmers cannot afford inputs at current prices, which have increased sixfold since pre-war levels. Other key risks include a deterioration of the input to food price ratio (which could erode farmer profitability), continued currency depreciation, security disruptions that cut off market access, and post-harvest losses that waste production. Mitigation measures include monthly monitoring of price ratios, targeted subsidies if

margins fall below thresholds, the Finance Facility's currency protection mechanism (which triggers when depreciation exceeds 35 percent over six months), conflict sensitive geographic targeting, and investment in storage infrastructure.

These quantitative findings are aligned to the qualitative insights drawn from farmers during field visits throughout the 2025 winter season. For example, Mohamed Magrabi, a farmer from Basalola Village in the New Halfa Agricultural Scheme, celebrated a successful wheat harvest after adopting improved farming practices supported by financing from the Agricultural Bank of Sudan.

Mohamed Magrabi
"I obtained a loan from the Agricultural Bank of Sudan, which enabled me to purchase improved seeds, fertilizers, and pesticides. So far, my five feddans have produced more than 70 sacks of wheat, and the harvest is still ongoing''

Due to the timely availability of inputs facilitated by the project, farmers in New Halfa scheme were able to prepare their fields and meet the planting window for the winter season.

Mohamed Akasha, a farmer in block 1, in the Scheme
"We started our preparations early, and we were glad to receive fertilizers from [the project supported] Al Ebdaa Bank at the right time. We are glad that Al Ebdaa Bank provided us with fertilizers on time to catch up with the important winter cultivation season. As farmers, we look forward to full funding, through loans, for agricultural operations, including land preparation, seeds, fertilizers, pesticides, and harvesting."

6. Limitations

Our study has four main limitations. First, the potato yield analysis is based on a small sample of potato farmers that were included in the yield cut assessments. However, the sampled area collectively represented approximately 100 acres or 40 ha. This is a large enough area to provide meaningful insights. Second, the dataset obtained from the beneficiary monitoring data from project partners did not capture production data for other crops (e.g., onion and cowpea), which limits the ability to conduct comparative yield analysis on these crops. Despite this, we are confident that our analysis focused on wheat and potato capture the main winter field crops in Sudan. Third, the ongoing active conflict situation constrained and slowed down the collection of household survey data. As such, only the wheat survey data are used in this analysis while complementary survey data collection on potato was still on going at the time of reporting. Lastly, we estimate the reach and contribution to crop production by extrapolating input use and yields from the surveys. While the use of population weights from representative samples would be preferable, this was not possible given the challenges of survey data collection in Sudan. We are confident in our estimates since they combine actual input data from project documents and survey data on input use. Despite these limitations, we are confident in the robustness of the findings presented given the methodological rigor and consistency of the results across different statistical and econometric approaches employed how aligned the results are to literature in Sudan.

We recognize additional constraints on the project impact forecast model. First, we assume constant post-harvest loss rates, but higher yields could overwhelm storage capacity and increase losses. Second, we limit the geographic scope to accessible areas (Gezira, Rahad, Gadarif, New Halfa, North Kordofan, and parts of Darfur), so findings may not apply to other regions. Third, we did not measure yield increases for summer rain fed crops because actual data are not yet available. Future analyses should track real-time allocation using distribution records and farmer surveys. Finally, we do not account for potential disruptions from security escalations, flooding, or drought beyond the modelled price shocks.

7. Conclusion and implications

The war in Sudan has disrupted food production and supply chains, threatening the livelihoods of millions since 15 April 2023. The Sustain Sudan project was designed to contribute towards restoring local food production by increasing fertilizer and improved seed supply and facilitating increased access and use by farmers. These goals are pursued using a market-based approach that supports private sector – led fertilizer and seed imports, local seed production and distribution, coupled with demand – and supply – side financing and strengthened advisories to improve input use efficiency. Since its inception in July 2025, the project has facilitated the importation of 48,500 MT of fertilizers and 5,200 MT of Irish seed potato into Sudan for the 2025 winter season through four Sudanese agrodealers.

This assessment was conducted in Kassala, Khartoum and River Nile States out of the 11 States, which were reached by project supported inputs. Kassala State hosts the New Halfa Scheme where 12,500 MT of project-linked fertilizer were distributed through the Agricultural Bank of Sudan (ABS), enabling the reopening of credit lines to smallholders after years of inaction since the start of the war. Khartoum and River Nile States were the loci for Irish potato production activities during the 2025 winter season, where the project supported the distribution of 4,000 MT of fertilizer and 5,200 MT of seed potato. This report assesses the extent to which these interventions improved crop yield, farmer incomes, and food security outcomes. We also estimate the project reach and contribution to wheat and potato production during the 2025 winter season.

We used data from three separate sources; project beneficiary monitoring from 8,000 farmers, potato yield cut assessments representative of about 100 acres and a detailed wheat household survey of 490 farmers including 316 project beneficiaries and 174 non-beneficiaries. We did this to ensure that we capture the yield of potato and wheat supported by the project during the winter season. We then employed several statistical techniques to assess the impact of the Sudan project activities on livelihood outcomes. We first used basic statistical techniques for comparing the means between outcomes of interest. Second, we examined the causal effects of being a project beneficiary on livelihood outcomes measured

by wheat production, income, and food security using the Inverse Probability Weighted Regression Adjustment approach. We use data on input application rates per hectare from the household survey, the yield cut assessment and literature to estimate area (covered) under production, total production and the reach, i.e., the total number of farmers estimated to be using the project supported inputs for wheat and potatoes.

We find statistically significant differences between project beneficiaries and non-beneficiaries in terms of wheat and potato yields, and food security outcomes. Wheat yields among project beneficiaries were on average 596 kg/ha or 27% higher than for non-beneficiaries. This difference is statistically significant. Since non-beneficiaries also used nearly comparable fertilizer rates, we compared our estimated beneficiary wheat yields to yields in traditional farming systems where fertilizer use is limited. The project beneficiary wheat yields were 1,189 kg/ha or 74% higher than the average wheat yields (1,600 kg/ha) with limited fertilizer use under traditional production systems.

Beneficiaries had a three-fold potato yield gain (18.8 t/ha compared to 6.3 t/ha among non-beneficiaries) mainly because beneficiaries received both improved seed and fertilizers. All, (100%) more beneficiaries were food secure compared to 42% among non-beneficiaries. In addition, project beneficiaries had about USD 526 more annual household income than non-beneficiaries, but the statistical significance dissipates after controlling for other variables in a multivariate regression framework. Among beneficiaries, female-headed households benefited more compared to male-headed households. The positive effects are expected given that the project beneficiaries used higher fertilizer quantities than non-beneficiaries, and a higher proportion accessed credit and complementary advisory and extension services.

Overall, the project contributed substantially to national wheat and Irish potato production. The project directly reached an estimated 101,144 farmers and made large and significant contributions to national crop production. In terms of wheat, project interventions contributed to about 101% of the national production and covered about 126% of the total area under wheat during the 2024/2025 season. We used the 2024/2025 data for

comparison as the most recent available national statistics. This increased production is consistent with the recovery trends in agriculture production systems in Sudan in the last few years. For example, wheat production increased by 130% between 2023/2024 and 2024/2025. The potato interventions contributed about 65% of the national annual production and covered 40% of the total area under potato production relative to the 2024/2025 statistics. These overall reach and production results are a testament of the significant contributions of the Sustain Sudan project to local food production during the 2025 winter season in Sudan.

The positive results from this assessment demonstrate the impact of market led agricultural interventions in a conflict situation. The project played a significant catalytic role to de-risk private sector and facilitate imports through various financing mechanisms including credit guarantees, letters of credit, first loss guarantees, grants and other instruments. Some of these instruments were issued to microfinance institutions to facilitate onward lending to smallholders. Another pathway the project facilitated increased farmer access to fertilizer is through its contribution to lowering fertilizer prices at the time the imports arrived in Sudan. These findings show that market-based approaches can effectively enhance productivity and food security in conflict-affected countries like Sudan. Realizing these positive outcomes will require coupling such interventions with financial mechanisms that reduce investment risks for private sector actors. While it may be difficult to attribute these outcomes solely to this project given several other agricultural interventions, the Sustain Sudan project contributed to the positive outcomes of the 2025 winter season. Future studies can develop long-term and statistically representative panel surveys to capture impacts over time and to estimate the reach of interventions.

The donor cost per extra ton of food (USD 9.6) is approximately 104 to 156 times lower than food aid on a per ton of food basis, and 8 to 11 times lower on an input-to-input comparison. The donor cost of USD 117 per ton of fertilizer facilitated by the Sustain Sudan project is much lower compared to USD 1,000 to 1,300 for direct donor funded fertilizer. These figures represent extraordinary donor value for money; they do not imply that the total economic cost of production is USD 9.6 per ton.

Based on the evidence, the Sustain Sudan Project should immediately scale up its operations while maintaining a clear focus on staple food crops. The following recommendations fall into immediate, short term, and ongoing actions. Each derives from the analysis of winter 2025 outcomes and the identified risks.

For immediate actions, we recommend launching the Sustain Sudan Finance Facility, a EUR 90 million de-risking fund with EUR 10 million first loss from donors. This single action serves as the most critical enabler for scaling. Without this facility, farmers cannot afford inputs at current prices, which have increased sixfold since pre-war, and banks will continue withholding agricultural credit. We also recommend targeting a 70/30 food to cash allocation for all future fertilizer distributions. We should enforce this target through a combination of vouchers, credit guarantees, and input tracking mechanisms. These tools will ensure fertilizer reaches staple food crops rather than diverting to cash crops.

The 2025 winter season saw a higher proportion of fertilizer used on potatoes than originally modelled. While potatoes are a food crop and provide valuable nutrition, we need better tracking to ensure that staple grains such as wheat receive sufficient fertilizer volumes in future seasons. Another immediate action is to activate price monitoring of input to food ratios. We should establish a monthly reporting system that triggers mitigation measures such as targeted subsidies when the ratio falls below a sustainable threshold for farmer profitability. Finally, we need to diversify fertilizer blends beyond Urea and DAP for summer season crops. Urea and DAP alone do not provide balanced nutrition for rainfed sorghum and millet because many Sudanese soils lack sulfur, potassium, and zinc.

For short term actions, we recommend scaling up proven agronomic practices based on North Kordofan trials (Aune & Ousman, 2011). We should promote micro dosing and seed priming (soaking seeds before sowing), which have shown yield gains of 70 to 110 percentage points for sorghum and millet and conservation agriculture systems to optimize input and water use. These low-cost techniques are particularly suitable for resource constrained farmers. We also recommend investing in post-harvest handling infrastructure. Current post harvest losses range from 12 to 15 percent for wheat and potatoes to 8 to 12

percent for sorghum and millet. Reducing these losses by half through investment in hermetic storage bags, drying platforms, and small-scale processing units could increase net food availability by an estimated 200,000 to 300,000 MT annually without additional fertilizer. Another short-term action is to assess opportunities for seed multiplication for potatoes and cereals with robust quality assurance and control. The project's seed potato target of 10,000 MT annually requires significant multiplication capacity. We should collaborate with the International Potato Center (CIP) on potatoes and the Agriculture Research Corporation (ARC) and other local agricultural research stations to support local certified seed production. Finally, we should commission soil mapping across major production zones including Gezira, Rahad, Gadarif, New Halfa, and North Kordofan. This will enable site specific fertilizer recommendations, improve agronomic efficiency, and reduce waste. The planned fertilizer mega demonstrations for the 2026 summer season is a good start. There is need to leverage existing spatial soils data products to fasten identification of site-specific fertilizer recommendations.

For ongoing actions, we recommend monitoring input to food price ratios monthly and triggering mitigation measures such as targeted subsidies if farmer profitability margins fall below sustainable thresholds. We should establish a dashboard accessible to all partners. We also recommend conducting annual farmer training on good agronomic practices and complementary good fertilizer application through farmer field schools, mega demonstrations and other channels targeting at least 50 percent of beneficiary farmers each year. Finally, we should maintain conflict sensitive targeting by starting in the safest areas and gradually expanding as security permits. We need to use daily security monitoring and diversify geographic reach to reduce exposure to any single conflict zone.

The Sustain Sudan project must address agricultural finance to catalyze scaling; otherwise, farmers' and agrodealers' constraints in access to finance and de-risking could impede the reduction of the remaining food deficit. The Sustain Sudan project has laid the foundation and proven this concept and is currently exploring opportunities.

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Annexes: Project Impact model

Annex A: Detailed Calculations and Assumptions

A.1 Phased Input Targets (2025-2027)

Season	Fertilizer (MT)	Seed potato (MT)	Total Inputs (MT)
2025 Winter (Actual)	48,500	5,200	53,700
2026 Summer	40,000	–	40,000
2026 Winter	50,000	10,000	60,000
2027 Summer	130,000	–	130,000
2027 Winter	70,000	10,000	80,000
TOTAL	338,500	25,200	363,700

A.2 Key assumptions

Parameter	Value	Source
Fertilizer supplied	48,500 MT	Project records
Seed potato supplied	5,200 MT	Project records
Seed potato planting density	2.5 t/ha	CIP guidelines
Wheat fertilizer application rate	100 kg N/ha (0.1 t N/ha)	Gezira trials
Potato fertilizer application rate	83 kg N/ha (0.083 t N/ha)	University of Gezira
Beneficiary wheat yield	2.79 t/ha	2025 winter season impact assessment report
Non-beneficiary wheat yield	2.19 t/ha	2025 winter season impact assessment report
Beneficiary potato yield	18.8 t/ha	2025 winter season impact assessment report
Non-beneficiary potato yield	6.3 t/ha	2025 winter season impact assessment report
Post-harvest loss – wheat	12.90%	APHLIS Sudan
Post-harvest loss – potato	15.00%	University of Gezira
Weighted net availability factor (winter)	0.865	Calculated

A.3 Fertilizer application rates

Crop	Season	N Application Rate (kg/ha)	Source
Sorghum	Summer (rain-fed)	50–64	North Kordofan trials (Aune & Ousman, 2011)
Millet	Summer (rain-fed)	30–40	Micro-dosing trials (Aune & Ousman, 2011)
Wheat	Winter (irrigated)	86–129	Gezira trials
Potatoes	Winter (irrigated)	83	University of Gezira

A.4 Agronomic efficiency

Crop	Season	Efficiency Factor	Context	Source
Sorghum	Summer	19-40 kg grain/kg N	Rain-fed	Togo/North Kordofan (Aune & Ousman, 2011)
Millet	Summer	~30 kg grain/kg N (est.)	Rain-fed	North Kordofan (Aune & Ousman, 2011)
Wheat	Winter	24-30 kg grain/kg N (estimated)	Irrigated	Derived from Gezira trials; further study needed
Potatoes	Winter	Not applicable	Irrigated	WAS Trading yield estimates rather than AE

A.5 Baseline and target yields

Crop	Season	Non-Beneficiary Yield (t/ha)	Beneficiary Yield (t/ha)	Yield Increase	Source
Sorghum	Summer	1.9	N/A	0.5	North Kordofan trials (Aune & Ousman, 2011)
Millet	Summer	0.45	N/A	0.5	North Kordofan trials (Aune & Ousman, 2011)
Wheat	Winter	2.19	2.79	+27% (Actual)	2025 winter season impact assessment report
Potatoes	Winter	6.3	18.8	+198% (Actual)	2025 winter season impact assessment report

A.6 Post-harvest loss estimates

Crop	Loss (%)	Source
Sorghum	12.20%	APHLIS Sudan, 2021
Millet	8.80%	APHLIS Sudan, 2021
Wheat	12.90%	APHLIS Sudan
Potatoes	15.00%	University of Gezira

A.7 Sensitivity analysis

Parameter	Scenario	Yield Increase / AE Range	Three-Year Net Production (million MT)	Change from Target
Winter (Wheat)	Conservative	20% increase	2.087	–5%
	Target (Actual)	27% increase	2.188	—
	Optimistic	40% increase	2.375	9%
Summer (Sorghum/Millet)	Conservative	30% increase	2.661	–16%
	Target	50% increase	3.17	—
	Optimistic	70% increase	3.679	16%
Wheat Agronomic Efficiency (AE)	Low AE	20 kg grain/kg N	1.97	–14%
	Target AE	25 kg grain/kg N	2.292	—
	High AE	30 kg grain/kg N	2.614	1

A.8 Projected net food production (2026–2027)

Season	Total Fertilizer (MT)	Fertilizer to Staples (70%) (MT)	Seed Potato (MT)	Scenario 1 (Optimistic) Net Production (MT)	Scenario 2 (War-Impacted) Net Production (MT)
2025 Winter (Actual)	48,500	–	5,200	653693	653,693
2026 Summer	40,000	28000	0	1044400	1,044,400
2026 Winter	50,000	35,000	10,000	906400	906,400
2027 Summer	130,000 (S1) / 84,500 (S2)	91,000 (S1) / 59,150 (S2)	0	3394300	2,206,295
2027 Winter	70,000 (S1) / 45,500 (S2)	49,000 (S1) / 31,850 (S2)	10,000	1246700	830,355
Total 2026–2027 (S1)	290,000	203,000	20,000	6591800	–
Total 2026–2027 (S2)	220,000	154,000	20,000	–	4,987,450
Three-year cumulative (2025–2027 S1)	–	–	–	7245493	–
Three-year cumulative (2025–2027 S2)	–	–	–	–	5,641,143
Average annual deficit reduction (S1)	–	–	–	2.415 million MT (127% of deficit)	–
Average annual deficit reduction (S2)	–	–	–	–	1.880 million MT (99% of deficit)

Annex B: Risk Mitigation and Price Shock Analysis

B.1 Risk mitigation matrix

Risk	Mitigation strategy	Responsible party
Input prices rise faster than food prices	Monthly price ratio monitoring; targeted subsidies if threshold exceeded	CIMMYT, Sustain Africa
Banks unwilling to lend	Finance Facility 50% risk participation; pilot banks; Central Bank engagement	Sustain Africa, 249 Startups
Currency depreciation	Unfunded risk participations; tail-end currency protection (>35% trigger)	Sustain Africa, 249 Startups
Post-harvest losses	Investment in storage infrastructure; farmer training on drying/storage	CIMMYT,extension partners
Security disruptions	Conflict-sensitive targeting; diversify geographic reach; daily security monitoring	CIMMYT, Clingendael
Inadequate farmer training	Expand extension network; farmer field schools; demonstrate micro-dosing/seed priming	CIMMYT, 249 Startups
Seed quality gaps	Local multiplication; quality assurance systems	CIMMYT

B.2 Price shock analysis (balanced scenario, with and without Finance Facility)

Scenario	Price increase	Application rate factor	Net production (MT)	% of target
No shock	0%	1	5,358,247	100%
Moderate shock	50%	0.85	4,554,510	85%
Severe shock	100%	0.7	3,750,773	70%
Severe + no Finance Facility	100%	0.5	2,679,124	50%
Severe + with Finance Facility	100%	0.75	4,018,685	75%

The Finance Facility maintains production at 75% of target under severe shock, compared to only 50% without it, a 25-percentage point improvement

Annex C: Supplementary Data

C.1 IFPRI Fertilizer Price Data (November 2025 – January 2026)

Fertilizer Type	Average Price (million SDG/ton)	Increase from pre-war
Urea	4.17	~6×
DAP	4.99	~6×
Weighted Average	4.55	~6×

C.2 APHLIS Post-Harvest Loss Estimates (Sudan, 2021)

Crop	Annual Production (MT)	Loss Percentage	Annual Losses (MT)	People Fed by Lost Grain*
Sorghum	3,529,180	12.20%	430,783	2,393,239
Millet	900,750	8.80%	79,260	440,333
Wheat	676,380	12.90%	87,253	484,739
Total	5,106,310	—	597,296	3,318,311

*Based on 180 kg/person/year consumption (FAO estimate for Sudan)

C.3 North Kordofan Micro-Dosing Trial Results (Aune & Ousman, 2011)

Crop	Treatment	Yield (t/ha)	Yield Increase	Gross Margin (USD/ha)
Sorghum	Control (no fertilizer)	0.48	—	49.5
Sorghum	0.9g NPK + seed priming	1.01	110%	206.5
Millet	Control (no fertilizer)	0.44	—	44.9
Millet	0.3g NPK + seed priming	0.76	73%	90