Supporting Emergency Needs, Early Recovery and Longer-term Resilience in Syria's Agriculture Sector

Endline Report of the Impact Assessment of the FCDO-funded FAO Programme in Syria

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Executive summary

Background: Funded by FCDO, FAO Syria implemented the "Supporting emergency needs, early recovery and longer-term resilience in Syria's agriculture sector" programme, delivering "emergency" and "recovery" support to vulnerable smallholder farmers across Syria. The programme's main objective was to increase food availability through improved smallholder production and build resilience and recovery of households and the agricultural sector against shocks. The programme's theory of change depicts that these objectives are achieved through increasing the productive capacity of households in the form of direct asset transfers of agricultural inputs on one hand and enhancing access to alternative income sources as well as irrigation technologies on the other hand.

Aim of this study: In this endline report, we analyse the impacts of the programme on a broad set of outcome indicators. These include food security status, the use of harmful livelihood strategies to cope with shortages of food, agricultural crop and livestock production, and income generated from agricultural value chain activities. The impact analysis adopts a quasi-experimental approach using household survey data collected from beneficiary and non-beneficiary households before, during and after the intervention took place. We also explore whether the key indicators vary meaningfully by gender and by access to irrigation. This impact assessment builds on earlier analyses of the baseline and midline data in which we found that, against a background of severe insecurity and a drought, the programme had a strong positive impact on household livelihoods and welfare.

Time trends: In this study, we first examine the time trends for the overall sample to present changes that occurred in Syria between the baseline and the endline surveys. There is an overall significant reduction in the use of harmful coping strategies, particularly in the sale of productive assets as well as for children taking extra jobs to support household needs. These overall positive changes correlated with the end of the drought period which was affecting Syria and the agriculture sector in the past years as well as the lower intensity of conflict events. Stronger security and more rainfall benefited smallholder farmers in Syria, lifting the tide for all. On the other hand, and although in decline, we find that households do still rely considerably on credit to ensure adequate consumption. Share of households who engage in value chain activities increased, particularly concerning the sales of crop and livestock produce. Households report that prices of agricultural inputs (such as seeds and tools) remain too expensive, echoing the sharp increase we detected at midline, particularly for agro-chemicals. Although we are unable to prove this directly with the data, we posit that these challenges can be linked to the

hyperinflation occurring in the region caused by the financial and currency crises in Lebanon and Syria.

Comparison of groups at endline: We also analyse the endline survey which was newly collected by FAO Syria, taking into account differences between the beneficiary and non-beneficiary groups as well the difference by intervention type. The data show that households in the beneficiary group are better off in regards to food security. They also rely less on harmful coping mechanisms on average. We find that these positive differences in food security mainly include households who received the vegetable kits or seedlings. Moreover, we observe that households who received livestock vaccines, poultry or beekeeping did not increase their diet diversity and food security. However, beekeeping beneficiaries showed stronger resilience against productive asset depletion to deal with shocks while beneficiaries of livestock vaccines are less likely to rely on credit to deal with food shortages.

Impact assessment: In a third step, we match and analyse the panel data we collected to quantify the causal impact of FAO's programme on food security and agricultural production. The data uses a smaller sample of households who were interviewed both at baseline and endline. While smaller samples are not desirable as such, the panel structure of the data implies that these estimates are our most rigorous calculations of causal programme impacts, methodologically speaking. The rigorous impact evaluation analysis has four main findings:

1. **The FAO programme causally and significantly strengthens the food security of vulnerable smallholders** in Syria by 13% from baseline values, which is particularly evident for households who received support in vegetable production.

2. **Female-headed households benefited considerably** from the programme increasing their food security status by 32% compared to female-headed households who did not receive support.

3. **Impact was also stronger for households with access to irrigation**, who saw a notable improvement of 23% in their food security status due to the programme.

4. In contrast to the midline impact assessment findings, we find **notable evidence on the positive impacts on harvests and yields**, particularly for vegetable crops.

Over and above these findings, unintended positive or negative findings were not detected.

Methodological observations: Conducting an impact evaluation which requires panel survey data in a complex and challenging environment is an achievement in itself. The M&E team of FAO Syria worked tirelessly to reach most of the households who had been interviewed at baseline and were able to follow up with them. There were changes in the identified target beneficiary

villages and households due to post-baseline context analysis recommendation conducted by FAO and, hence, in the sample. This somewhat limited the extent of the analysis feasible. While a new sample of beneficiaries is included in the endline, this approach is no magic wand, as the new data complicates the analysis and consequently the interpretation of the findings. The planned qualitative assessment that will be conducted by FAO's Evaluation Office is key to deepening our understanding of the impact pathways, complementing the findings we outline in this report.

Lessons learnt: We derive six lessons from our analysis.

1. **Building resilience requires comprehensive and integrated programmes** with a long-time horizon to counter the multiple shocks faced in a conflict-affected setting.
2. To continue **fine-tuning and strengthening the targeting** as we observe varying heterogeneous impacts among different beneficiary subgroups (e.g., female-headed households or smallholders with access to irrigation).
3. To **cluster interventions**, rather than to spread interventions widely and thinly.
4. To conceptualise the intervention as an **agricultural social safety net for bad times**, which may come back sooner rather than later.
5. To continue to **strengthen rural markets** in Syria as a way of reducing dependency on credit, either with vouchers or cash, thus improving resilience.
6. Finally, to **continue to invest in learning** about how best to build food security and resilience through humanitarian agricultural interventions in conflict-affected settings, as such learning is a global public good.

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ACLED	Armed Conflict Location and Event Data
DEWS	Drought Early Warning System
DFID	Department for International Development
FAO	Food and Agriculture Organisation of the United Nations
FCDO	Foreign, Commonwealth and Development Office
FCS	Food Consumption Score
HDDS	Household Dietary Diversity Score
HH	Household
IDPs	Internally Displaced Persons
ISDC	International Security and Development Center
KIIs	Key Informant Interviews
M&E	Monitoring and Evaluation
MAAR	Ministry of Agriculture and Agrarian Reform
MoFA	Ministry of Foreign Affairs
RCSI	Reduced Coping Strategy Index
RIMA	Resilience Index Measurement Analysis
SPEI	Standardised Precipitation-Evapotranspiration Index
SPU	Sprout Production Unit
ToC	Theory of Change
WFP	World Food Programme

1. Introduction

The "Supporting emergency needs, early recovery and longer-term resilience in Syria's agriculture sector" project is a FAO programme in Syria, funded by FCDO (previously DFID). FAO Syria implemented the programme between October 2017 and May 2021 in nine Governorates across Syria, using various types of interventions.

The programme has **three key objectives**:

1. To increase food availability for vulnerable households through improved smallholder production;

2. To build sustainable access to productive assets, income and food supply; and

3. To foster enabling environments for resilience building and recovery of the agricultural sector.

In this endline report, we present the findings of the impact evaluation of the overall programme with particular focus on resilience outcomes.

First, we examine **changes in trends** in the food security, resilience and agricultural activities of smallholder farmers across Syria. We pay specific attention to changes in food security and resilience across the three waves at the governorate levels and present how households face climatic and economic shocks.

Second, we analyse the **current status of households at the endline** comparing differences in outcomes of food security and resilience indicators, agricultural and livestock production, and income generated from the value chain activities between the beneficiary and non-beneficiary groups.

Third, we build on the baseline and midline findings to assess **the impact of the programme** over time on various outcome indicators related to food security, the use of harmful coping strategies, crop production, and engagement in value chain activities. All these outcome indicators will provide a holistic overview on how the programme and the interventions strengthened the resilience of households against recurring shocks. We will pay particular attention to the outcomes for female-headed households.

The report is structured as follows. Section 2 presents an overview of the FAO programme activities, Section 3 describes the design adopted to study the impact of the programme, the sampling strategy, the outcome indicators, the data collection and processing, and safeguarding and ethics. Section 4 presents the results on the overall changes in the past two years in Syria. Section 5 provides findings on the endline survey of the overall programme and the specific

intervention packages. Section 6 presents the main findings on the impact assessment as well as results based on the heterogeneity analysis. Section 7 concludes with lessons learned.

2. The intervention

In this section, we discuss the specific study context, describe the programme's theory of change and main activities, as well as specify the scope of the assessment.

2.1 Context

The year 2021 marks 10 years since the start of the Syrian crisis which has caused hundreds of thousands of deaths and the protracted displacement of over 13 million Syrians, including 6.7 million IDPs[1]. The unprecedented depreciation of the national currency in the last two years, coupled with the imposition of further sanctions and the exacerbation of the economic crises in neighbouring countries, has resulted in new challenges to the ordinary Syrian in accessing and purchasing essential food, medicine, fuel, among other basic necessities. In Syria, about 9 million people are estimated to be in need of food and livelihood assistance.[2] Prevalence of iron deficiency anaemia is increasingly becoming widespread for children below five; with anaemia prevalence of 25.9 % for children under the age of five and 35.3% anaemia deficiency among children in Idlib.[3,4] Low agricultural production and weak markets have contributed to exacerbating food insecurity and worsening public health.[5]

Agriculture has played a central role in the livelihoods of the Syrian people. Before the onset of crises, the agriculture and livestock sectors contributed 18% of the country's GDP and 23% of its exports, involving 17% of the workforce in production.[6] Syria produced on average 4.1 million tons of wheat in the years before the war; it managed to do so by relying on oil which was heavily

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[1]WFP Syria Situation Report #4, April 2021. Available at: https://reliefweb.int/sites/reliefweb.int/files/resources/2021%2004%20WFP%20Syria%20External%20Situation%20Report%2004%20-%20April%202021.pdf

[2] Human Rights Watch Report 2021 on Syria. Available at: https://www.hrw.org/world-report/2021/country-chapters/syria Accessed on 18 June 2021.

[3] Nkunzimana, T., Custodio, E., Thomas, A.C., Tefera, N., Perez Hoyos, A., & Kayitakire, F. (2016). Global analysis of food and nutrition security situation in food crisis hotspots. March 2016. EUR 27879. ISBN 978-92-79-57814-4. DOI: 10.2788/669159

[4] Kern, J. - World Food Programme Syria (2017). Nutrition Interventions - Syria 2017. http://documents.wfp.org/stellent/groups/public/documents/communications/wfp290774.pdf

[5] Doocy, S., Tappis, H., Lyles, E., Witiw, J., & Aken, V. (2017). Emergency food assistance in Northern Syria: An evaluation of transfer programs in Idleb Governorate. *Food and Nutrition Bulletin, 38*(2), 240-259.

[6] FAO/WFP Crop and Food Security Assessment Mission to the Syrian Arab Republic, 09 Oct 2018. Available at: https://docs.wfp.org/api/documents/WFP-0000099336/download/?_ga=2.88828563.902524887.1543320124-1314015625.1540996852 accessed on: 18 June 2021.

subsidised for use in agriculture. During the crisis, the agricultural sector has remained remarkably resilient, where agriculture has provided an important social safety net for the estimated 6.7 million Syrians residing in rural areas. However, the resilience of this sector came at a cost. There has been a sharp reduction in both the quality and quantity of crops produced. In 2017, FAO estimated the costs of lost production, damaged, and destroyed agriculture assets and infrastructure to be approximately USD 16 billion.[7] The crisis has impacted the agricultural sector - and the people relying on it - differently across the country. These heterogeneities have been shaped by many factors including the territorial control by various actors, proximity to borders, violence spillovers, and agro-ecological zones and conditions. According to FAO, the crisis has primarily impacted the agriculture sector through access to and management of natural resources and the functionality of the agricultural value chains and rural labour markets.[8]

2.2 Theory of change

Against this background, the FCDO programme targets both smallholder farmers and the agricultural sector in Syria at large, with a view to increase access to agricultural assets and recover the rural agricultural sector. More specifically, the starting point of the interventions is that crisis-affected small-scale farmers face significant constraints in accessing agricultural inputs and sufficient water, which limit local food production. To alleviate these constraints, the programme provides direct agricultural inputs to households for crop, vegetable, and livestock production, and improves and rehabilitates systems for irrigation, water resource management, and fodder production. The programme includes both emergency and resilience packages.

The **emergency packages**, which can be seen as a direct asset transfer, aim to immediately increase farmers' access to high-quality seeds and livestock. In turn, this is intended to have two positive impacts in the short-run. First, it is meant to increase livestock and agricultural production at the household level, which is crucial for establishing and maintaining the supply of sufficient as well as more nutritious food. At the same time, the transfer means that higher quality inputs should be at the farmer's disposal. In the *medium-term*, both channels could contribute to higher productivity levels, strengthen household-level food security, diversify opportunities for income generation, relax budget constraints and reduce the need to take out credit to purchase inputs and food. These impacts, in the long-term, should improve nutrition,

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[7] FAO, Counting the Cost: Agriculture in Syria after six years of crisis, 2017, p.1. Available at: http://www.fao.org/3/b-i7081e.pdf.

[8] FAO, Context Analysis in support of the DfID funded project: "Supporting emergency needs, early recovery and longer-term resilience in Syria's agriculture sector 2017-2020." Jan 2019.

health and related well-being outcomes, both for the beneficiaries and their communities at large.

The **resilience packages**, including the rehabilitation of irrigation systems at the community level and the provision of local value chain market infrastructure, is expected to unlock similar pathways of positive impacts. In the first instance, the packages are meant to increase access to water and input supply among farmers, which, in the *short-term*, should boost production levels, especially in drought years, both at the household level and at the village level. In the *medium-term*, these improvements should increase agricultural productivity and decrease vulnerability to weather shocks, such as droughts, for the entire community. This is a key difference to the pathways of the first package, which operates only at the household level in the short- and medium-terms.

Figure 1a. FAO programme's theory of change
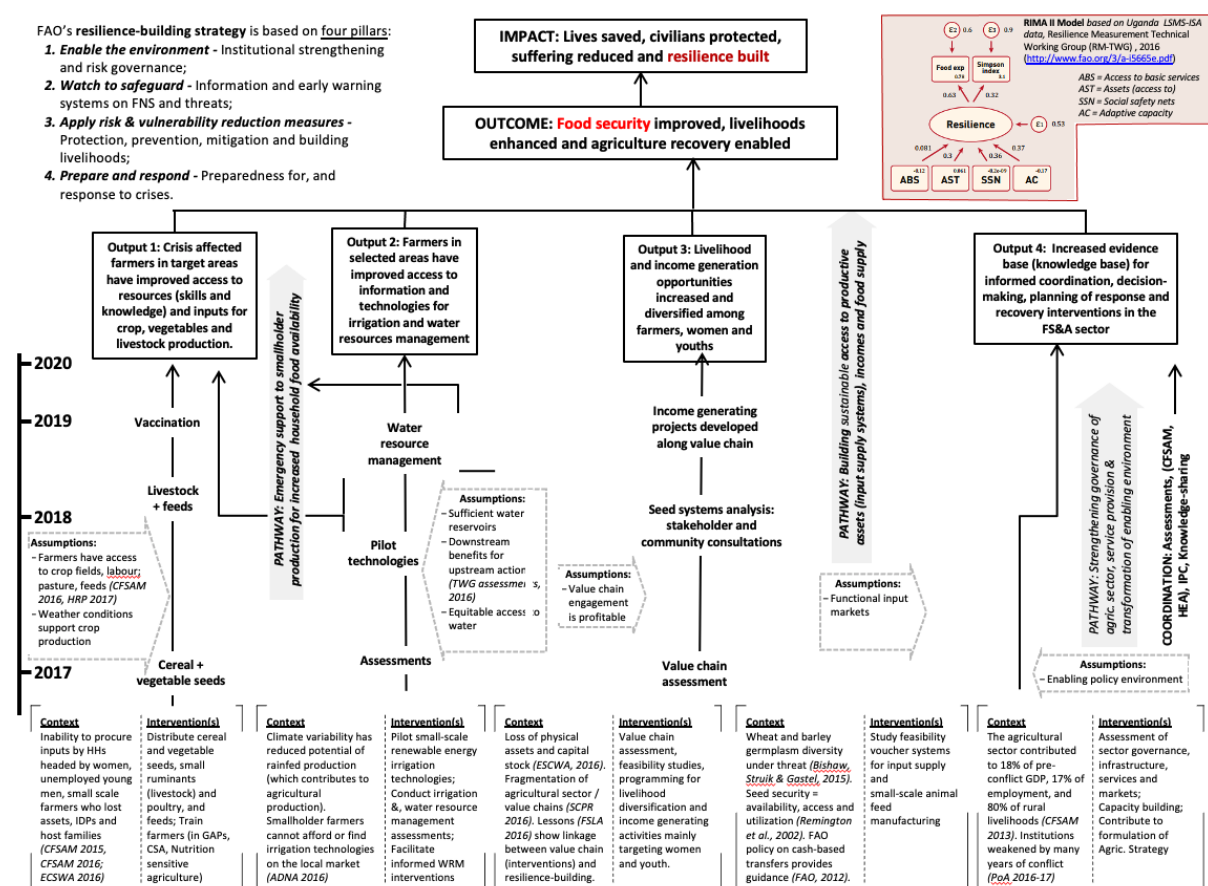
Source : FAO Syria

Due to the nature of the two packages and the parallels in their impact pathways, we expect that both packages can reinforce each other's impacts in the short, medium, and long terms, enabling agricultural recovery, strengthening food security, and building resilience. Figure 1a summarises the detailed theory of change as developed and adapted by the FAO team. The figure clearly describes how the different interventions contribute to the programme output and under what assumption these lead to the desired programme outcomes and impacts.

Next, we will describe the type of interventions implemented under this programme and the scope of the assessment and impact evaluation.

2.3 Programme activities

The programme activities undertaken by FAO Syria Damascus office under the FCDO programme fall generally under "**emergency**" or "**resilience and early recovery**" categories. Emergency activities include:

1. The support in vegetable production through two types of interventions. The first component includes the **provision and distribution of vegetables seeds, agriculture inputs and tools, including drip irrigation kits.** This intervention took place between July 2018 and June 2019 and reached about 3,400 households. The second component, which was implemented between February and September 2020, included the **provision of vegetables seedlings** and agricultural inputs and tools and reached about 3,500 households.

2. The provision of **poultry kits** to support poultry family farming, which has been coupled with hatcheries to enhance the sustainability of the support. The distribution took place between February 2019 and March 2020 and reached about 700 households. 43 hatcheries were distributed for collective utilization (one hatchery for each ~ 20 households).

3. **Provision of animal feed,** which has been implemented under two interventions. The first was implemented between January 2020 and March 2021 included the establishment of Sprout Production Units (SPUs) which produce sprouts as green fodder. The second intervention includes the distribution of cow fodder, which was implemented under an additional fund by FCDO in 2021 and targeted smallholder farmers who own 1-3 heads of cattle.

4. PPR **livestock vaccination** to fight against severe disease on sheep and goats to reduce mortality and improve overall animal health. This component was part of a larger

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vaccination campaign at the national level, and has reached more than 13,000 households.

Resilience and early recovery activities included the following activities:

1. The rehabilitation of damaged irrigation systems and infrastructure at the community level in Deir-Ez-Zor, Homs and Rural Damascus to improve access to water.

2. Provision of beekeeping as an alternative income generating activity for households who do not own land or have a stable income from farming. The intervention was implemented from February 2019 till September 2019 and reached 500 households.

3. Seed multiplication schemes to increase the availability and the accessibility of high-quality seeds of Syrian crop varieties through informal seeds system channels. This scheme was implemented in two phases. The first was between November 2018 and August 2019 which supported 12 farmers to produce 40 tons of seeds and the second was between December 2019 and August 2020 and reached 85 farmers in total to produce 1,000 tons of early seeds generation.

4. The establishment of low tunnel nurseries as in situ seedlings production to increase the provision of high-quality vegetable seedlings. The 500 nurseries were established between February and September 2020.

All these activities under both emergency and resilience support have been implemented to various degrees across Syria, where different components of these packages had specific criteria for target households and were implemented at different times throughout the lifetime of the project. Generally, the programme prioritised targeting vulnerable rural farmers with one or more of the following characteristics:

1. Households headed by women and/or disabled;

2. Unemployed young men susceptible to the appeal of armed groups;

3. Small-scale farmers and herders who lost their productive assets and/or lack access to inputs;

4. IDPs and IDP host families.

Additional selection criteria of beneficiaries were also taken into account. For example, for beneficiaries who received poultry support, FAO has ensured to reach more vulnerable households. Hence, additional criteria such as households should be food insecure or do not have adequate access to continuous sources of income were also taken into consideration. For

vegetable production, households needed to own / have access to a small plot of land with at least 200-600 square meters.

Figure 1b. Shows a map of Syria highlighting the total number of households reached by each intervention across Syria.

<u>Figure 1b. Number and location of households reached under FCDO programme.</u>
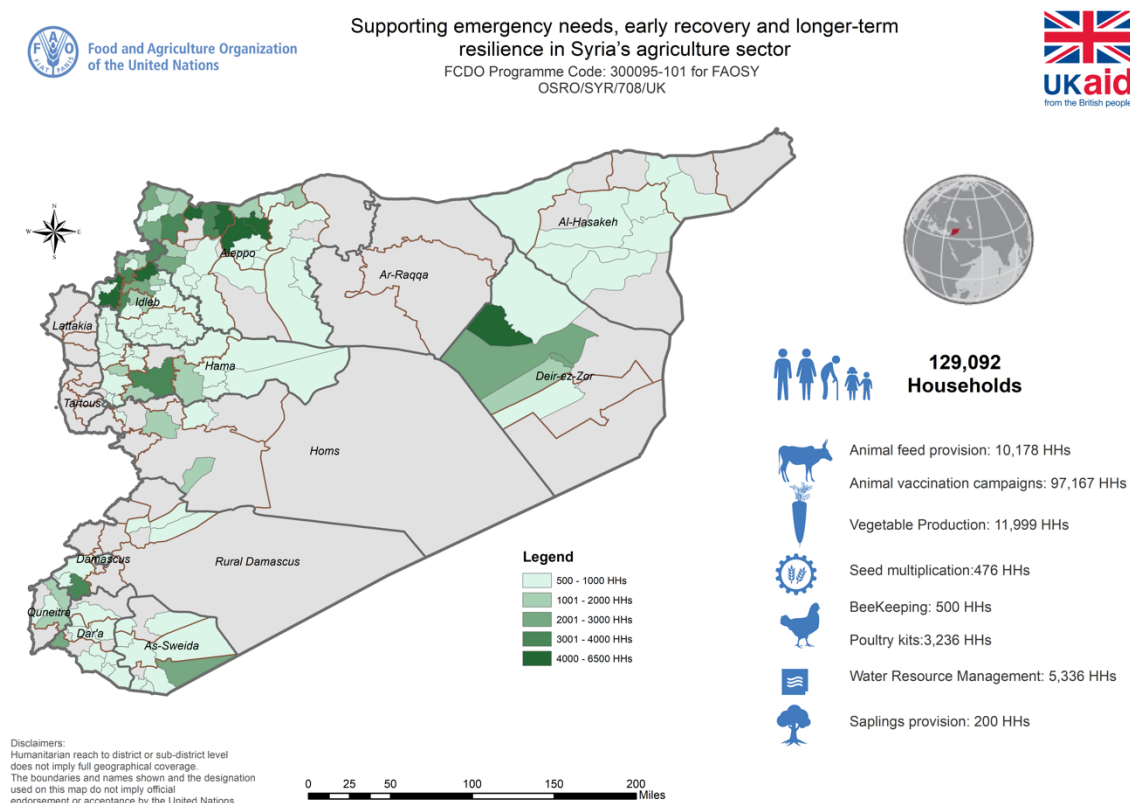
Source : FAO Syria

2.4 Scope of assessment

Given the breadth of the programme in terms of its activities, targeting and geographic locations, this impact study was designed to cover a specific selection of these interventions. Moreover, the volatile situation in Syria and the changing nature of the working environment where FAO operates meant that certain planned aspects of the programme (and hence this study) required ongoing adjustment and flexibility. For example, not all components of the programme were implemented at same time but, instead, were implemented in different phases. Phase 1 of the

programme, which was implemented in 2018 and 2019, included mainly the provision of vegetable seeds. The rest of the interventions were implemented iteratively in phases 2 and 3 of the projects in subsequent years. These included the distribution of poultry and beekeeping in 2019 and early 2020, and the vaccination of livestock and provision of vegetable seedlings in late 2020. This flexible approach in the implementation process under these difficult settings of operation meant that the impact assessment study design required equal flexibility to ensure the coverage of the different activities. This is most evident when the beneficiary group targeting required adjustments with respect to its timing and its locations to ensure that FAO reached the most vulnerable households during that period. Moreover, information on the households at baseline was not readily available for phase 2 and 3 interventions, which also made it difficult to include all interventions in the impact assessment design and framework.

Given these adjustments and the methodological requirements of impact assessments, the report mainly focuses on programme activities that were delivered in late 2018 and throughout 2019. These include the provision of vegetables seeds and poultry, as part of the emergency packages, and beekeeping, as an alternative income generating activity under early recovery packages. For these activities, we were able to track and follow-up with the majority of the sampled households from either baseline or midline. Moreover, we analyse the impact of livestock vaccination and vegetables seedlings, but using only endline household cross-sectional data. Furthermore, other types of activities (including the setup of low tunnels and SPUs as well as the provision of cow fodder) were analysed separately using other methods but do not fall under the impact assessment study, while seed multiplication schemes and irrigation of damaged water systems are not included in this report.

Table 1 shows the type of interventions implemented under this FCDO programme, the assessment method used, available data, and the team responsible for the analysis and the production of the findings.

Table 1. Programme interventions and the scope of the assessment.

Intervention	Assessment Methods	Available Data	Responsible for Analysis
Vegetable Kits (including seeds, tools, and irrigation drop kits)	Impact assessment with control group	Household survey data at baseline, midline, and endline	ISDC
Poultry (coupled with hatcheries)	Impact assessment with control group	Household survey data at midline and endline	ISDC
Beekeeping	Impact assessment with control group	Household survey data at midline and endline	ISDC
Livestock Vaccines (mainly sheep and goats)	Cross-sectional analysis with control group	Household survey data at endline only	ISDC
Vegetable Seedlings and agricultural tools and inputs	Cross-section analysis with control group	Household survey data at endline only	ISDC
Sprout production units (green fodder)	Post-distribution analysis just for beneficiary group	Short post-distribution assessment data (not full survey data) at endline	FAO
Low tunnel nurseries (in situ seedlings production)	Post-distribution analysis just for beneficiary group	Post-distribution key informant interviews (KIIs)	FAO
Rehabilitation of Irrigation Systems	Community-based assessment	Satellite Data (separate report)	FAO
Cow Feed (Additional Fund)	Post-distribution analysis just for beneficiary group	Short post-distribution assessment data (not full survey data) at endline	FAO
Seed Multiplication	No assessment undertaken	N/A	N/A

Hence, the main bulk of this analysis will pertain to the interventions where we have sufficient baseline and endline data to produce reliable and robust findings. This includes the provision of vegetable kits, poultry, beekeeping, vegetable seedling, and livestock vaccination. In our view, the focus on these activities enables the rigorous assessment of large parts of the programme and gives us methodological confidence in our approach and findings. We believe that the lessons learnt from this exercise also reflect, in a wider sense, the impacts of the overall

programme given that similar beneficiaries and target areas were covered later in the programme.

In an appendix of this report, we also provide a summary of the post-distribution findings of the remaining interventions, particularly for SPUs, low tunnels, and the provision of cow feed. This analysis was conducted by the team of FAO Syria and the findings are summarized and included in this report for completeness. We opted not to undertake an impact assessment on the seed multiplication scheme due to the difficulty in tracking farmers who indirectly benefit from this scheme. Beyond the small number of direct beneficiaries, we are not able to sample households given that the distribution is conducted centrally (combined with other national schemes). For irrigation rehabilitation, FAO produced an impact analysis using satellite data, which is available separately.

3. Impact evaluation design, data and methods

In this section, we describe the design of the impact evaluation study, the sampling strategy for the endline and the overall survey, the outcome indicators, data collection processing and cleaning, as well as ethics and safeguarding.

3.1 Study design

To analyse the impact of the programme, the study uses a quasi-experimental design that compares villages and households that received the interventions (the "beneficiary group") with villages and households that did not receive the intervention (the "control group"). Such "impact evaluation" design is key to establishing causal effects of programmes and can also be applied, with careful adjustments, in insecure and humanitarian emergency contexts.[9]

In our study, beneficiary villages and households will, thus, have received at least one programme activity, while control group villages and households will not have received any. A notable share of the beneficiary and control households who were interviewed at the endline were also surveyed at baseline and midline, with about 13% of households dropping out of the study at endline.

This quasi-experimental setup allows us to infer the *causal* impacts of receiving (any) programme activity, and to distinguish the differential impacts of receiving the different modalities of the

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[9] Puri, J., A. Aladysheva, V. Iversen, Y. Ghorpade and T. Brück (2017). "Can Rigorous Impact Evaluations Improve Humanitarian Assistance?". Journal of Development Effectiveness, vol. 9, no. 4, pp. 519-42. https://doi.org/10.1080/19439342.2017.1388267

intervention. By having control group observations, we can ensure that any changes we observe among beneficiaries between baseline and endline are the result of receiving these programme activities. Specifically, it allows us to rule out that any observed changes in outcomes among beneficiaries are the result of other systematic changes, such as seasonality, or due to events that might have taken place during the implementation period, such as drought.

In order to make this comparison valid, it is key that the control group is not systematically different from the beneficiary group, in terms of location and socio-economic characteristics. This means that we need to ensure that we survey a control group that is *on average* "structurally" similar to the beneficiary group. These structural similarities should hold at: a) the village level (such as same governorates, comparable accessibility of villages, similar exposure to conflict and agro-climatic conditions) and b) the household level (such as similar household demographics).

A critical component of this research design is that the midline and endline surveys interview exactly the same beneficiary and control households who were part of the baseline sample ("panel study"). In other words, a fixed set of households is tracked over time in the baseline, midline, and endline surveys, in both the control and beneficiary groups. Following up with the same households is the only way to guarantee that the changes induced by the programme are accurately captured and are not confused with other changes among households and villages during the implementation period. In addition, repeated interviews with the same households over time builds trust by households in the team of enumerators, improves data quality and increases the ease of data collection follow-up surveys conducted in the future.

Given the changes with the targeting in year 1 and 2, the tracking of the households across beneficiary and control groups needed to be adjusted in the rollout of the programme. First, the support for 262 households from the baseline beneficiary group in our sample were discontinued, and these households did not receive support as originally planned. Adjustments in the targeting were due to post-baseline context analysis recommendation to eschew any potential disputes including the do not harm principle, which for example saw the reallocation of the beekeeping intervention, and hence the target group, from rural Damascus to Daraa. Moreover, the need to select villages and households based on specific technical criteria for certain intervention (e.g., Seed multiplication and SPUs) did not align with the already pre-identified target villages. Hence, a large proportion of the existing sampled beneficiaries (around 40%) in our baseline data cannot be classified as "beneficiaries" anymore.

Second, and in order to compensate for the drop in the sample size of the beneficiaries, we opted to collect data from a new sample at midline, where we were able to easily identify who received which type of support ex-post. We increased the sample size by 308 households to cover

proportionally the number of households who received various components of the intervention. The main downside of such an approach is the absence of the baseline observations of these new households, which makes a straightforward and a rigorous assessment more challenging, yet not impossible. Moreover, we included an additional sample at the endline to cover beneficiary households that received support for year 3 activities of the programme. This includes mainly households who received livestock vaccination and vegetable seedling support.

Third, given the change in the structure of the households, the initial balance in the household characteristics does not hold anymore. However, the large sample of control households at later waves, which we continued to follow up with, allows us to match a sub-sample of these control households to look as similar as possible to the beneficiary group. Indeed, such an approach makes the findings more rigorous, but reduces the overall sample size.

For the analysis, we used two approaches: First, we examined the impact evaluation using only the tracked households from beneficiary and non-beneficiary groups. Second, we only use the endline surveys to make better use of the additional sample of beneficiaries that we introduced at later stages. Both of these methods resulted in generally similar findings, which is encouraging.

Figure 2 shows a graphical description of the changes in the composition of the sample across the three waves. Almost 46% of households in the beneficiary group at baseline were not part of this group at midline as they did not end up receiving support as initially planned (this is depicted in Figure 2 by the change from T0 to C2 between baseline and midline). These households are now classified as control households in the overall panel dataset and analysis. The rest of the baseline beneficiary group (T1) have received support from the programme and were continued to be tracked at midline and endline (with slight differences due to sample attrition, i.e., households were not available for interviewing). T2 is the new additional sample that was interviewed only at midline to compensate for the drop in the sample size in the beneficiary sample and was also followed up with at endline. T3 is the new beneficiary sample introduced at the endline to cover phase 3 activities that were not identified during earlier stages. Attrition (or dropout) rates in the sample between all three waves is about 13%, which is a very good figure given the context and the unplanned changes in the targeting.

Hence, based on this adjusted design, the complete panel of households who were interviewed in all three waves (i.e., before and after the intervention at baseline, midline and endline) consists of 880 households: 622 households are in the control group (of which 238 were intended beneficiaries) and 258 are in the beneficiary group. The attrition rate is 13% for the beneficiary group, 10% for the discontinued group and 15% for the control group.

Figure 2. Structure of the panel sample and changes in group allocation
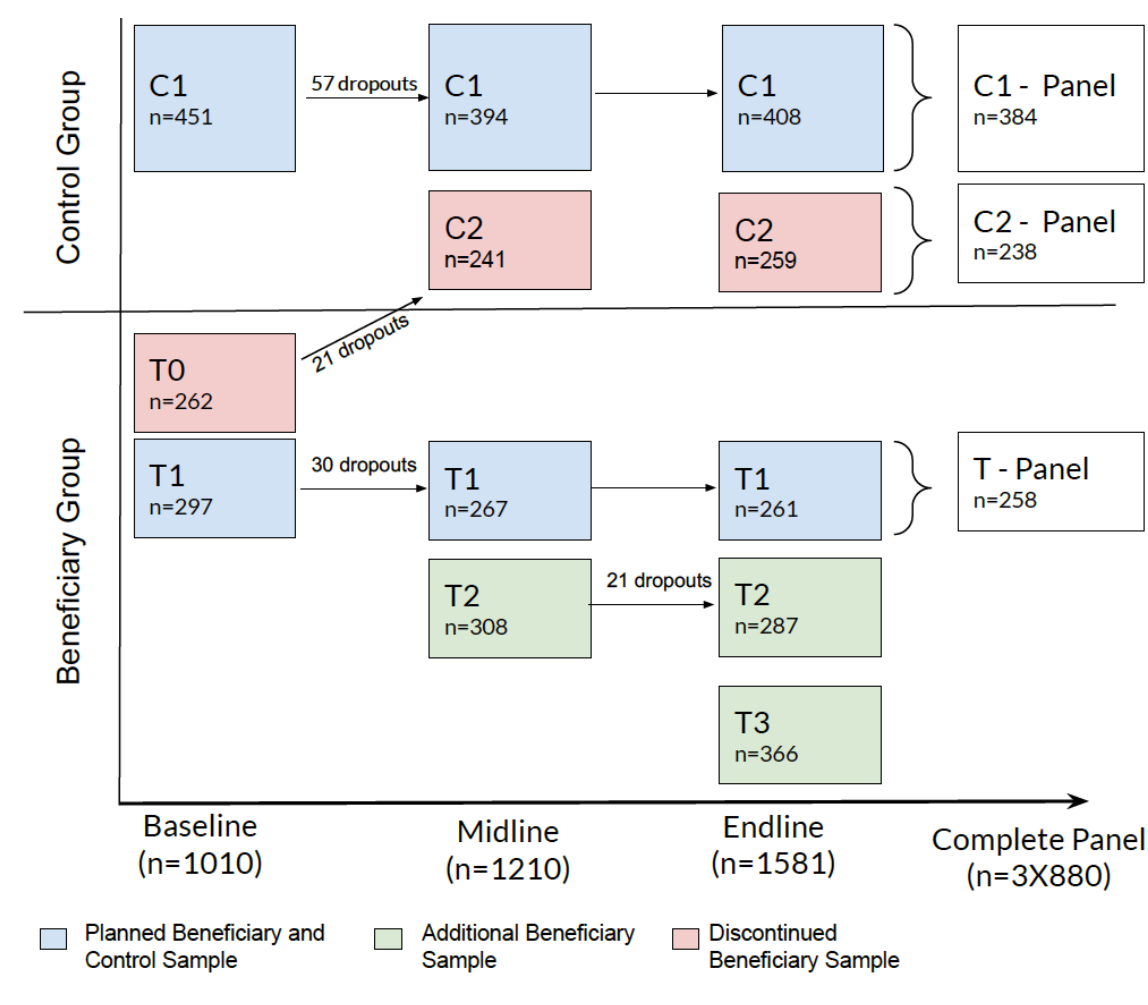
Next, we examine how the different types of interventions are covered by the sample. As mentioned earlier, the implementation has taken place in phases. The first phase included the distribution of vegetable toolkits, as well as a part of the beekeeping support (September 2018 - June 2019). The second phase included the distribution of poultry, irrigation rehabilitation, and the remaining beekeeping support (July 2019 - March 2020). The third phase included the distribution of livestock vaccines, salt blocks, and vegetable seedlings and the establishment for low tunnel nurseries (April 2020 - December 2020).

The main bulk of the analysis and findings will be based on the panel sample, which partly covers interventions conducted in phase 1 of the programme. These include the provision of vegetable toolkits and beekeeping. The new sample in T2 includes additional observations from households who received vegetable toolkits, poultry and beekeeping from phases 1 and 2 (which were also followed up at endline), while T3 contains households who received vegetable

seedlings and livestock vaccination from phase 3 of the programme. Therefore, for the analysis of the intervention-specific impacts, we will be comparing cross-sectional waves (and not the just panel dataset) in order to cover the range of interventions.

Table 2. Intervention type across all three waves and panel sample size

#HH	Baseline	Midline	Endline	Panel BM	PanelBE	PanelME	Full Panel BME
Vegetable Kits	263	333	318	235	229	318	229
Poultry	23	77	72	19	16	72	16
Beekeeping	27	165	158	13	15	158	13
Irrigation	5	0	5				
Livestock Vaccine	0	0	271				
Vegetable Seedlings	0	0	90				
Intervention Total	318	575	914	267	260	548	258
Control	692	635	667	635	667	622	622
Total	1010	1210	1581	902	927	1170	880

BM = baseline & midline; BE = baseline & endline; ME = midline & endline; BME = Full Panel

Table 2 shows the distribution of the sample by type of intervention across all three waves after correcting for the change in the beneficiary targeting from baseline. Moreover, the last four columns show the panel structure (i.e., the households that were tracked across the different waves). The full panel includes primarily beneficiary households who received the vegetable kit intervention and a small proportion of households who received beekeeping and poultry. The sample of households who received irrigation activities is very small and hence will be excluded from the intervention-specific analysis. On the other hand, the panel between midline and endline contains a larger proportion of households who received these interventions.

The main analysis for this report will focus on the differences between endline and baseline from the panel dataset, as well as the changes for these households from midline to endline (we will not include the impact analysis between baseline and midline, as this was covered in detail in the Midline Report dated 10 May 2020). Moreover, additional analyses using only cross-sectional data from the endline wave will be used to calculate simple differences between beneficiary households who received the livestock vaccination support and the vegetable seedlings versus the control group.

Table 3. Imbalances in location and household head gender of the Panel dataset

	Control Group	Beneficiary Group	p-value
n	667	260	
Governorate (%)			<0.001
Al-Hasakah	90 (13.5%)	73 (28.1%)	
Aleppo	112 (16.8%)	69 (26.5%)	
As-Sweida	81 (12.1%)	35 (13.5%)	
Dar'a	35 (5.2%)	3 (1.2%)	
Deir-ez-Zor	100 (15.0%)	51 (19.6%)	
Hama	173 (25.9%)	2 (0.8%)	
Homs	11 (1.6%)	7 (2.7%)	
Quneitra	65 (9.7%)	20 (7.7%)	
HH Head Gender = % Male	550 (82.8%)	178 (68.7%)	<0.001
HH Head Age	49.41 (13.03)	49.27 (12.47)	0.879
HH Head Crop Farmer	55.26%	57.22%	0.436
HH Head Herder	13.74%	10.61%	0.053
HH Head Completed Education (%)			0.043
No Schooling	130 (21.9%)	72 (30.3%)	
Primary	359 (60.5%)	129 (54.2%)	
Secondary	64 (10.8%)	18 (7.6%)	
Tertiary	40 (6.7%)	19 (8.0%)	
Agricultural Asset Ownership (%Yes)			
Irrigated Land	0.37 (0.48)	0.36 (0.48)	0.658
Rainfed Land	0.41 (0.49)	0.34 (0.48)	0.060
Poultry	0.22 (0.42)	0.20 (0.40)	0.392
Cattle	0.15 (0.36)	0.12 (0.32)	0.251
Sheep	0.20 (0.40)	0.23 (0.42)	0.342

Note: The p-value shows the significant level of the mean difference between the two groups for each variable. A value of less than 0.1 implies a significant difference, and a value less than 0.01 implies a strong significant difference.

Table 3 shows the baseline balance of the characteristics of households in these two groups in the panel dataset. In the first instance, we observe a varying geographic coverage, where almost none of the households in the beneficiary group are located in Hama (0.8%) while the highest shares of beneficiaries at the endline are in Al-Hasakah (28.1%) and Aleppo (26.5%). Second, we observe a significant discrepancy in the gender of the household head. 68.7% of household heads in the beneficiary group are males compared to 82.8% in the control group. The average age of

the household head in both groups is 49 years. In the control group, 55% of the income of households is generated from crop farming, and 14% from herding. This figure is similar in the beneficiary group with 57% and 11%, respectively. Moreover, we observe that households in the control group are on average better educated. 30% of household heads in the beneficiary group have not completed any level of education, compared to 22% in the control group. Given that these imbalances could affect the estimation of the programme impact, we opted to match households (based on propensity score matching techniques) in the control group who are similar on these characteristics to the beneficiary group. This reduces the overall sample size of the control group, but ensures consistency between the comparison groups.

3.2 Outcome indicators

The endline survey has three objectives: First, it provides detailed information on the current status of households. Second, it provides detailed information on key project indicators to examine the time trends compared to baseline values. Third, it serves as the basis to understand the nature and magnitude of the programme impacts.

Indicators. The selection of the outcome indicators primarily reflects the resilience status of households in Syria, and are based on the main components of the RIMA index (Resilience Index Measurement Analysis). RIMA was developed by FAO and has undergone a number of iterations since its original development.[10] Its latest iteration, RIMA-II, comprises a multi-dimensional index and is designed to be tailored to relate to a range of different resilience-related outcomes aside from food security.

Collecting large volumes of household-level data may not always be feasible in countries affected by instability and fragility. For this reason, the size of the RIMA questionnaire has been reduced to take these contextual aspects into consideration, and at its core is the resilience capacity module, which is composed of information on:

(i) Access to Basic Services (e.g., distance and accessibility to markets and public services);

(ii) Assets (e.g., ownership of household, productive and livestock assets);

(iii) Social Safety Nets (e.g., cash and in-kind transfers and networks);

(iv) Adaptive Capacity (e.g., number of different crops grown, income sources, literacy);

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[10] One key reference is http://www.fao.org/emergencies/resources/documents/resources-detail/en/c/416587/.

(v) Food Security (dietary diversity and spending on food);

(vi) Shocks (e.g., climatic, conflict, and economic)

In our survey, we collected information to provide an overview of the resilience capacity of households in Syria. However, we were not able to include the exact modules and questionnaire as proposed by RIMA due to difficulty in obtaining official approval on all the questions that compose this overall resilience index. Therefore, we opted to present findings from these different sub-components separately (where available) and build a narrative around the resilience of households, rather than rely on one single indicator. Another reason for not using the overall RIMA indicator is that we do not have all the information from all the survey waves, which makes the indicator sensitive to missing data that are crucial to its structural composition. This can lead to biased and misleading results. Hence, we will not be able to clearly differentiate if variations in the index are due to missing components or due to actual changes.

Building on the RIMA recommendations and given the methodological and contextual challenges, we will focus on the following set of outcomes in our impact assessment of the programme:

1. *Food Consumption and Security:* we will use the Food Consumption Score (FCS) and the Household Dietary Diversity Score (HDDS) to measure food access, diversity, and security. The FCS is a well-known indicator used in humanitarian settings and was developed by WFP.[11] It is calculated based on the 7-day consumption behaviour of households prior to the interview. Each food category is weighted by a pre-specified multiplier (e.g., by 3 for meat). The indicator ranges between 0 and 114 and households are classified as food poor if they have a score below 28, and "acceptable" if they have a score larger than 42. The HDDS, on the other hand, measures the diversity in diets of households eaten the day before the survey and is a simple sum of all the food groups consumed on that day.

   Moreover, we will use the Reduced Coping Strategy Index (RCSI), which will be used primarily to examine the indirect severity of food insecurity at the household. The indicator contains information on the harmful strategies households had to employ in the past seven days in order to deal with a shortage of food. The larger the indicator the more food insecure households are (and consequently less resilient).

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[11] https://inddex.nutrition.tufts.edu/data4diets/indicator/food-consumption-score-fcs

2. *Coping strategies:* indicators for the use of harmful livelihood coping strategies will help in assessing how households adopt strategies for consumption-smoothing, asset-preservation (insurance), or asset-stripping (distress) during situations of potential or actual food shortages. The set of strategies include, for example, reduction in asset and non-food expenditure, taking up credit to buy food and, in extreme cases, child labour

3. *Agricultural input and production*: Since the target beneficiary households constitute mainly smallholder farmers and other households whose livelihoods largely depend on value chain activities in farming (e.g., labourers and traders), the quantities of crops grown are a key determinant of the availability and access to food. We will also use yields for the five major crops produced by households in our sample. These include wheat, barley, eggplant, cucumber, and tomato, providing sufficient coverage for both staple crops and vegetables. Income generated from value chain activities, such as sales of crop and livestock products, trading in agricultural products, and engagement in post-production activities will be used as indicators to measure the household socio-economic status and adaptive capacity.

Moreover, we will take into account the household composition (e.g., gender of household head) and asset ownership (e.g., land and livestock) as well as contextual factors (e.g., exposure and severity of shocks) to understand the heterogeneity of these outcome indicators.

3.3 Data and methods

Questionnaire. The questionnaire was developed jointly with FAO Syria's M&E unit. The objective was to ensure that the endline questionnaire was as similar as possible to that at baseline and midline and had been tested in a training session at baseline and sent for approval by the local authorities at each wave of data collection. The final endline questionnaire administered in the field was slightly reduced to that of the baseline, given that the responsible ministry in Syria had reservations on some questions due to their sensitive nature. This included, for example, the removal of one of the questions in the RCSI indicator on the need to prioritise food to children over adults. In these instances, we recalculated the index for previous waves to match that of the endline, which could lead to variations from previous reports. Overall, the questionnaires across all three waves are highly comparable and include detailed information on location, household profile and characteristics, agricultural holding, access and activities (including handling, processing, and value chains) as well as information on input markets and livestock. For the measurement of food security and resilience, the following modules were included: household food supply and consumption (including dietary diversity), coping strategies, exposure to shocks,

and access to Drought Early Warning Systems (DEWS). Moreover, in the endline questionnaire, we included an additional module on livestock production.

Data collection. Data collection for the endline survey took place in January 2021 (rainy winter season). Training of enumerators was conducted by the FAO Syria M&E team before the start of the data collection. In comparison, the baseline data was collected in November 2018 (rainy late autumn season), while the midline data was collected in January 2020 (rainy winter season). Hence, we do not expect any notable challenges in comparability of the surveys due to seasonality between the three waves, which could affect agricultural production and access to diverse food. The trained enumerators conducted the household interviews based on paper-based questionnaires.

Data processing. Data entry was conducted at the FAO office in Syria. FAO staff entered the information from the questionnaire sheets into computers using Microsoft Access. Upon receiving the raw data files, ISDC staff cleaned and merged the data using unique identifiers and analysed the data using the software R.

Statistical methods. Descriptive statistics were used to compare average trends in the outcome indicators across the waves. For analysing the endline data and the respective packages of support that were implemented in phase 3 of the programme, we used t-test estimation to compare differences in outcome means between the beneficiary and control groups. Endline data matching was based on propensity scores with replacement. Hence, all mean values in the control group were weighted based on the replacement p-score weights. We needed to use replacement because the number of female-headed households in the control group was too small. For the impact assessment of the panel dataset, we used difference-in-difference estimation from ordinary least-squares linear regressions (OLS).

3.4 Ethics and safeguarding

ISDC and FAO have their own ethical guidelines for the best practices in conducting fieldwork and empirical research.[12] We strictly followed these practices and guidelines. We ensured that respondents provided their verbal consent in participating in the study, which clearly explained the purpose of the study and the use of the data. Moreover, we were committed to the use of the *do no harm* approach, ensuring that the security, safety, integrity, and well-being of participants and staff are respected and protected at all times. All respondents had the right to withdraw from the study at any point without fear of penalty. In particular, we ensured that no benefits to

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[12] ISDC's guidelines are available under https://isdc.org/ethical-principles-for-collecting-primary-data-and-conducting-fieldwork/

respondents were withheld for the purpose of the study and that non-beneficiaries were misled for participating. The selection of beneficiary households to the study built directly on the selection of the beneficiaries by FAO. ISDC did not influence or control who received which type of support and what criteria the beneficiaries were selected on. Households that were sampled for the study were selected from the pool of beneficiaries randomly. We substituted households if they did not agree in taking part of the study using a backup list of beneficiaries.

Given the unusual and unique country-specific settings, FAO Syria did not seek formal IRB approval for the data collection or for conducting the study. Official approval has been obtained from local authorities (MoFA and MAAR), which included the evaluation of the questionnaire used and the scope and purpose of the study and the use of data. In addition, we have followed ISDC's and FAO's guidelines to ensure best practices in conducting fieldwork.

Anonymized data was used for the purposes laid out in the objective of this study and will not be made publicly available. Personal information associated with respondents including names and phone numbers were only used to follow up with households in future waves. We also created a unique anonymized ID number for each household which is mainly used for matching purposes. Personal information of the respondents is stored and managed by FAO offices in Syria.

4. Time trends in Syria

In this section, we examine the overall trends in household food security, exposure to shocks, access to inputs and income generation from value chain activities. We do not differentiate between beneficiary and control households at this stage, as the aim of this analysis is to provide an overview over the changes that took place in Syria at large. We will break down the impact on these indicators that were induced by the programme in the subsequent sections.

Food Security. Figure 3a shows the status of the food security across the three waves using the full sample. At endline, 76.8% of households are classified as having acceptable food security as measured by the Food Consumption Score (FCS). We observe a slight reduction in the number of households with acceptable food consumption score at endline compared to that of the midline. However, there are no notable changes in the share of households that fall in the most food insecure group (poor), which remains below 4% across all three waves.

Figure 3a. changes in the food security status in Syria
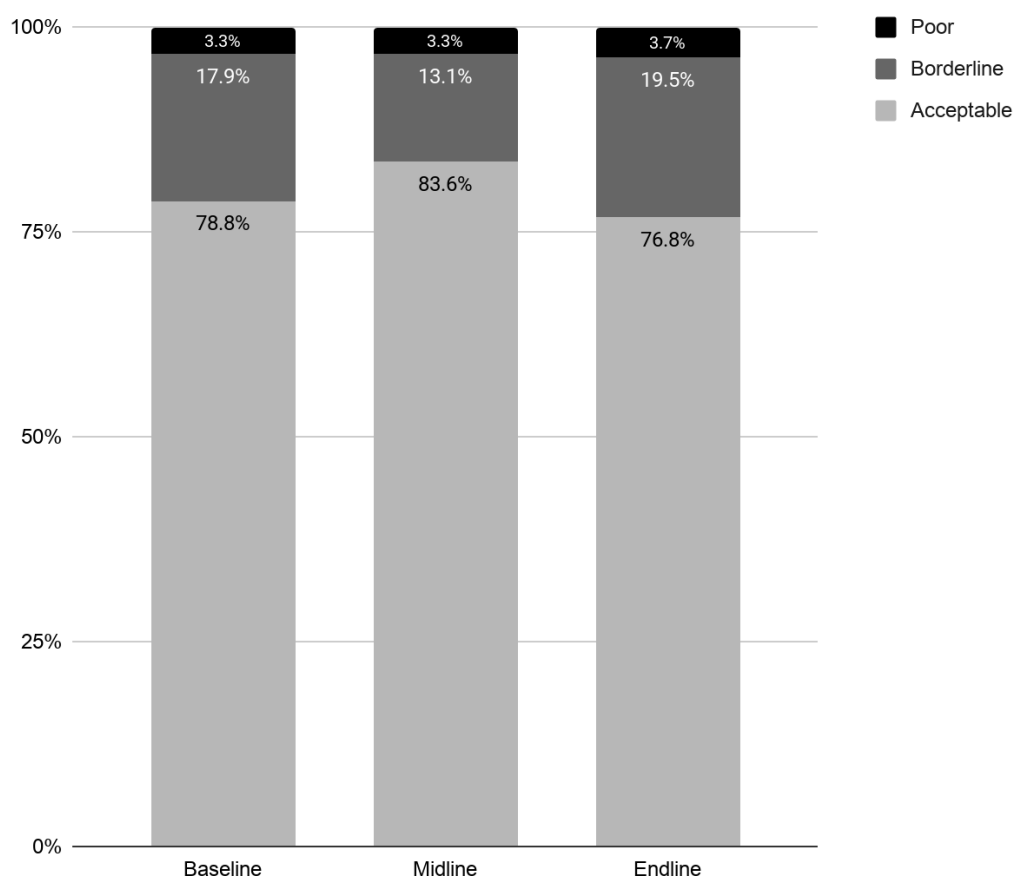
Figure 3b shows the breakdown of the FCS by governorate.[13] As clearly shown in the bar graph, the largest proportion of food insecure households surveyed reside in Al-Hasakah and Aleppo. In Al-Hasakah, we observe a slight overall improvement in the food security status of surveyed households over time. 53.7% of households from our sample in Al-Hasakah have acceptable food security levels compared to 47.4% at baseline. On the other hand, we observe a declining trend in the acceptable food security status of surveyed households in Aleppo, where the share of households with acceptable food security decreased from 71.8% at baseline to 55.8% at endline. This trend is also similar in the samples from the governorate of Hama, where 76% of households have acceptable food security levels compared to 93 % of households at baseline. In As-Sweida , Dar'a, Homs, and Quneitira, most households in our sample have acceptable food security levels.

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[13] It is important to note that the sample is not representative at the governorate level and should not be used to generalize the findings at this level.

Figure 3b. Changes in food security status by Governorate.
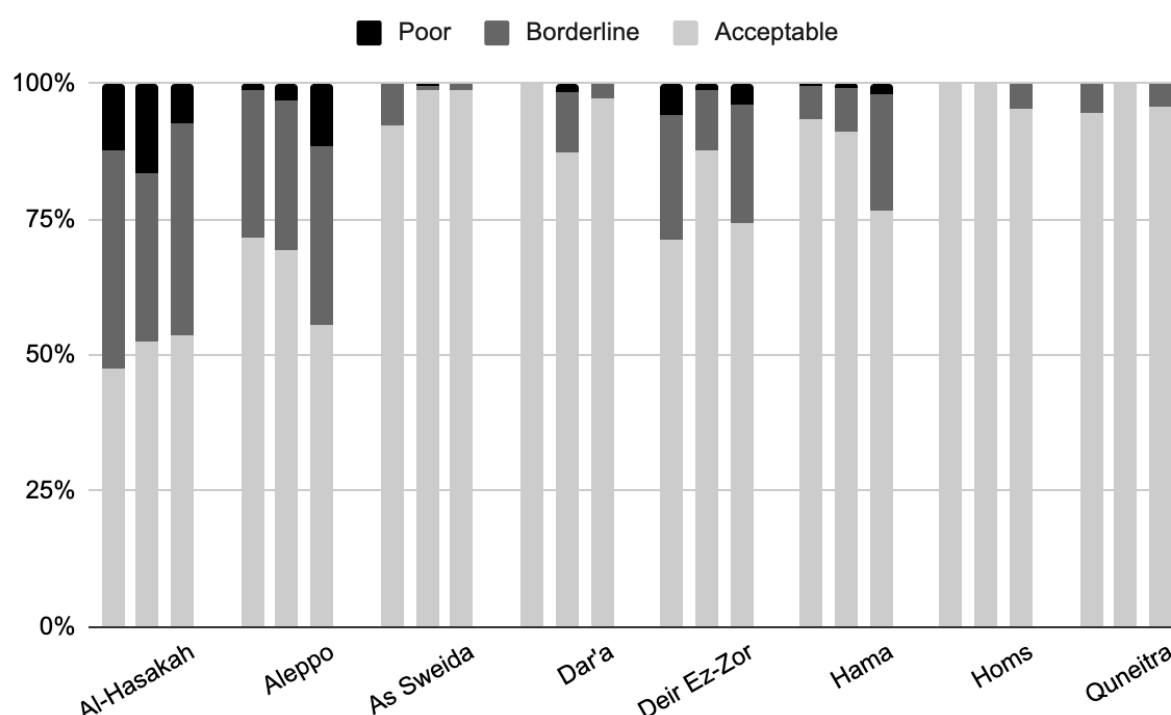
Shocks. We find a strong and significant drop in the share of households impacted by drought compared to baseline (Figure 4). At baseline, 67% of households reported experiencing drought. This share dropped to 7% at midline and rose back to 20% at endline. These changes are also reflected clearly using objective drought indicators as shown in Figure 5 by the Standardised Precipitation-Evapotranspiration Index (SPEI). SPEI takes a value between -2.33 and 2.33 where any value below 0 signifies drought episodes.[14] The figure shows the value of the SPEI using time log-scales of 3-month and 12-month periods to measure the intensity of drought severity and duration. SPEI-3 provides a nuanced snapshot of the variation in drought during the time period between 2016 and 2021; however, it does not account for seasonal effects. SPEI-12 provides a better estimate of longer drought episodes. Syria had witnessed a long period of drought from 2016 until the winter of 2018/2019. We also observe the increased prevalence of drought in the period between the midline and endline, where the SPEI-12 drops to below -1 points, which reflects the increased share of households reporting drought in our sample.

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[14] http://spei.csic.es/home.html

Figure 4. Significant decrease in reported shocks between baseline and midline
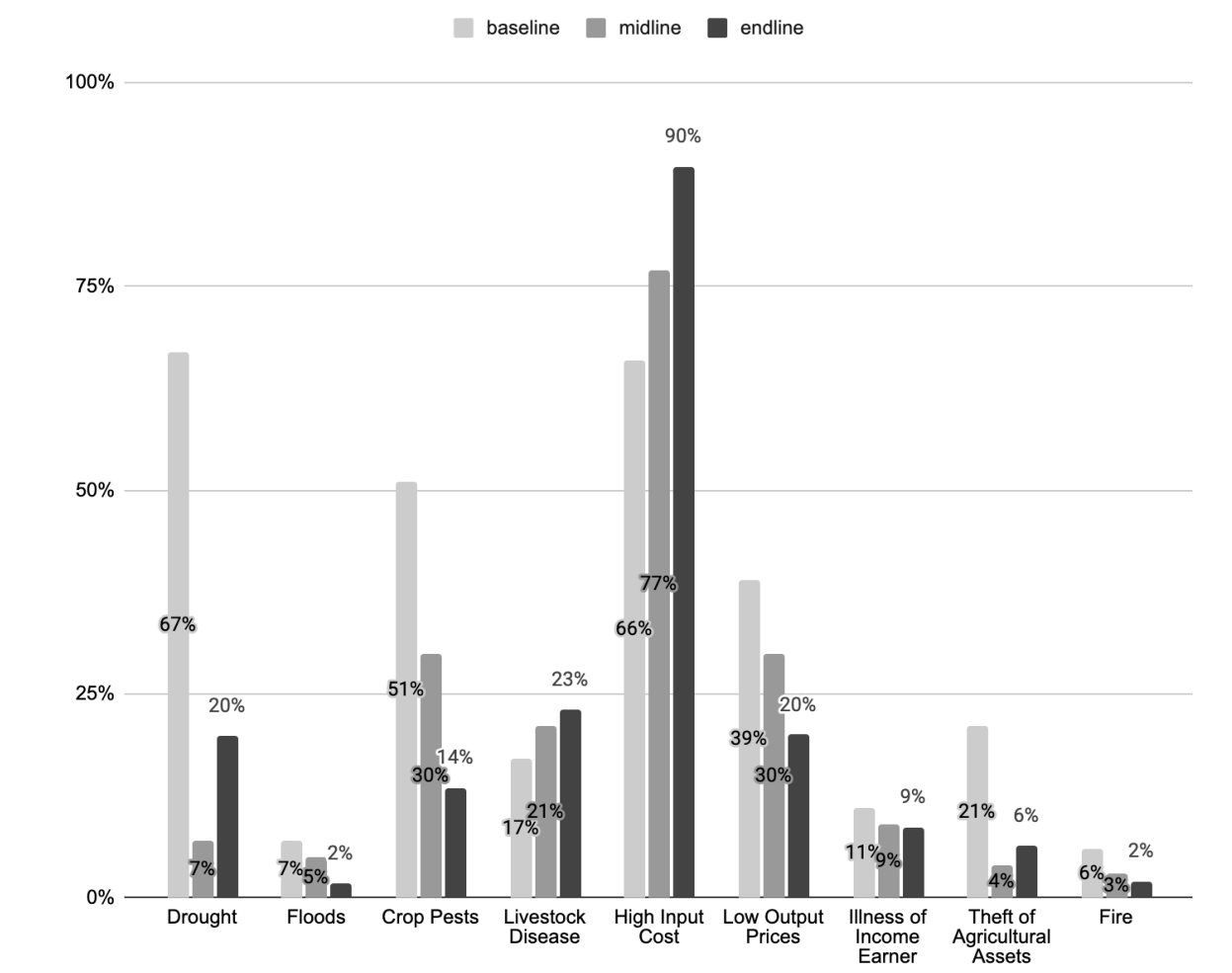
Returning to Figure 4, we also observe a notable decline in the share of households reporting crop pests from 51% at baseline to 14% at endline. Theft of agricultural assets has also reached a low share of 6% compared to 21% two years ago at baseline. In addition to the reduction in theft, additional security indicators are improving. Figure 6 shows a continuously decreasing trend in violence related to the Syrian conflict during the same period. The reduction of all types of violence dropped on average by half between 2018 and 2019 and to one third between baseline and endline.[15]

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[15] Data on conflict events and fatalities are generated from the ACLED database (https://acleddata.com/).

Figure 5. 2019 marked an end to a long drought episode in Syria
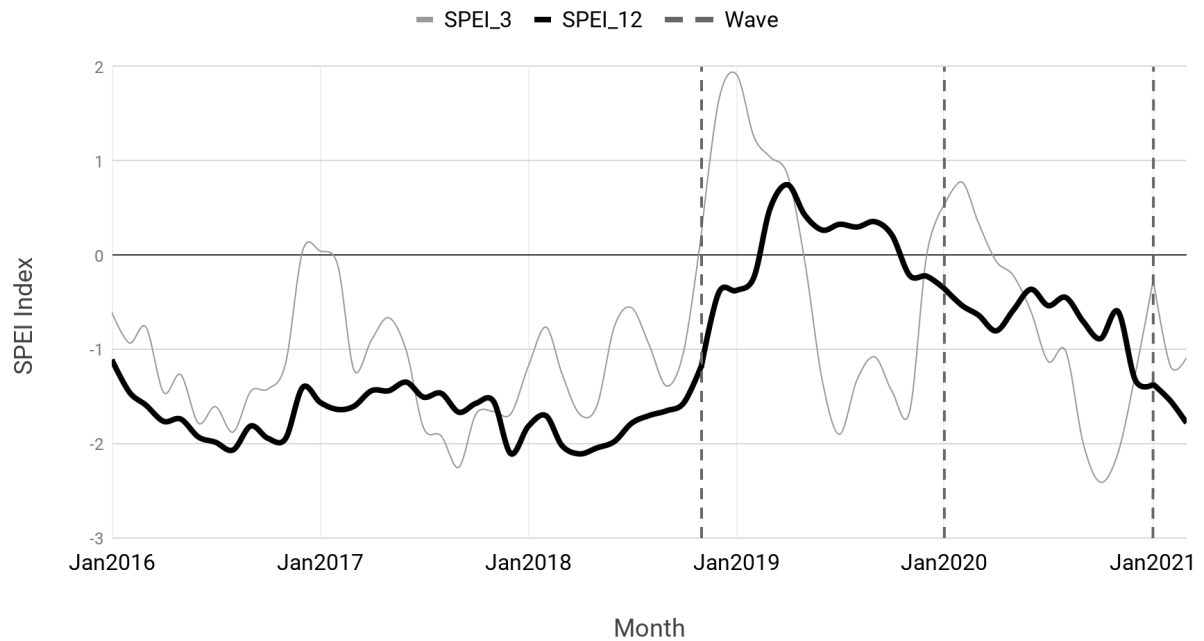
Figure 6. Violent conflict events and fatalities in Syria: a decreasing trend
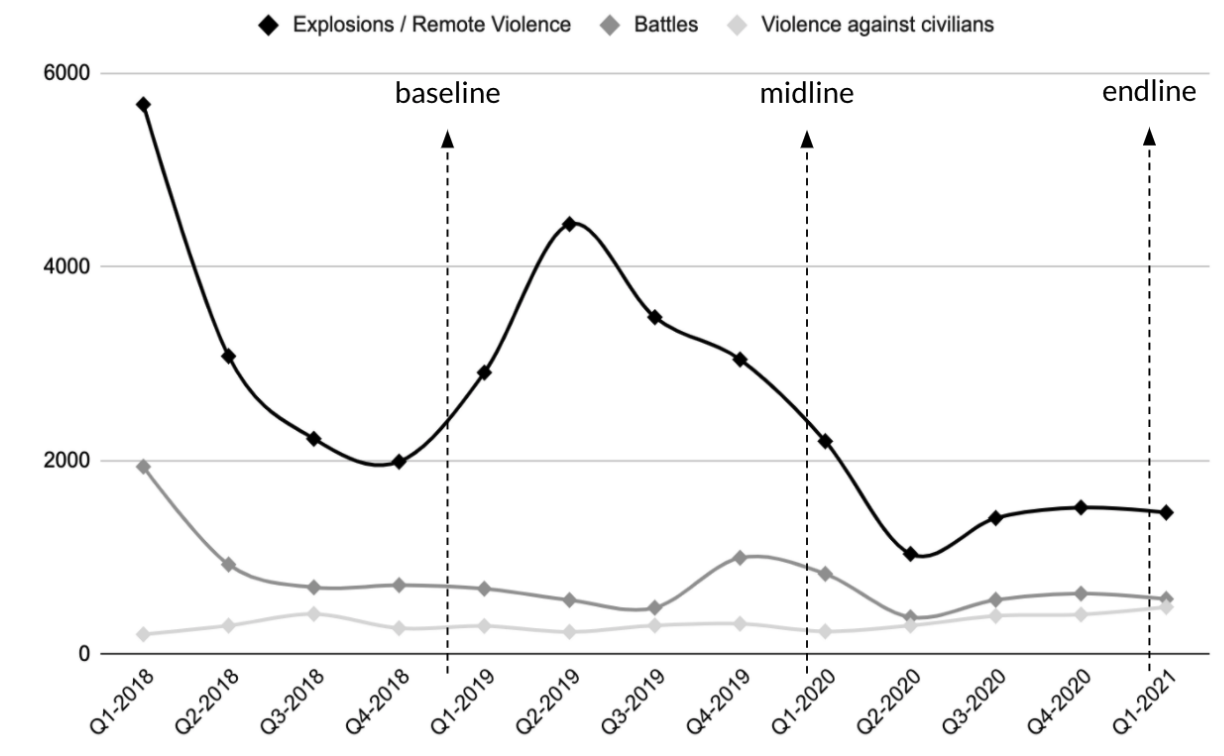
The increase in costs for agricultural inputs remains one of the notable shocks that households faced during the past two years in Syria. As shown through the increasing share of households reporting high input costs in Figure 4, the macroeconomic and currency crises in Lebanon and Syria including the hyperinflation in basic goods has impacted smallholder farmers significantly in terms of their access to affordable agricultural inputs. The share of households reporting high input costs has increased from 66% at baseline to 77% at midline and continued to increase a year after to 90% at endline (Figure 4). On the other hand, the share of households who reported low agricultural output prices has decreased from 39% at baseline to only 20% at endline. Both these changing figures reflect the volatility in the agricultural market (and the Syrian market at large), which increased both costs for producers and consumers in the past two years.

Figure 7a. Households face inflationary prices of agricultural inputs
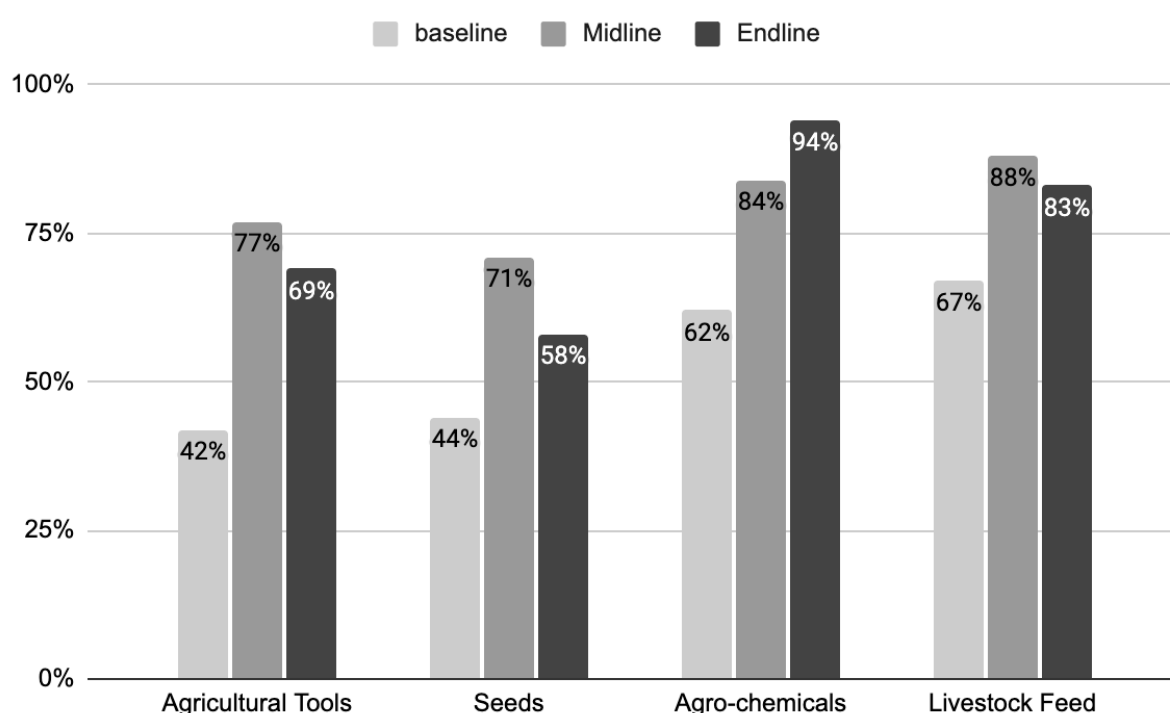
In Figure 7a, we plot the share of households who reported that prices are too expensive for four agricultural inputs: Agricultural tools, seeds, agro-chemicals, and livestock feed. As expected, we find that households continue to report expensive productive input prices, however, less severely in comparison to midline. 69% of households at endline find that agricultural tools are too expensive compared to 42% at baseline, however this figure is now lower than what was

reported at midline 77%. We also observe a similar trend for seeds and livestock feed, where it increased significantly from baseline to midline; however, not at endline when there was a slight reduction but significantly higher levels compared to baseline values. This slight decrease could be explained either through the adjustment of the input costs given the changes in the exchange rate (Figure 7b), which leads to the reliance on local tools, seeds, or livestock feed. In addition, smallholder farmers may have adjusted their expectations of the prices over time, getting used to high prices. Finally, we find that 94% of households reported that agro-chemicals are very expensive which increased from 62% at baseline and 84% at midline. This reflects the need to import these specific inputs in times of weakening exchange rates (Figure 7b).

Overall, the reported shocks signify a mostly positive trend for the agricultural sector and smallholder farmers in Syria during the years 2019 and 2020. A long episode of drought has come to an end and the lower crop pests suggest that the production and yields in the country at large could improve. The increase in input costs during the lifespan of the programme, on the other hand, has generated additional economic burden on farmers.

Figure 7b. Average quarterly price of 1 USD in SP at the informal market

Source: https://sp-today.com/en/
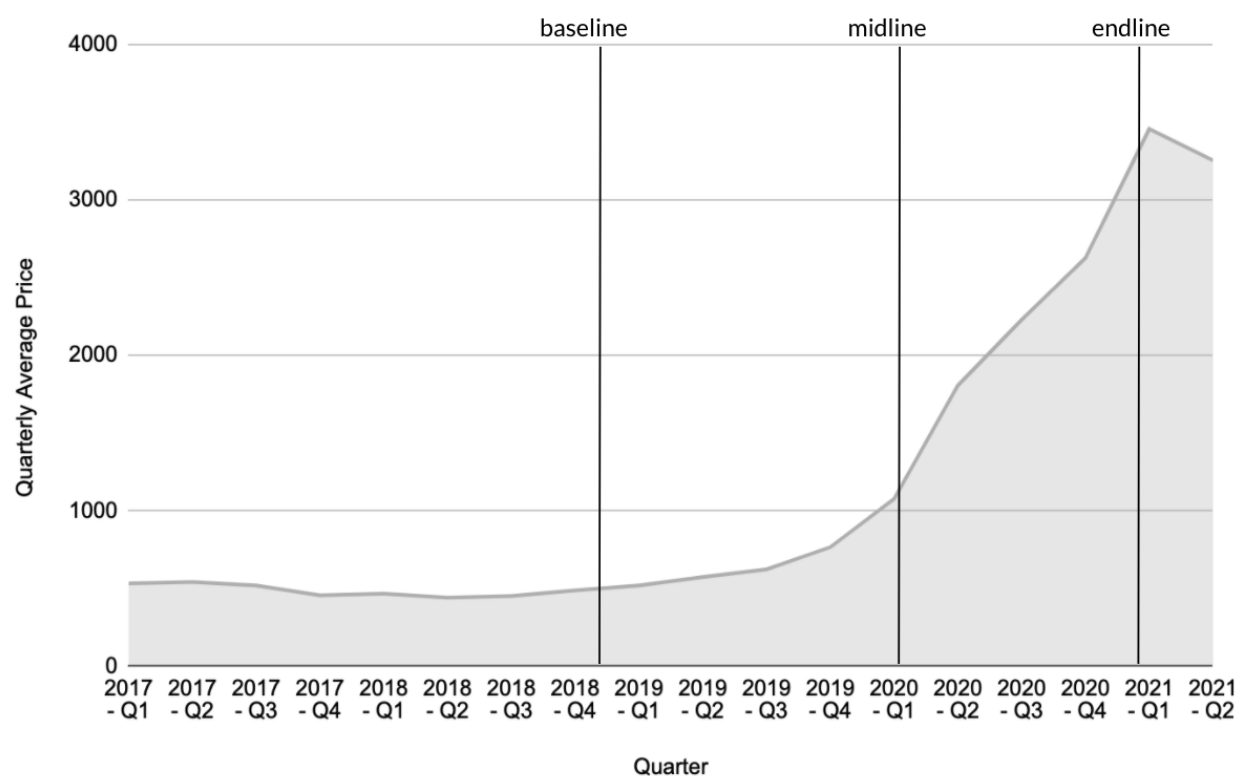
Income from value chains. Lastly, we present the changes in both the share of households who engage in value chain activities as well as the income generated from engaging in these activities. We examine five types of value chain activities: Trade in livestock and agricultural produce, sale of own agricultural produce, sale of their own livestock produce, post-production processing and, lastly, the engagement in activities related to agricultural supporting services. Figure 8a shows the percentage of households across all three waves who engage in these post-farming activities. Trade in agriculture crops and livestock outside the farmer's own produce is relatively low, where only 6% of households engage in such activities. We observe slight changes between baseline and midline, where this figure drops to 2%, which might reflect the challenges in trade due to the macro-economic crises that started in 2019. These shares rise back at the endline to their initial value of 6%. On the other hand, we see a consistent rise in the engagement in sales of their own agricultural produce and livestock. These shares change from 40% at baseline for agricultural produce to about 57% at endline, and from 18% at baseline for livestock produce to 28%.

In Figure 8b, we present the income generated from the engagement in these activities. All values in Syrian Pounds are converted to USD based on the 12-month average currency exchange before the data collection. The exchange rate is based on the informal market as was obtained through open-source platforms online and depicted in Figure 6b. For baseline, we use the exchange rate of 1 USD = 462 SP, for midline 1 USD = 760 SP, and for endline 1 USD = 2,528 SP. Despite the increase in the share of households who engage in the sale of their own agricultural and livestock produce, the income generated from these activities in USD did not significantly change between midline and endline. Although households have reported a higher income in Syrian Pounds, the USD value generated from these activities remains similar. Given that most of these products are sold at the local market, we do believe that households who engage in post-production activities benefited despite the macroeconomic and hyperinflation shock that Syria is currently facing. This is also reflected by the decreasing share of households who report "Low output prices" (see above). For example, we find that the average Food Security Score for households at endline who engage in at least one of these value chain activities is 57.6 compared to 52.8 for households who do not engage in any activity. This difference is strongly significant at the 1% level.

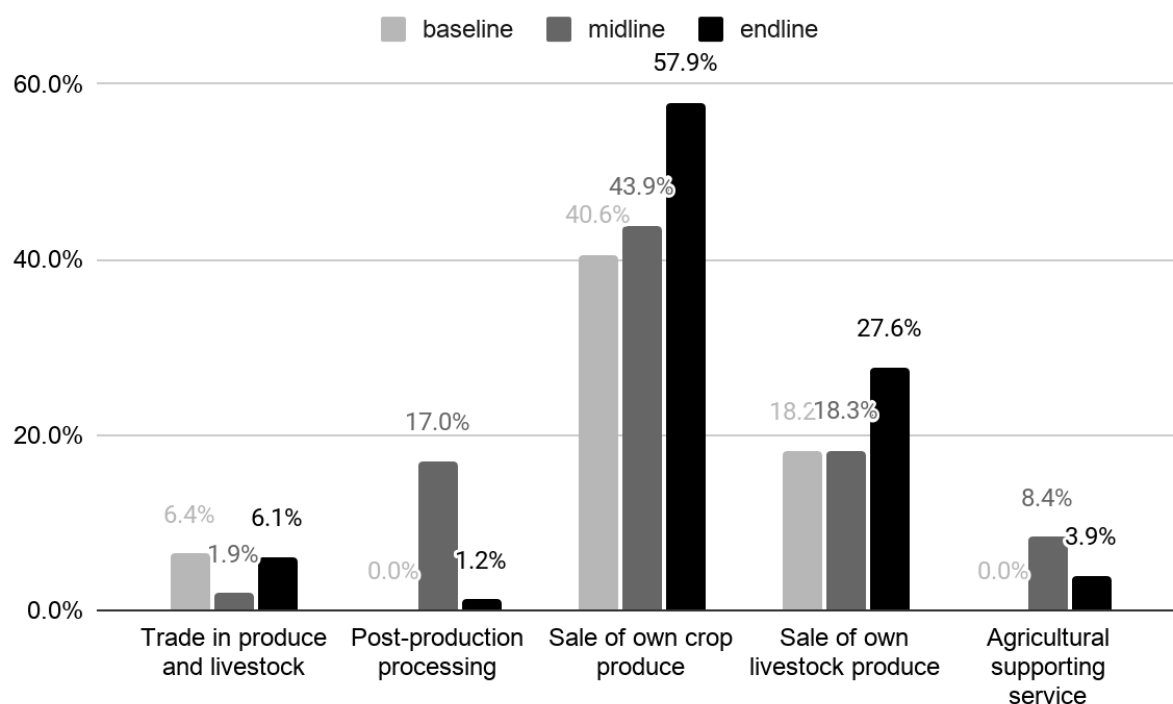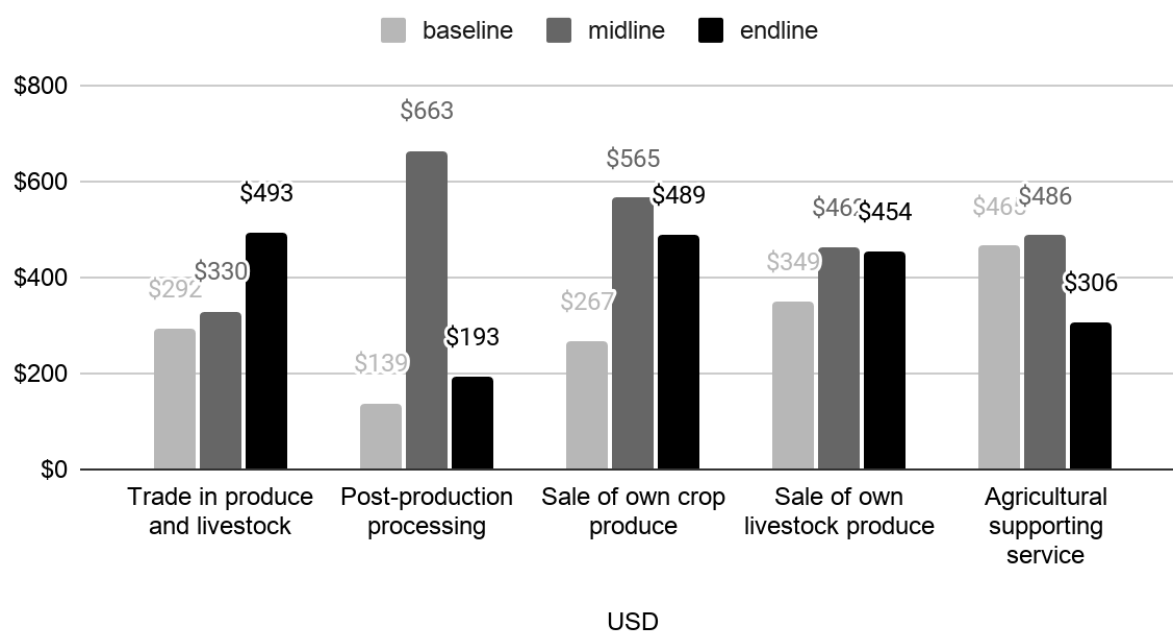Figure 8a. Increase in the shares of household engaging in post-production activities

Figure 8b. Income generated from agricultural value chain activities (in USD)

Note: Prices converted to USD based on the average SP to USD informal market price of the past 12. These figures include only households who engaged in value chain activities.

5. Programme endline analysis

In this section, we present the findings from the endline survey by comparing the beneficiary and non-beneficiary groups. We use only the endline survey at this stage to ensure that all beneficiary households, including the newly sampled ones, are fully covered in the analysis and in the interpretation of the findings. We will first present the results for the differences in the outcome variables for the overall beneficiary sample and then offer the analyses by type of intervention. Note that these findings are suggestive and important but not causal in a strict sense; they do not represent the final, formal impact analysis, which is presented in section 5. The purpose of this section rather is to walk the reader through the data analysis towards the firmer and more rigorous methodological approach. In that sense, this section is merely a stepping stone. The impatient reader keen to learn about full causal impacts may wish to skip to section 5 without delay.

5.1 Endline analysis of the overall programme

We balance the household characteristics of the two groups by matching only households from the control group that are very similar to those in the beneficiary group. Table 4 shows the differences between the households' profiles after matching for the gender and age of the household head, main income source, location and ownership of livestock and land. Although we still observe some marginal differences for some variables due to insufficient observations in the control sample, we are confident that the similarities between households is strong enough to generate unbiased findings.

We find, first, that the sample across the two groups covers eight governorates, where the main activities of the programme have been implemented (apart from Idlib, which was only sampled at endline from treatment villages). 30% of the sample in the beneficiary group are female-headed households and the mean age of the household head is 49 years old. The highest share of income is generated from crop farming. 45% of households reported that crop farming was their main occupation, followed by herding. 27% of the beneficiary sample have not completed any level of education. Moreover, we ensure that the two groups are balanced by asset ownership of land and livestock. In the endline sample, 48% of beneficiaries own irrigated land and 38% own rainfed land. 42% of the sample own sheep (driven mainly by the additional sample which mainly received livestock vaccination support), 13% of households own cattle, and 30% own poultry.

Table 4. Household characteristics are more balanced at endline after matching

	Control Group	Beneficiary Group	p-value
n	558	902	
Governorate (%)			0.013
Al-Hasakah	15.9%	11.3%	
Aleppo	11.0%	10.8%	
As-Sweida	13.7%	11.9%	
Dar'a	6.2%	5.0%	
Deir-ez-Zor	18.8%	21.0%	
Hama	22.0%	27.9%	
Homs	7.2%	3.4%	
Idlib	0.0%	3.4%	
Quneitra	5.2%	5.3%	
HH Head Gender = % Male	60.5%	69.6%	0.022
HH Head Age	49.16	49.34	0.850
HH Head Crop Farmer	46.0%	43.8%	0.413
HH Head Herder	35.3%	41.3%	0.045
HH Head Completed Education (%)			0.073
No Schooling	21.5%	27.0%	
Primary	59.1%	54.6%	
Secondary	13.0%	9.3%	
Tertiary	6.3%	9.2%	
Ownership of Agricultural Assets (%Yes)			
Irrigated Land	51 %	48 %	0.370
Rainfed Land	44 %	38 %	0.129
Poultry	31%	30%	0.827
Cattle	11 %	13%	0.338
Sheep	38 %	42%	0.225

Note: For shares, the sd is not shown. A p-value larger than 0.1 implies that the variable means are not different between the two groups

The consistent balance of the sample at endline after matching reassures us that households in both groups are comparable in location, gender, education, and main income sources. Hence, any differences we detect in the outcome variables are likely to be attributable to the programme.

Table 5 shows the average food security outcomes in both groups at endline. The food consumption score (FCS) is slightly higher in the beneficiary group (56.99 points) compared to the control group (55.01). The household dietary diversity score is similar across the two groups while the reduced coping strategy index (RCSI) is, on average, lower in the beneficiary group

(11.65 points) compared to the control group (12.06 points). However, we do not detect any statistical differences between any of the indicators between these two groups at endline. These data hence do not yet offer a clear conclusion using simple cross-sectional differences, even after controlling for sample balance. We will revisit this topic with more complex methods in section 6.

Table 5. Food security indicators at endline

	Control Group	Beneficiary Group	p-value
n	558	902	
FCS	55.01 (16.60)	56.99 (17.65)	0.116
HDDS	7.63 (1.82)	7.52 (1.74)	0.481
RCSI	12.06 (7.96)	11.65 (7.89)	0.572

Note: Standard deviation (sd) in parenthesis. For shares, the sd is not shown. A p-value larger than 0.1 implies that the outcome means are not different between the two groups.

Table 6 compares the share of households who adopted harmful coping strategies in the past 30 days before the survey took place to deal with food shortages or not having enough money to purchase food. First, we find that households in both groups did not revert to selling productive assets to compensate for food shortages, which is considered to be the most severe and irreversible strategy. Only 15% of households in the beneficiary and 13% in the control group reported that they needed to sell productive assets to cope with food shortages. Second, we observe that a high share of households continues to buy food on credit. 68% of households in the beneficiary group have used this strategy in the 30 days preceding the survey, compared to 69% in the control group. The only marginally significant difference detected is in the reduction of non-food expenditure in the beneficiary group which is higher than that of the control group.

Table 7 presents the results at endline for agricultural production, both for the quantity harvested (expressed in kilograms) and yields (expressed in tonne / hectare) for the main five crops grown by smallholder farmers. Beneficiary households who grow wheat harvested on average 3,077 kg in total compared to 4,122 kg in the control group (these numbers do not take into account land size but given that the two groups are comparable in size of land by design the estimate should hold). The production of barley, however, was on average slightly higher in the beneficiary group at 4,494 kg compared to 3,697 kg in the control group. This is similar to eggplant, with an average of 1,449 kg per household in the beneficiary group compared to 1,147 kg in the control group. We observe a strong significant difference in the production of tomatoes, where beneficiaries, who produced this vegetable, harvested on average 1,323 kg compared to

687 kg in the control group. These results are encouraging, particularly given that vegetable seed intervention has led to households increasing the production of vegetables.

Table 6. Rates in the use of harmful strategies at midline

	Control Group	Beneficiary Group	p-value
n	558	902	
Sale of Productive Assets	0.13 (0.34)	0.15 (0.35)	0.545
Take Food on Credit	0.69 (0.46)	0.68 (0.47)	0.717
Reduce Non-Food Expenditure	0.62 (0.49)	0.71 (0.45)	0.025
Reduce Asset Expenditure	0.69 (0.46)	0.74 (0.44)	0.309
Child Jobs	0.11 (0.32)	0.16 (0.37)	0.213
Sale of Food Aid	0.12 (0.33)	0.04 (0.19)	0.127
Sale of NFI	0.08 (0.27)	0.07 (0.25)	0.801

Note: Standard deviation (sd) in parenthesis. For shares, the sd is not shown. A p-value larger than 0.1 implies that the outcome means are not different between the two groups.

Table 7. Crop production and yields at endline

	Control Group	Beneficiary Group	p-value
n	510	902	
Wheat Harvest (kg)	4,122	3,077	0.049
Barley Harvest (kg)	3,697	4,494	0.229
Eggplant Harvest (kg)	1,147	1,449	0.431
Cucumber Harvest (kg)	1,087	994	0.887
Tomato Harvest (kg)	687	1,323	0.030
Wheat Yield (t/ha)	2.79 (0.95)	2.67 (0.89)	0.158
Barley Yield (t/ha)	1.41 (0.52)	1.35 (0.58)	0.454
Eggplant Yield (t/ha)	21.86 (10.82)	23.99 (11.70)	0.350
Cucumber Yield (t/ha)	13.86 (6.80)	12.13 (8.42)	0.307
Tomato Yield (t/ha)	20.77 (12.12)	21.17 (12.32)	0.859

Note: Standard deviation (sd) in parenthesis. For shares, the sd is not shown. A p-value larger than 0.1 implies that the variable means are not different between the two groups.

With respect to yields, households in the beneficiary group did not attain a better yield than those in the control group for wheat and barley, at 2.67 t/ha and 1.35 t/ha respectively. The lack of detectable difference in yields for these two crops is not surprising, given that the programme did not provide inputs specifically for the production of these two crops. On the other hand, we find that households in the beneficiary group have had larger yields for eggplants and tomatoes,

at 23.99 t/ha and 21.17 t/ha, respectively. However, these differences are not statistically significant.

Table 8 presents the results for livestock production and yields. We focus on the main livestock types owned by households, namely cattle, sheep and poultry. In terms of cattle milk production, we find no differences between the control (23 litre daily) and beneficiary group (22 litre daily). However, we find large differences for the production of sheep milk for the beneficiary group at an average of 28 litres daily compared to 11 litres for the control group. This difference is significant at the 1% level. Although the positive difference in production of sheep milk is notable for the beneficiary group, the yields per sheep are slightly lower (0.43 per sheep per day) than that of households in the control group (0.58 per sheep per day).

Table 8. Livestock production and yield at endline

	Control Group	Beneficiary Group	p-value
n	558	902	
Cattle Daily Milk (L)	23.99 (24.23)	22.12 (23.90)	0.606
Sheep Daily Milk (L)	11.05 (16.28)	27.73 (40.20)	<0.001
Daily Chicken Eggs	6.27 (4.18)	10.76 (11.17)	<0.001
Daily Milk per Cattle	12.51 (6.56)	10.74 (6.05)	0.176
Daily Milk per Sheep	0.58 (0.23)	0.43 (0.18)	<0.001
Daily Eggs per Chicken	0.48 (0.16)	0.89 (0.65)	<0.001
Cattle Meat (Kg / Season)	175.00 (43.34)	200.00 (108.67)	0.473
Sheep Meat (Kg / Season)	328.49 (1,055.9)	372.00 (549.29)	0.855
Wool (Kg / Season)	38.94 (49.33)	82.28 (109.89)	0.001

Note: Standard deviation (sd) in parenthesis. For shares, the sd is not shown. A p-value larger than 0.1 implies that the variable means are not different between the two groups.

Moreover, beneficiary households produce more eggs on average (about 11 eggs per day) compared to the control group (6 eggs per day), and this increased production is driven mainly by increased daily yields per chicken (0.89 on average for the beneficiary households compared to 0.48 for the control households). We find no statistically significant differences in the production of meat (expressed in kg per season) between the two groups for either cattle or sheep. It is important to note that the share of households engaged in production of meat is relatively small. On the other hand, we find that households in the beneficiary group produce on average more wool per season than households in the control group.

Table 9 presents the results of income generated from value chain activities between the two groups at endline. First, households in the beneficiary group generated more income from trading in agricultural produce (595 USD on average), almost four-fold the average income from a control household. We find no strong differences in the income generated from the sale of agricultural cereal and vegetable crops (both at about 430 USD). However, we find that beneficiary households earn less income from the sale of their own livestock produce (416 USD) compared to the control group (528 USD). This requires further investigation given that beneficiary households produce more livestock products on average, as shown in Table 8.

Table 9. Income generated from post-production activities at endline

	Control Group	Beneficiary Group	p-value
n	588	902	
Income from agricultural trade (USD)	150.20 (190.01)	595.58 (431.43)	<0.001
Income from post-processing (USD)	129.29 (203.80)	158.67 (177.04)	0.742
Income from sale of own crop produce (USD)	433.17 (457.28)	430.80 (388.81)	0.946
Income from sale of own livestock produce (USD)	528.08 (432.46)	416.01 (396.58)	0.061
Income from agriculture support services (USD)	268.64 (275.72)	325.10 (227.16)	0.432

Note: Standard deviation (sd) in parenthesis. For shares, the sd is not shown. A p-value larger than 0.1 implies that the variable means are not different between the two groups.

Finally, we compare if and how households across both groups were affected by shocks at endline. Table 10 shows the average difference of reported shocks between the beneficiary and control groups. On average, we find that households in the beneficiary group reported lower prevalence of drought (19% compared to 21% in the control group), lower prevalence of high input costs (87% compared to 93% in the control group), and lower crop pests (11% compared to 14% in the control group). On the other hand, we find that beneficiary households reported higher incidence of livestock disease (26% compared to 19% in the control group). This difference in reported livestock disease is mainly driven by both the larger share of households who engage in livestock production in this beneficiary group and by the targeting in the endline sample for households that received livestock vaccinations. We find that 40% of households who received the livestock vaccination interventions have reported experiencing shocks related to livestock disease compared to only 4% in a similar control group. In other words, given that the vaccination support was provided in the past 12 months, we are not likely to observe any positive effects in the reduction of livestock disease at this stage.

Table 10. Differences in exposure to shocks at endline

	Control Group	Beneficiary Group	p-value
n	667	914	
Drought	0.21 (0.41)	0.19 (0.39)	0.443
Floods	0.03 (0.17)	0.01 (0.10)	0.038
Crop Pests	0.16 (0.37)	0.11 (0.32)	0.040
Livestock Disease	0.19 (0.40)	0.26 (0.44)	0.024
High Input Costs	0.93 (0.26)	0.87 (0.33)	0.002
Low Out Prices	0.19 (0.40)	0.21 (0.40)	0.649
Illness of Income Earner	0.10 (0.30)	0.08 (0.27)	0.412
Theft of Agricultural Assets	0.07 (0.26)	0.06 (0.23)	0.297
Fire	0.03 (0.16)	0.02 (0.12)	0.239

Note: Standard deviation (sd) in parenthesis. A p-value larger than 0.1 implies that the variable means are not different between the two groups.

Next, we compare the reported severity of drought. First, we find that although there are no statistical differences between the two groups in the exposure to drought occurrence at endline, the severity of the self-reported shocks is higher in the control group than that of the beneficiary group. Figure 9 shows the distribution of severity for households who reported experiencing drought in the past 12 months. Almost 70% of households who reported experiencing drought in the control group faced severe to very severe effects compared to 51% of households in the beneficiary group. This implies that households in the beneficiary group are more resilient against the negative impacts of drought. We find the same trends for the impact of livestock disease, where 61% of beneficiary households reported severe to very severe impact compared to 70% of control households.

Figure 9. Severity of drought
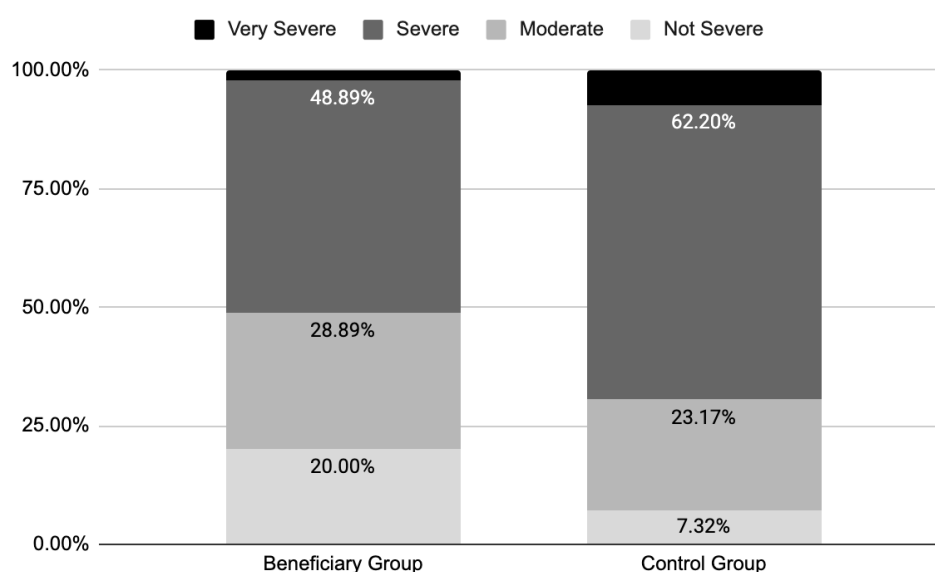
5.2 Endline analysis by type of support packages

Next, we examine the main outcomes of interest by the type of intervention, focusing mainly on the Food Consumption Score as a measure of food security, and the reduction in sale of productive assets and buying food on credit as measures of resilience.

Figure 10 shows the mean difference in food security separately for all five interventions at the endline. It is important first to note that the control groups were matched differently for each intervention to maintain balance of the sample and to make the comparison more rigorous and robust. The results can be interpreted as follows: If the mean difference and the error bars do not intersect the zero line, then it implies that the effect was significant. A mean value greater than zero signifies a positive effect, and vice-versa.

First, households who received vegetable kits or vegetable seedlings are on average better off in regards to their food security status at the endline, which is comparable to findings from midline. Households who received vegetable kits have increased their FCS by about 5 points on average, which is more than a 10% improvement from their initial values. Similarly, households who received vegetable seedlings and irrigation support also saw a 5-point significant improvement. Moreover, we find a positive effect on food security, albeit not significant at the 10%, for the beneficiaries of livestock vaccines.

Households who received support in beekeeping and poultry provision, on the other hand, did not have a notable change in their food security at endline. Although the mean differences are negative, they are not statistically significant. These intervention-specific variations in the results on food security could be explained directly through the nature and timing of the interventions. Given that households who have received vegetables have more direct access to diverse and healthier food, we are likely to find a stronger effect on food security within these groups.
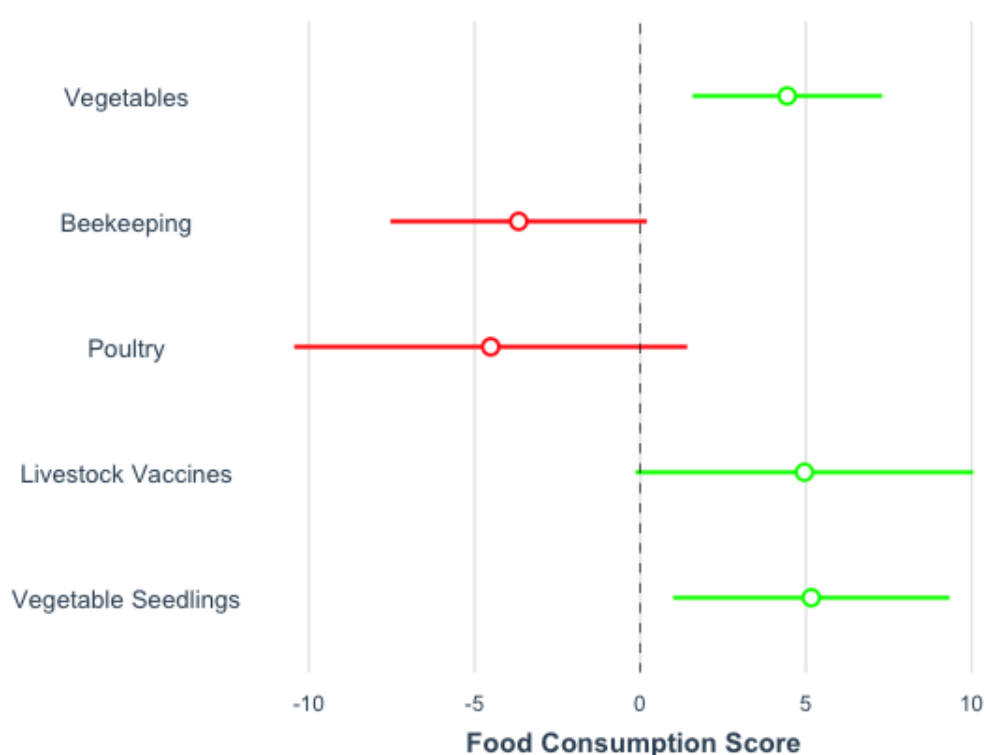
Second, we examine the differences in resilience, focusing on two harmful coping strategies households used to deal with shortages of food. Figure 11 shows the difference in the share of households who did not adopt these harmful livelihood strategies. In other words, a negative mean difference implies that households in the beneficiary groups are less likely on average to have used this harmful coping compared to households in the control group (which is desirable). The first panel presents the findings from the sales of productive assets. Households who received the beekeeping interventions are less likely to sell their productive assets, which is related to the support they received. On the other hand, we find that the beneficiary group that

received the livestock vaccine were more likely to sell productive assets to deal with food shortages. Moreover, we find no notable difference for households who received vegetable kits, poultry, or vegetables seedlings.

Moreover, we do not find any significant difference in the reduction in buying food on credit, apart from beneficiaries who received livestock vaccines, which is explained with the negative effects in the sales of productive assets, implies that households do not use multiple coping strategies to deal with food shortages at the same time. Households who sell their productive assets, generate cash and are also less likely to borrow food on credit.

Figure 11. Endline resilience by intervention type
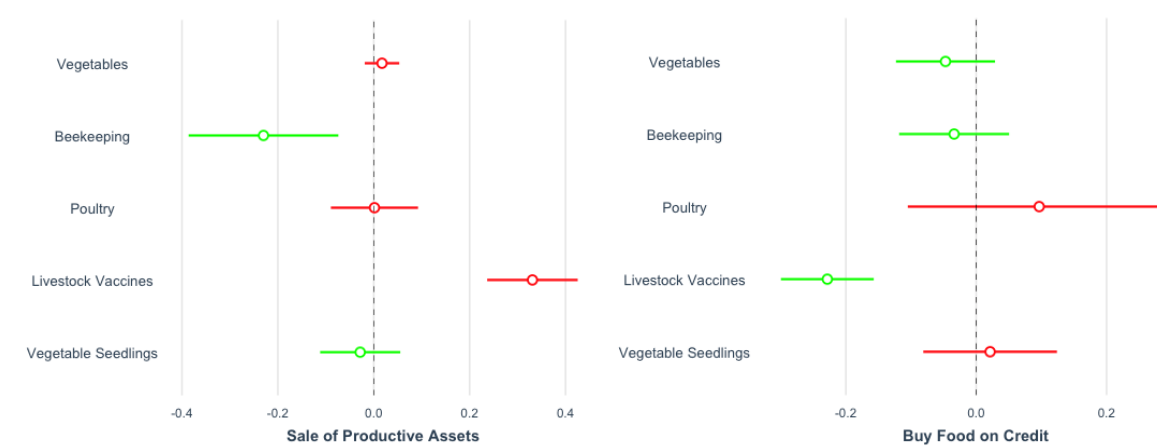
In summary, there are notable positive differences at endline for beneficiaries who received vegetable kits and seedlings and who grow vegetables in Syria as part of the FAO programme on addressing emergency needs and building resilience. These two intervention types had a clear direct effect on households' food security status. On the other hand, beekeeping and poultry activities did not lead to a positive strong impact. In contrast, livestock-based interventions have a larger potential to shape asset-based coping strategies. These two findings complement each other: different types of interventions are likely to have slightly different outcomes. If a bigger push in terms of achieving food security and better coping strategies were intended, more comprehensive interventions may be required which help smallholders improve their livelihoods in multiple dimensions.

6. Programme impact assessment

In this section, we present rigorous evidence on the impacts of the programme by using the panel dataset, which includes households who were tracked in both beneficiary and control groups between baseline and endline. We measure precisely the magnitude of the impacts of the programme on our main set of outcomes, focusing on food security, resilience, and agricultural production. These impacts can be interpreted as causal impacts; they represent our most reliable and sophisticated impact measurements. We show the overall impact of the programme using the average treatment effects; we then examine the heterogeneous impacts. Over and above these findings, unintended positive or negative findings were not detected.

Table 11. Baseline profile of tracked households in balanced panel dataset

	Control Group	Beneficiary Group	p-value
n	260	260	
Governorate (%)			0.770
Al-Hasakah	23.1%	28.1%	
Aleppo	30.0%	26.5%	
As-Sweida	14.2%	13.5%	
Dar'a	1.5%	1.2%	
Deir-ez-Zor	21.9%	19.6%	
Hama	0.8%	0.8%	
Homs	3.5%	2.7%	
Quneitra	5.0%	7.7%	
HH Head Gender = % Male	75.6%	68.7%	0.101
HH Head Age	49.84 (13.08)	49.27 (12.47)	0.609
HH Head Crop Farmer	59.8 %	57.22 %	0.389
HH Head Herder	13.5 %	10.61 %	0.112
HH Head Completed Education (%)			0.446
No Schooling	34.6%	30.3%	
Primary	53.7%	54.2%	
Secondary	6.9%	7.6%	
Tertiary	4.8%	8.0%	

Note: Standard deviation (sd) in parenthesis. For shares, the sd is not shown. A p-value larger than 0.1 implies that the variable means are not different between the two groups.

First, we present the balance table of the households included in this analysis (Table 11). After matching the two groups, the panel sample includes mainly households from Al-Hasakah (28%),

Aleppo (24%), and Deir-Ez-Zor. 69% of households are male-headed in the beneficiary group compared to 75.6% in the control (however, the difference is not statistically significant). Moreover, about 58% of the households on average generate income mainly from crop farming.

6.1 Average treatment effects

Table 12 shows the impact analysis on the three food security indicators. The first three columns show the differences between the beneficiary and control group at baseline, the second three columns show the differences at endline, and the last three columns show the difference-in-difference estimation (mean impact) between baseline and endline. **In regards to the food consumption score, we find a significant positive causal increase for the beneficiary group due to the intervention.** The mean impact is 6.67 points, which is a notable **13 % increase from baseline values which can be attributed causally to receiving the support.** In other words, in the absence of the programme, food security value would have stayed at around 52 points for the beneficiary group. We also observe improvements in the RCSI by 0.27; however, these improvements are not statistically significant.

Table 12. The positive changes in food security are directly attributable to FAO's programme

	Baseline			Endline			Impact		
	control	benef	p-value	control	benef	p-value	mean	se	p-value
n	260	260		260	260				
FCS	55.69 (18.19)	51.94 (17.32)	0.017	52.86 (17.50)	55.79 (18.64)	0.066	6.67	2.23	0.00
HDDS	7.80 (1.79)	8.05 (2.05)	0.145	7.08 (1.61)	7.06 (1.70)	0.874	-0.27	0.22	0.23
RCSI	9.45 (6.44)	10.02 (7.81)	0.364	10.37 (8.23)	10.67 (8.72)	0.699	-0.27	0.99	0.79

Note: Standard deviation (sd) in parenthesis. For shares, the sd is not shown. A p-value larger than 0.1 implies that the variable means are not different between the two groups. se = standard errors.

Table 13 shows the average treatment effect on the use of the harmful coping strategies. The comparison between baseline and endline shows a clear notable overall decline in the use of extreme strategies, such as the sale of productive assets. In fact, two coping strategies become quite rare in the overall sample by endline, with sale of productive assets and child work both being practiced by less than 10% at endline. Yet given the high differences between the two groups at baseline, where households in the control group have used these strategies more often than in the treatment group, the changes cannot be directly attributed to the programme.

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Moreover, the measures only take into account households who did not deplete these strategies previously and are bound to a value between 0 and 1, which makes the comparison less straight-forward, especially given that most households reached the lower bound of 0.

Table 13. A sharp decline in the use of harmful coping strategies in both groups

	Baseline			Endine			Impact		
	control	benef	p-value	control	benef	p-value	mean	se	p-value
n	260	260		260	260				
Sale of Productive Asset	0.42 (0.49)	0.25 (0.44)	0.008	0.06 (0.23)	0.07 (0.25)	0.595	0.17	0.05	0.00
Take Food on Credit	0.87 (0.34)	0.82 (0.38)	0.219	0.59 (0.49)	0.54 (0.50)	0.330	0.00	0.06	0.97
Reduce Non-Food Expenditure	0.87 (0.33)	0.75 (0.44)	0.002	0.68 (0.47)	0.73 (0.44)	0.196	0.18	0.06	0.00
Reduce Asset Expenditure	0.73 (0.45)	0.66 (0.48)	0.170	0.76 (0.43)	0.78 (0.42)	0.562	0.09	0.06	0.14
Children Take Jobs	0.37 (0.49)	0.27 (0.45)	0.090	0.06 (0.23)	0.08 (0.27)	0.347	0.12	0.05	0.02

Note: Means show the share of households who used this strategy in the past 30 days. Standard deviation (sd) in parenthesis. A p-value larger than 0.1 implies that the variable means are not different between the two groups. se= standard errors.

In terms of agricultural production, we find that beneficiary households have increased both the quantity of crops harvested and their yields, particularly their vegetable yields (Table 14). More generally, **we observe a consistent and large increase in quantities harvested and yields for all five main crops from baseline to endline**. Given the relatively small sample sizes and given the challenges of measuring production and yield accurately, the standard deviations of the point estimates are quite large, which in turn means most results are statistically insignificant using conventional notation. We do, however, observe significance levels of close to 0.2 (or smaller) for several indicators, which suggests that a larger survey sample and more accurate measurement may have resulted in more accurate point estimates and hence significant impact estimates. Given the challenges of conducting an impact evaluation in a setting like Syria and given the across the board increases in outputs and yields for the beneficiary group, we are confident to interpret our findings as impacts of the intervention.

Looking at Table 14 in more detail, we find that the mean impact in wheat yields is a strong 1,541 Kg, a 50% increase from baseline values for the beneficiary group. Moreover, we find that households in the beneficiary group produced more vegetables, with a 2,082 Kg mean impact for eggplants, 2,171 Kg for cucumber, and 1,551Kg for tomatoes. The mean impact estimates the

difference-in-difference between the two controls and beneficiary and the two periods. Hence, any significant mean impact can be attributed to receiving the intervention. These differences correspond to a **100% increase in the production of tomatoes, a 337% increase in cucumber production, and 320% increase in eggplant production.** Most importantly, these positive effects are driven by an increase in harvest in the beneficiary group, and not just the reduction in production in the control. Moreover, the positive increase in vegetable production is partly explained by the increased yields in the beneficiary group, particularly for tomatoes, which is statistically significant at the 5% level.

Table 14. Improvement in vegetable production and yields for supported households

	Baseline			Endline			Impact	
	control	beneficiary	p-value	control	beneficiary	p-value	mean	p-value
n	260	260		260	260			
Wheat_Harvest (kg)	4,975 (6,048)	3,014 (4,552)	0.080	4,439 (4,211)	4,020 (5,204)	0.498	1,541	0.20
Barley_Harvest (kg)	2,010 (5,768)	1,444 (1,901)	0.470	3,392 (2,761)	3,182 (3,144)	0.629	355	0.67
Eggplant_Harvest (kg)	2,446 (10,813)	649 (1,288)	0.088	814.56 (1,448)	1,100 (1,745)	0.372	2,082	0.16
Cucumber_Harvest (kg)	1860 (8,192)	644 (1,957)	0.199	379 (733)	1,334 (2,651)	0.147	2,171	0.21
Tomato_Harvest (kg)	2,154 (4,399)	1,503 (4,391)	0.256	1,038 (3,347)	1,937 (4,707)	0.227	1,551	0.11
Wheat_Yield (t/ha)	2.78 (1.29)	2.80 (1.04)	0.946	2.71 (0.93)	2.69 (0.93)	0.867	-0.04	0.88
Barley_Yield (t/ha)	0.64 (0.74)	0.92 (0.82)	0.038	1.26 (0.60)	1.45 (0.61)	0.034	-0.09	0.56
Eggplant_Yield (t/ha)	14.46 (11.89)	14.16 (10.56)	0.852	21.53 (11.21)	22.82 (10.64)	0.559	1.58	0.56
Cucumber_Yield (t/ha)	12.61 (11.48)	11.30 (9.79)	0.479	12.02 (7.55)	15.45 (8.17)	0.175	4.74	0.19
Tomato_Yield (t/ha)	19.96 (15.69)	17.43 (14.06)	0.189	18.65 (11.85)	22.98 (12.73)	0.056	6.86	0.03

Note: Standard deviation (sd) in parenthesis. For shares, the sd is not shown. A p-value larger than 0.1 implies that the variable means are not different between the two groups. Standard errors of the impact means are not shown.

These positive results in the quantity of vegetables produced and their yield are a vital indicator for the longer-term impacts of the vegetable seeds support. At midline, we did not find any positive impacts of the programme on these outcomes; however, two years after the distribution

of the vegetable toolkits, we started to observe a positive trend. At midline, we showed that the conditions were generally favourable to farmers across Syria, with reduced violence and increased rainfall. These positive trends then overshadowed the short-term impacts of the programme. Now we find that the impacts of the programme are starting to materialize and carry on into subsequent years.

6.2 Treatment effects by subgroups

Next, we examine the impact on gender and by access to water. Table 15 shows the breakdown of the impact assessment on the food security indicators by the gender of the household head. Consistent with the findings from midline, **we find a strong, positive and significant impact of the FAO intervention on both food consumption and on dietary diversity for female-headed households**. **The food security status as measured by the FCS increased by 32% due to the programme.** Therefore, the programme's targeting of female-headed households was very successful. Beneficiary female-headed households also reduced their adverse coping strategies by more than the comparable control female-headed households, though this change is not statistically significant (given the high variability of the RCSI variable across groups and time).

Table 15. Female-headed households have benefited significantly from the programme

	Baseline			Endline			Impact	
	control	beneficiary	p-value	control	beneficiary	p-value	mean	p-value
FCS	59.12 (20.37)	50.55 (19.88)	0.012	54.12 (17.60)	61.86 (19.60)	0.015	16.30	<0.01
HDDS	8.40 (1.84)	7.62 (2.01)	0.018	7.23 (1.57)	7.44 (1.54)	0.420	0.99	0.02
RCSI	12.66 (6.92)	12.63 (9.22)	0.984	11.18 (7.76)	10.24 (8.31)	0.509	-0.91	0.65

Note: Standard deviation (sd) in parenthesis. A p-value larger than 0.1 implies that the variable means are not different between the two groups. Standard errors of the impact means are not shown.

Table 16 shows the impact of the intervention on food security outcomes for households who have access to irrigation. We compare only households in the beneficiary and control group who do not face constraints in accessing irrigation to their land. We find **a strong positive effect of the FAO intervention on food consumption for households with access to irrigation**, **with a mean impact of 11 points. This is more than a 20% increase from baseline values that can be attributed to the programme**. On the other hand, we do not find a strong impact on dietary

diversity nor on RCSI (Table 14) - nor for households who do face water access constraints (not shown in the table). This implies that the intervention is more likely to achieve its impact if integrated with irrigation support or a pre-existing water access, underscoring the importance of having a resilient and functioning environment to allow farmers to benefit better from provided support. This is intuitively convincing as horticulture (and, to a lesser extent, livestock rearing) does require reliable access to water. As we argued in our Midline Report, future interventions in Syria should target the same farmers with multiple packages, as we are likely to observe stronger and more sustainable impacts. Strengthening the resilience of key farmers would then have a positive spillover on the sector at large, and consequently the food security situation in Syria.

Table 16. Intervention has stronger impact for households with no land irrigation constraints

	Baseline			Endline			Impact	
	control	beneficiary	p-value	control	beneficiary	p-value	mean	p-value
FCS	58.90 (20.12)	52.86 (18.82)	0.009	53.52 (18.19)	58.68 (19.55)	0.015	11.20	<0.01
HDDS	8.36 (1.94)	8.45 (2.17)	0.693	7.13 (1.66)	7.15 (1.77)	0.904	-0.07	0.81
RCSI	10.49 (6.23)	10.01 (6.81)	0.530	7.78 (7.01)	6.96 (6.25)	0.302	-0.33	0.76

Note: Standard deviation (sd) in parenthesis. A p-value larger than 0.1 implies that the variable means are not different between the two groups. Standard errors of the impact means are not shown.

7. Conclusions and lessons learnt

7.1 Conclusions

The "Supporting emergency needs, early recovery and longer-term resilience in Syria's agriculture sector" project was an ambitious programme run by FAO Syria and funded by FCDO, which was implemented in nine Governorates across Syria over a period of four years. The key objective of the programme was to provide emergency and resilience building support to increase food availability for vulnerable smallholder farmers, build sustainable access to productive assets and food supply, and foster an enabling environment for resilience building and recovery. The programme included over 10 different interventions, including the provision of vegetable kits, seedlings, beekeeping, poultry, livestock vaccines and cow feed as well as the

rehabilitation of irrigation systems and the establishment of SPUs, seed multiplication schemes and low tunnels for vegetable seedling production.

In this study, we conducted a rigorous impact evaluation of the programme, focusing on support for vulnerable households through the provision of agricultural and livestock assets (including vegetable seeds and seedlings, tools, beekeeping, poultry and livestock vaccines). The design of the study compared similar beneficiary and non-beneficiary households before and after the start of the programme in order to delineate the causal impact of receiving support on increasing agricultural production, strengthening food security, and reducing the use of harmful livelihood strategies.

Since the start of the programme in 2017, Syria has witnessed a multitude of economic, political and climatic shocks. Despite the gradual reduction in the incidence of conflict and violence in the past four years, farmers still faced challenges, particularly with the hyperinflation of input prices due to financial and currency crises that is currently taking place in Syria and the region at large. On the other hand, the year 2020 has brought the end of a long drought period in Syria, which positively impacted all farmers. We observe improvement in the food security status of households in 2020 at midline. However, due to macroeconomic shock we see a reduction in food security to pre-programme levels. This depicts the volatility of the agricultural sector in Syria which remains shaped by exogenous factors like weather as well as economic and political shocks.

Against this backdrop, **the programme was successful in reaching its targeted farmers, providing timely support, and achieving short-term positive impact on food security and livelihoods.** Specifically, the programme increased the overall food security status of households which, in the absence of the intervention, would have been worse off. These effects were mostly prominent for vulnerable households who received the vegetable intervention which included seeds, tools, and irrigation drip kits. The food security benefit from the programme was strong among female-headed households, who increased their food security status by 32% compared to baseline levels, underscoring the importance of targeting vulnerable groups and particularly women. The increase in food security can be explained by the higher production and yields of vegetable crops in the beneficiary group.

On the other hand, we do not observe strong evidence of impact of food security for other types of interventions including poultry and beekeeping. This highlights the importance of understanding and building on intervention pathways in achieving programme goals and outcomes. We do find, however, significant evidence on the impact of the beekeeping intervention on resilience, measured through the reduction in sale of productive assets. Given

that the various interventions were not clustered and targeted to the same households, we are less likely to find strong evidence for long-term impact on resilience, which require a multitude of factors to ensure households are able to face recording future shocks without compromising their food consumption or productive asset capacity. The absence of a positive finding for food security for beekeeping could also be a statistical artefact driven by relatively low statistical power for this small subset of the overall programme.

7.2 Lessons learnt

Based on these conclusions, we provide six lessons learnt below. We rank these lessons in terms of their perceived priority to FAO Syria. The lessons are primarily intended for FAO specifically and other organizations working in Syria generally. Although these recommendations and lessons learnt are tailored to the programme being evaluated, there are a number of lessons that can be considered in the design of future interventions that work in similar contexts and scales.

1. Resilience. Smallholder farmers in Syria face multiple significant shocks including economic, climatic and conflict-related. Such challenging context calls for ensuring that households are able to cope with recurring shocks without the need to rely on irreversible negative coping mechanisms, that is it calls for strengthening their resilience. While building resilience is a priority, it is a complex and multidimensional process taking years. We recommend that FAO and its stakeholders aim to provide households with reliable access to social safety nets, productive agricultural and livestock assets, functional markets and value chains and irrigation, which in turn will lead to increased adaptive capacity and stronger food security in the long-term. This holistic approach in resilience-building implies that programmes should carefully improve targeting and the clustering of interventions to achieve higher, long-lasting impact. This will reduce the pursuit of adverse and often irreversible coping strategies, which reduce resilience permanently.

2. Targeting. We recommend FAO as well as other international and local stakeholders who work in similar context and settings to better fine-tune their beneficiary selection criteria. We particularly encourage that future support continues to be targeted at female-headed households who clearly benefited directly from the programme both immediately after receiving support and two years on.

3. Clustering. It appears that the interventions were spread very widely, and perhaps too widely, across regions and beneficiaries, resulting in only marginal benefits per beneficiary household and village. Such an approach may fail to unlock agricultural potential if constraints are multi-

dimensional. For example, households may need seeds *and* adequate irrigation to produce effectively. We recommend to FAO that multiple intervention components are targeted to similar households to increase overall impact and its sustainability in the long-term, as well as strengthen resilience against future shocks.

4. Emergency versus development. From our previous work with FAO Syria, we know about the value of, for example, a seed intervention in times of crisis. Yet in better times, a smaller scale programme as described above (which is effectively an agricultural social safety net) may offer fewer benefits. Yet we caution against simply ending such programmes when a crisis recedes temporality, especially in a regional and global context of extreme macro-economic uncertainty and in the midst of a pandemic. Should the weather fail or insecurity escalate or geopolitics impose further social and economic constraints, then receiving some support with production will become a critical determinant of survival once more.

5. Market development. Our analysis revealed the critical role of credit to support the rural Syrian economy. The good news is that inputs and outputs exist and can be traded (at least prior to the full outbreak of Covid-19). However, the bad news is that working and living on credit creates dependency and vulnerability, which will reduce resilience and inhibit the growth of the rural economy. Moves to strengthen rural markets are hence critical - as are moves to reduce the dependence on credit. Concerning the former, the smallholder support programme of FAO Syria which provides local market development can offer insights on how to proceed. On the latter, it may prove instructive to consider the simultaneous provision of inputs in kind, vouchers and cash and analyse the impacts of such different intervention modalities. A key benefit of vouchers and cash would be to enable FAO Syria to respond more flexibly to changing contexts.

6. Data. Conducting an impact assessment in an emergency setting is a challenge and an achievement in itself. Key to its success is the quality of the data and the research design. Given the constraints of the setting, this study succeeded in establishing clear causal impacts of the intervention, which is a significant achievement in methodological terms. Larger samples and cleaner research designs would help estimate impacts with more precision, particularly for programmes with multi-arm interventions. Complex interventions require complex tools, and quantitative causal impact designs might not be the right or sufficient tool for evaluating certain aspects of the programme. Additional qualitative methods and data are equally crucial and should be embedded in the project early on. However, the main lesson learnt on this issue is that relatively small efforts in rigorous learning can yield significant insights. Such insights are urgently needed in the humanitarian community working to establish food security and resilience in conflict-affected settings around the world. Every additional study is a critical

puzzle piece helping to build the knowledge on how to design more effective interventions for people most in need of support. Learning from humanitarian assistance is a global public good.

Author statements

Appendices

A.1 Programme outcome and impact indicators

Impact / Outcome Indicator	Baseline	Endline	Notes
IMPACT INDICATOR 1: % of population in targeted governorates considered to be food secure (not food insecure or at risk of food insecurity) (cumulative)	68% are food secure	71% are food secure	We use the food consumption score to measure food security
IMPACT INDICATOR 2: % of households in targeted areas not adopting irreversible / "negative" coping strategies (cumulative)	34%	91%	We only use sale of productive assets as an indicator of irreversible negative coping strategy
OUTCOME INDICATOR 1: % of supported households (and number of their individual HH members) with increased quantities of crops (cereals and vegetables) produced		23% of beneficiary increased the production of vegetables and 59% increased production of cereals compared to baseline	We compare changes in production for beneficiary households.
OUTCOME INDICATOR 2: % of supported households(and number of their individual HH members) who increased their income along agricultural commodity value chains	14% of beneficiary households engaged in sales of livestock produce and generated on average 358 USD and 42% engaged in the sales of crop produce and generated on average	23% engaged in sales of livestock produce and generated on average 438 USD and 76.5% in the sales of crop produce generated 455 USD on average. 73% of beneficiary households increased their income along	We compare changes in beneficiary households who engage in agricultural commodity value chains.

	258 USD	commodity value chains	
OUTCOME INDICATOR 3: %of supported households (and number of their individual HH members) demonstrating improved livestock production	Not Available	56% of supported households engaged in livestock production compared to only 43% in the control group. Beneficiary group produced higher eggs in total and egg yields as well as sheep milk and wool	We compare changes between beneficiary and control group at the endline.
OUTCOME INDICATOR 4: Number of individuals with disabilities supported by the programme	Not Available	12 % of beneficiary households at endline reported having disabilities	No baseline data on disability is available. Sample is not representative of the total beneficiaries with disabilities targeted by the programme.

A.2 Additional endline monitoring and assessment

In addition to the impact assessment of the interventions that were covered in the main study of the report, we provide additional post-distribution assessments of the three interventions that were conducted by the FAO Syria office. The interventions include the sprout production units (SPUs), the low tunnel for vegetable seedling production, and the distribution of cow fodder. The text in this appendix was drafted by the M&E team of FAO Syria.

A.2.1 Barley sprout production units (SPUs)

We provide a short assessment of the five barley sprouting production units set up by FAO in Aleppo, Hama, and Homs. The total number of direct beneficiaries in the sample was 39 cattle breeders including 16 from Aleppo, 15 from Hama and 8 from Homs, all of whom received: (i) sprouted barley; (ii) salt blocks; (iii) solar powered SPU as productive assets equipped with generators; (iv) and additional training on operational, maintenance and technical aspects. Each unit has on average two employees, and the number of direct and indirect beneficiary breeders contributing to each unit is on average 30.

The data collection and assessment of these SPUs were not part of the overall quantitative study and have been included to additionally cover the monitoring and evaluation of these units. We present findings for the short assessment focusing mainly on the breeders' feed production and revenue generation from joining these SPUs.

The daily amount of sprouted barley required is 15.4 Kg per day per breeder. On average, we find that a breeder owns two cows, where each cow requires a feed of 7.7 Kg of sprouted barley. The established units have decreased the amount of concentrated fodder required per breeder 22.4% (see table below). Before joining the barely sprouting unit, each breeder required daily on average about 9.5 Kg per cow. This implies that beneficiary breeders saved on average 5,670 SYP every day (given an average price of 1331 SYP per 1 Kg of concentrated feed). Hence, in total, each unit provided savings of a value of 5.1 million SYP each month.

Daily amount of concentrated feed for one cow per (Kg)	Daily saving in the use of concentrated feeds per cow	Unit price of 1 Kg of concentrated feed (in SYP)	Daily saving per breeder (in SYP)	Monthly saving per breeder (in SYP)	Monthly saving per SPU (in SYP)

Before using SPUs	After using SPUs	amount	percent				
9.5	7.4	2.13	22.4%	1,331	5,670	170,100	5,103,000

The next table shows the amount of milk (litres) produced before and after using sprouted barley for feeding. We found that beneficiary breeders had increased the yield of milk production per cow of 11.7%. On average, each cow produced 2 extra litres per day which has the value of 1,540 SYP at the current market price. In total, the average monthly revenue for each supported breeder is approximately 92,400 SYP, assuming that each breeder owns two cows.

Daily amount of Milk produced per cow (in litres)		Daily increase in milk production per cow		Unit price of 1 litre of milk (in SYP)	Daily revenue (in SYP)	Monthly revenue (in SYP)
Before using SPUs	After using SPUs	amount	percent			
17.1	19.1	2 litres	11.7%	797	1,540	46,200

These benefits also carry forward to the post-production of cheese. The amount of milk required to produce 1 Kg of cheese before using sprouted barley feeds was 7 Kg. Due to the improvement in both quality and density of the milk produced, this amount decreased to 5 Kg, increasing the cheese yield per cow.

Additional benefits in the use of sprouted barley as concentrated feeds include: increased the activity and movement of cows, decreased the number of disease cases and increased the production of milk. Other spillover effects, as reported by breeders, includes the reinforcement of community and participatory work at the community level.

The most notable challenge as reported by the cattle breeders was the consistent electricity outage at the units. The units have no electricity supply up to 50% of the time despite the installation of solar panels during its setup. In response, the FAO emergency programme has provided electricity generators to address the issue of insufficient power; this might increase the long-term costs in the operation of the units.

The breeders have suggested additional components to sustain the production units:

1. Backup water tank to ensure sustainable access to water (FAO has provided tanks of 2 tons of water initially).

2. Additional power solar panels to be installed on the units to increase power supply.

3. Periodic maintenance and technical support.

4. Security and protection of the units.

In summary, the SPUs have increased the production, yield and revenue for participating breeders across all five units. In order to ensure the sustainability of the production and operation of these units, it is important that the units have affordable access to electricity in the long-term. Moreover, the success of the units depends primarily on the community cohesion of the breeders participating in the units, including its operation, maintenance and protection.

A2.2 Low tunnels for vegetable seedling production

Low tunnels for the vegetable seedlings production intervention were implemented in 2020 to help farmers to produce their needs of vegetable seedlings, in the circumstances of the high prices and the unavailability of high-quality seedlings in the market. Targeted beneficiary farmers received the necessary equipment (low tunnel, irrigation tools, peat moss, trays, Vegetable seeds and training), where each shared the produced seedlings with 7 other farmers could sell the surplus seedlings and generate additional income.

An assessment by FAO was implemented in the first week of May-2021 on the "low tunnel for vegetables seedlings' production", using Key informant Interviews (KIIs). Interviews with 90 beneficiary farmers were carried out by FAO-resilience officers in the six governorates targeted with this intervention, which include As-Sweida, Dar'a, Deir- ez-Zor, Al-Hasakah, Hama and Homs. FAO M&E team analysed the data where the findings can be summarized as follows:

The average number of the produced vegetables seedlings in each low tunnel was about 4000 for summer vegetable seedlings. About 2 to 3 family members on average worked at the nurseries, and on average 7 farmer households benefited from the produce of seedlings from these established low tunnel systems. The average price for one seedling produced from local seeds is about 50 SYP and about 150 SYP from improved hybrid seeds. The produced seedlings are mainly distributed among the farmer group benefiting from each unit. Hence, the average price of the produced seedling from one low tunnel is about 330,000 SYP / Farmer. In addition to direct benefits, farmers using these units also reported selling extra production and generating additional income in the 2020 season. However, In the 2021 season, the production of the seedlings has decreased by about 50% and some farmers stopped the production in the low tunnel completely due to the significant increase in the input prices of hybrid seeds, fertilizers, and peat moss as a result of the economic crisis and the inflation rate. Other challenges reported by the farmers include seedling pest infection, lack of electricity and fuel needed for irrigation, and extreme weather conditions.

In terms of reported benefits, farmers confirmed that the interventions helped in introducing new hybrid varieties of seeds, increased the planted areas and improved the vegetable production and productivity, generated additional income to the farmers and achieved self-sufficiency of vegetables for beneficiary households, which could enhance food security status overall.

To ensure the operational sustainability of the tunnels, farmers laid out the following needs and requirements. First, the provision of necessary inputs to continue the operation of these tunnels, including plastic sheets, seeds, peat moss, shading nets, fertilizer, fungicides and insecticide. Second, the investment in improving the quality of local seeds as a low-cost alternative to the more expensive hybrid varieties. Third, additional training on preparing compost as an alternative to expensive peat moss, as well as training in new techniques such as grafting with strong pest-resistant roots. Lastly, the replication and expansion of the intervention to reach larger groups of farmers.

A2.3 Provision of cow feed

Additional funding by FCDO for the cow feed distribution as part of the emergency was obtained in 2021 and distribution took place in March and April of 2021 in four governorates including Aleppo, Deir Ez-Zor, Hama and Homs. Beneficiaries were selected based on the criteria of owning 1 to 3 heads of cattle, where their main source of livelihood was from livestock keeping. Given that intervention took place very recently and that we do not have baseline information

on the beneficiary households, we provide post-distribution and monitoring analysis of the activity.

For that purpose, FAO sampled beneficiary households from all four governorates using stratified-cluster probability sampling strategy to select households in the sampling frame. districts were purposefully selected from the four governorates, while 68 beneficiaries were randomly selected based on 90% confidence interval and ±10% precision. Data collection took place in May 2021. All sampled respondents confirm that they received 500Kg (10 bags of 50Kg) of concentrated feed for cows. The main bulk of support was delivered in March 2021 in Aleppo, Deir Ez-Zor and Hama, and in April in Homs. A large proportion of respondents reported receiving the support on time (85% in Homs, 96% in Deir Ez-Zor and 100% in Aleppo and Hama).

A large share of respondents reported using the feed for their own cattle (100% in Aleppo and Hama). 30% and 3% of beneficiary households in Deir Ez-zor and Homs respectively will store the feed for later use. No households reported selling to or sharing the feed with other cow breeders.

Each farmer owns two cows on average and the support has saved breeders about 450,000 SYP. The savings were mainly used to buy other agricultural inputs (46%), food (34%), non-food household expenditure such as education (9%) and clothes (12%). Despite that any impact on livestock production is unlikely to be observed at the time of the interview (only one month after distribution), farmers have reported an immediate increase in milk production after receiving the concentrated feeds which ranged from a 13% increase in Aleppo to a 33% increase in Deir Ez-Zor. In addition, 94% of the respondents said that they don't need other supplies/inputs than the necessary cows feed they received, and 6% said that they need a milking machine more than cow feed.