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Monitoring and Impact Analysis of the EU-Funded Smallholder Support Programme (SSP) for Agriculture Transformation

Midline Report for FAO Syria

ISDC - International Security and Development Center

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Executive summary

Background: FAO Syria is implementing the “Smallholder Support Programme” (SSP). The main objective of this programme is to contribute to the transformation of the agriculture sector in Syria by empowering vulnerable smallholder farmers and livestock keepers to be more productive, efficient and profitable as well as more informed, self-organised and risk aware. The programme’s theory of change depicts that this objective can be achieved through providing both direct and indirect support to smallholder farmers, which leads to the increased access to and use of good quality agricultural inputs, irrigation and water management, agricultural value chain activities, and information shared related to food security and early warning. The programme delivers multiple interventions across the whole of Syria. These mainly include, but are not limited to low tunnels and seedling distribution, seed multiplication, irrigation systems, vouchers for agricultural input, livestock feed and milk production. The programme also contributes to a national artificial insemination campaign.

Study aim: The aim of this midline study is to analyse the immediate impacts of the programme on smallholder farmers in Syria on a broad set of outcomes related to food security, crop and livestock production and productivity, income generation from value chains activities, as well as access to information, services, and risk preferences by comparing survey evidence from 2020 with newly collected data from 2022. Our rigorous impact analysis applies a quasi-experimental approach using large household survey data collected from both households in targeted and control villages. Within targeted villages, we collect information from direct and indirect beneficiaries to provide a complete picture of how the interventions generate impacts at the individual and village levels. We analyse the overall effect of receiving any type of support, but also examine the impacts of specific interventions. We also provide findings for female-headed households.

Time trends: In our set of analyses, we generate descriptive statistics comparing changes between baseline and midline in the overall sample without differentiating between the beneficiary and non-beneficiary groups except for FCS, HDDS, and rCSI scores. These results provide an overview of the current welfare status of smallholder farmers in Syria. In summary, we find that:

- The overall food security status in Syria has declined but remains above critical thresholds. Households, however, are relying more on using harmful coping strategies to deal with food shortages and to maintain these acceptable levels. On average, we see a

sharp increase in the Reduced Coping Strategy Index and a shift in purchasing essential food items such as olive oil and chicken meat from cash to credit. Moreover, households are more concerned about food shortages in the future compared to two years ago.

- Affordability of agricultural inputs is also becoming a challenge compared to 2020. We observe a notable increase in the share of households who find that prices of seeds, livestock feed and agricultural tools are excessive. On the other hand, most of the farmers report that the quality of these inputs remains good.
- A larger share of households report facing drought in the past year. At baseline only 10% of households experienced drought shocks while this figure has increased to 55% at midline. Moreover, households are more concerned about future drought episodes compared to two years ago. On a positive note, we see a notable drop in the share of households reporting other types of shocks, such as crop pests, floods, low output prices, illnesses and theft.
- Most farmers have a certain level of co-dependency in sharing information. There was an increase from 6 % to 83.3 % of respondents who regularly use information from one another on drought early warning. The use of information from fellow farmers remains high regarding both harvest and cultivation. Moreover, the share of farmers who rely on support provided by the extension centres has increased since baseline and is used more frequently to access markets and increase productivity.
- Finally, farmers at midline are more likely to take risks and are less willing to share without expecting anything in return compared to baseline. These attitudes, which have implications on decision-making, are likely correlated with the economic and climatic challenges and concerns facing small-holder farmers in Syria at midline.

Midline impact assessment: Next, we analyse the midline survey, which was collected by FAO Syria in January 2022, and provide an analysis of the impacts of direct and indirect support for the overall programme. We also differentiate the impacts by intervention type.

For the overall direct impacts:

- We find a notable **significant positive impact on food security** (as measured by the Food Consumption Score) and on dietary diversity (as measured by the Household Dietary Diversity Score). More importantly, we find that households who received support from FAO had to rely less on harmful coping strategies to deal with shortages compared to a control group. These three positive results underscore the importance of the programme in ensuring adequate food access and availability, particularly in times increasing food

insecurity. Furthermore, we find small but positive spillover effects of the programme on food security to households residing in targeted villages but did not receive direct FAO support. This underscores the importance of the programme in ensuring adequate community-level food security beyond the beneficiaries themselves.

- Moreover, we find a **significant positive impact on household income generated in the past 12 months from crop farming and livestock keeping** respectively by 80 USD and 150 USD, on average. For income generated from value chains, we find that the overall programme had a positive effect on income of direct beneficiaries who engaged in value chain activities of wheat products by 60 USD on average.
- We find a **significant positive impact on the production of rainfed wheat** (appx. 422 kg higher production per direct beneficiary per year) but no other impact on the production of other main crops. More importantly, we find that there is a **positive impact on yields of barley and irrigated wheat**. As for livestock production and productivity, we find the direct beneficiaries produce on average 3 litres per cow per day more compared to a similar control group.
- We find that **direct beneficiaries use extension services more frequently** (12% points for MAAR) compared to the control group and are **more likely to use public extension services and the internet to obtain information on drought early warning**.
- Finally, we find that households who receive direct support from FAO **value future time preferences and are more willing to share**.

For the intervention-specific impacts, we find:

- *Artificial insemination*: we find a positive significant impact on food security, income from livestock, particularly through increased milk productivity of cows. However, there is no significant effect on overall income in the short-term.
- *Low tunnels and seedling distribution*: we find a positive and significant impact on strengthening food security and reducing the use of harmful coping strategies, which is prominent both at the household-level (i.e., direct beneficiaries) as well as at the village-level (i.e. indirect beneficiaries). Furthermore, we find a significant increase in the share of households cultivating cucurbits and other vegetables compared to the control. Similarly to artificial insemination, we find no significant impact on overall income in the short-term.

- *Seed multiplication*: We find positive and significant impacts on the use of coping strategies for direct and indirect beneficiaries. Furthermore, direct beneficiaries of seed multiplication show a higher income from crop farming and wheat value chains. Also, indirect beneficiaries show higher incomes from wheat values chains through the seed multiplication intervention.
- *Vouchers*: we find the strongest impacts on food security through vouchers. We observe that households receiving vouchers shift in their income from wheat to cattle products. This might be influenced by the severe drought episodes during the intervention phase.
- *Irrigation campaign in Ar-Rastan*: Indirect beneficiaries of the irrigation rehabilitation in Ar-Rastan are less likely to apply coping strategies to deal with food shortages. Furthermore, the intervention increased income from wheat value chains by 136 USD, decreased the likelihood for indirect beneficiaries in facing water constraints by 8% points and the severity of drought impacts by nearly 20%.

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List of abbreviations

BMZ	German Federal Ministry for Economic Cooperation and Development
CS	Cross-Sectional Data
DEWS	Drought Early Warning System
EU	European Union
FAO	Food and Agriculture Organisation of the United Nations
FCS	Food Consumption Score
HDDS	Household Dietary Diversity Score
HH	Household
HHH	Household Head
ISDC	International Security and Development Center
M&E	Monitoring and Evaluation
MAAR	Ministry of Agriculture and Agrarian Reform
OLS	Ordinary Least Square
PSM	Propensity Score Matching
rCSI	Reduced Coping Strategy Index
SSP	Small-holder Support Programme
ToC	Theory of Change
USD	U.S Dollar

1. Introduction

In this report, we present results from our midline analysis of the FAO Syria Smallholder Support Programme (SSP) for Agriculture Transformation. FAO Syria started implementing the programme from January 2019 and it will run until the end of 2022. The programme is co-financed by the European Union (EU) for the period January 2019 - December 2022 and the German Federal Ministry for Economic Cooperation and Development (BMZ) for the period December 2019-March 2022. This midline impact evaluation report covers both FAO activities supported by the EU and, since a large share of the SSP activities were jointly funded by EU and BMZ, impact findings from jointly funded activities. These findings will also be presented as part of the separate but related endline report for the BMZ.

Since the start of the crisis in 2011, the agricultural sector in Syria has significantly transformed and weakened. In the past three years, unfavourable weather conditions, trade restrictions, and hyperinflation of agricultural inputs had created additional challenges not just to the agricultural sector in Syria as whole, but to everyday Syrians. In 2020/21, rainfall during the cropping season was markedly worse in terms of amount and distribution as compared to recent years (FAO, 2021)¹. The first substantial rainfall of the 2021 season was delayed for two months and the rainfall varied significantly across the country, resulting in erratic weather conditions, especially in the eastern regions of Syria. In addition, insufficient and poorly distributed rainfall during the season, coupled with limited availability of irrigation, hyperinflation and high fuel cost resulted in a significant decline in the quantity and quality of crops such as cereal, barley and wheat (FAO, 2021). These climatic and economic challenges had also a negative effect on livestock production. At the end of 2020, natural pasture had significantly decreased following unequal rain distribution, resulting in poor livestock production. Livestock conditions further deteriorated due to high feed prices, resulting in an increased occurrence of livestock wasting, weakness and spread of diseases.

At the same time, the country's economic state has sharply worsened and hyperinflation became the new norm for everyday Syrians. In the past two years, the Syrian pound lost most of its value against the US Dollar, generating uncertainty and challenges for producers and consumers alike. The price of food and commodities spiked significantly, leading to lower standards of living. For example, by October 2020, the price of subsidised packs of bread doubled, while reducing the weight of each pack and limiting the number of packs purchased per family. According to WFP,

¹ Food and Agricultural Organisation of the United Nations, FAO, 2021. *FAO Crop and Food Supply Assessment Mission to The Syria Arab Republic*. Special Report

food prices in May 2020 were 69% higher than six months earlier and had increased by 197% year on year (WFP, 2021)². WFP estimated that about 12.4 million people or 60% of the population were food insecure, a 5.4 million increase as compared to the end of 2019. Moreover, trade-restrictions on fertilisers and petroleum products have resulted in shortages in the domestic market, which negatively impacted imports of key agricultural inputs.

Against this backdrop, there is an urgent need to support agricultural activity and markets in Syria, particularly for smallholder farmers to strengthen food production and lower food insecurity. The SSP, therefore, presents a critically important intervention to support smallholder welfare and the agricultural sector in Syria, and provides an entry point for long-term reforms of agricultural markets and institutions. The overall objective of the programme is to transform the agricultural processes away from centralised to more decentralised and locally-led agricultural investments and returns, thereby fostering an environment for self-empowerment, local agricultural ownership, informed decision-making guided by market values. Vulnerable smallholder farmers and livestock keepers are identified as a key entry point to initiate this transformative process from the bottom-up.

The project has two specific objectives:

- Specific Objective 1: To make smallholder farmers and livestock keepers more productive, efficient and profitable;
- Specific Objective 2: To make smallholder farmers and livestock keepers and their communities as a whole more informed, self-organised and risk-aware.

To achieve these objectives, the programme delivers a complex intervention that delivers multiple components at the village and household levels. The components can be categorised into three groups, including measures to expand access to inputs, markets, and commercialisation; measures to develop stronger agriculture value chains; and measures to foster greater access information and services.

The overall aim of this midline report is to rigorously evaluate the short-term economic and behavioural impacts of the SSP. More specifically, the report will answer the following questions:

² World Food Programme Vulnerability Analysis and Mapping, WFP/VAM. 2021. *Syria Country Office Market Price Watch Bulletin, Issue 81*.

- What are the immediate impacts of the SSP on the well-being, and resilience (e.g, food security, dietary diversity, income, use of coping strategies) of smallholder farmers in Syria?
- What are the direct agricultural impacts on crop and livestock production and productivity?
- Did the programme affect farmer risk and time preferences, and their access and use of information and services in their decision-making?
- Which intervention types are driving the programme impacts?
- Are there any positive or negative spillover effects of the programme?

We present empirical results based on midline survey data from smallholder farmer households collected by FAO across the whole of Syria in January 2022. Specifically, the dataset contains information from 2,342 households across three groups:

- Designated "direct" beneficiaries of the programme, which received any intervention as part of the SSP at the household level (N = 814).
- Designated "indirect" beneficiaries, who reside in a village that received an intervention but where the household themselves does not receive direct support (N = 827).
- Control households (non-beneficiaries) residing in non-targeted villages that have similar characteristics and are geographically close to targeted villages, but where no interventions were delivered (N = 701).

The results in this midline report are divided into two overarching sections:

First, we examine the changes in trends between baseline and midline in food security, exposure to shocks, prices and quality of inputs, access to information and services, as well as attitudes of smallholders. We pay specific attention to changes at the Governorate level. Second, we present insights into the programme impact on food security, livestock and crop production and productivity, income generated from market participation, as well as attitudes and risks preferences of smallholders two years into the programme. We compare both the direct effects of the programme (direct beneficiaries versus non-beneficiaries) and the indirect effects of the programme (indirect beneficiaries versus non-beneficiaries).

The report is structured as follows. Section 2 presents an overview of the SSP activities, the programme's theory of change, and the scope of the impact assessment. Section 3 describes the design adopted to study the impact of the programme, the outcome indicators, the data

collection and the methods used in the analysis. Section 4 presents the results on the overall changes in the past two years in Syria. Section 5 provides main findings on the midline impact of the overall programme and the specific intervention packages, focusing on direct and indirect impacts as well analysis by gender of household head. Section 6 concludes and provides lessons learned.

2. The Smallholder Support Programme

2.1 Programme activities

The programme activities undertaken by FAO under the EU-funded component of the SSP include the following:

Activity	Description	Target HHs	Governorates
Artificial Insemination	Through the artificial insemination campaign, high productive cattle breeding is enhanced.	11,329	Aleppo Al-Hasakah Deir-Ez-Zor
Buffalo and Cow Milk production	Milk collecting and processing systems are established at the community level. Specific managers are trained. Producer and processor groups are built. A legal registration system and established milk units are promoted.	548	Al-Hasakah Deir-Ez-Zor
Feed Production	Through the Farmer Field School/ Farmer Business School (FFS/FBS) for livestock practices, training on fodder to improve production practices and promote reuse of crop and agriculture residues in animal feed is provided.	3,034	Aleppo Al-Hasakah Deir-Ez-Zor
NABTA	Entrepreneurship programme training and grants.	1,973	Aleppo Homs
Seed Multiplication	Educate farmers from different regions as seed champions, then organise farmer networks for participatory seed multiplication, sustainable practices and community-based distribution. Promote awareness for seed handling, use, and adoption of improved and certified seeds.	630	Aleppo Deir-Ez-Zor Homs
Seedling Distribution	Distribution of certified seeds explicitly to vulnerable farmers to ensure equity and avoid elite capture.	5,729	Aleppo Al-Hasakah Deir-Ez-Zor Homs
Seedling Low Tunnels	For the production of vegetables and provided to part of the farmers who also received seedlings.	824	Aleppo Al-Hasakah Deir-Ez-Zor Homs
Silage Distribution	Silage distribution to bridge food shortages as a Covid-19 response.	3,046	Aleppo Al-Hasakah
Vouchers	Vouchers for productive inputs and assets to build farmer	854	Aleppo

	capacity, especially for pioneer young entrepreneurs, vulnerable smallholders and/or vulnerable breeders.		Al-Hasakah Deir-Ez-Zor Homs
Irrigation	Rehabilitate and innovate small scale irrigation and drainage systems and introduce water-saving irrigation techniques for increased water productivity.	20,000	Homs

2.2 Theory of change

The theory of change of the SSP builds on the overall objectives aiming at building resilience and sustainable food and nutrition security with a focus on the most vulnerable small holders and to transform agricultural processes into a more decentralised and locally-led activity, which fosters an environment for self-reliance and enables informed-decision making guided by market values. Two specific objectives are outlined to provide support to vulnerable smallholder farmers and livestock keepers both (women, men and youth) to be more productive, more self-reliant, and to support vulnerable smallholder farmers and livestock keepers, and their communities as a whole, to be more informed, more self-organised and more risk-aware. The first specific objective will enhance food access through increased availability of agricultural commodities from production to marketing, through better access to production inputs (such as water and seeds), credit and technical training. This will increase the productivity of targeted smallholders affected by the crisis and their income. The second specific objective will focus on improving food security-related and agriculture-based livelihood coordination. The interventions which are designed and delivered by FAO will contribute to achieving these two specific objectives as follows.

In the first instance, the rehabilitation of the irrigation system will increase access to water, while training and capacity building in relation to this activity will increase access to information and technologies for the use of irrigation and sustainable water management (output 1.1). Second, interventions that deliver capacity building on feed production and distribution, livestock management, agro processing & marketing development will contribute to the increased access to business and market opportunities and revenue through value chains (output 1.2). Third, the support and promotion of seed multiplication, distribution of seedlings and the establishment of low tunnels will directly increase access to good quality seed and enhance the scope to contribute to seed production (output 1.3). Finally, capacity building and training will lead to improved access to information related to food security and early warning, as well as enhancing dialogue and information sharing (outputs 2.1 & 2.2).

The success in achieving these outputs and outcomes can be measured through the following indicators:

- Improved access to water for crop & livestock production;
- Increased production of crops & livestock;
- Increased productivity of crops & livestock;
- Increased income through the engagement in these activities;
- Improved response, risk management, and decision-making;
- Increased food security and improved capacity to cope with shocks.

2.3 Scope of the impact assessment

Table 1 provides an overview of the scope of the assessment showing the sample size, methods and outcomes used for the analysis of the overall programme, as well as for the specific interventions. First, we have 812 observations in the beneficiary group at midline, which are used to estimate the overall programme impact. Second, we have 246 beneficiary observations in the panel sample, which we will use to cross-validate our findings. Third, we analyse the direct effects of the different interventions using the cross-sectional data where we have sufficient observations (depending on the outcome variable). These interventions mainly include: artificial insemination, seedling distribution, low tunnel production, seed multiplication and vouchers. Fourth, we examine indirect effects of the overall programme and for seedling distribution and low tunnels interventions, seed multiplication and the irrigation campaign in Ar-Rastan separately.

Table 1. Overall and intervention-specific scope of impact assessment

	Direct beneficiary sample size*				OUTCOMES	
Intervention Type	Baseline	Midline	Panel (same HHs)	Data & method**	Main outcomes	indirect effects
OVERALL	258	814	2x248=496	Panel & CS	Food security, dietary diversity & coping	Yes
Artificial Insemination	183	470	2x178=356	Panel & CS		No

Cow and Buffalo Milk production	10	43	2x10=20	CS	strategies	No
Feed Production	22	108	2x22=44	CS	Crop production, yields, & revenue	No
NABTA (Grants & Training)	0	58	0	CS	Livestock production, productivity & revenue	No
NABTA (Training)	0	23	0	N/A		No
Pre-Harvest Training	66	176	2x62=124	CS	Income from farming and value chain activities	No
Seedling Distribution	418	975	2x399=798	Panel & CS		No
Seedling Low Tunnels	188	420	2x179=158	Panel & CS	Access & utilisation of information, self-organisation & risk-awareness	Yes
Vouchers	21	196	2x20=40	CS		No
Notes. * 258 households from Idlib, Rural Damascus and Qahtaniyah (Al-Hasakah) are dropped from this study. ** CS = Cross-sectional data including matching to indirect and control households.						

3. Impact evaluation design

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 (denoted as the “direct beneficiary group”) with villages and households that did not receive the intervention (denoted as the “control group”). To measure the indirect effects of the programme, we also compare households who did not receive the intervention but reside in the same targeted villages (denoted as the “indirect beneficiary group”) with the control group. Hence, in our study, direct beneficiary households will have received at least one programme activity through the SSP, while indirect beneficiary and control will not have received any. The only distinction between a control and an indirect beneficiary household, is the fact that the latter group lives in the same villages as the direct beneficiary households and would have benefited from intervention activities indirectly in case these had local spillover effects.

This setup allows us to infer the impacts of receiving (any) programme activity, and to distinguish the differential impacts of receiving the different modalities of the programme. By having control group observations, we can ensure that any changes we observe among direct and indirect beneficiaries 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.

To make this comparison valid, it is key that the control group is not systematically different from the two beneficiary groups, 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, wealth, socio-economic status).

We initially designed the study to follow up with the same households in all three groups over time, what is termed as a panel study. For that, we sampled at baseline control and indirect beneficiary households that allow us to systematically compare these three groups after the intervention has been implemented. The main advantage of such a panel approach, is that any impacts induced by the programme are accurately captured and are not misinterpreted with other changes that took place between the two waves. Interviewing the same households also ensures that any biases driven by unobserved traits at the household level, which we cannot control for analytically, are minimised.

After our sample selection and data collection at baseline, however, there have been multiple changes that took place at the programme level and in Syria as a whole.

First, the specific programme activities and target locations were not yet fully finalised at the start of the baseline data collection. This implies that we were not able to ensure that all sampled beneficiary households and villages at baseline will end up receiving support from FAO. In fact, during our sampling adjustments at midline, we find that about 500 households in the beneficiary group did not end up receiving support as planned. Second, although the overall SSP programme objectives for the whole sample which covered both EU and BMZ projects were clearly defined at baseline, the specific interventions have only been finalised and approved after we conducted the baseline study. As described earlier, the programme includes many activities, and not all activities were covered in our baseline sample. A significant proportion of these intervention components hence cannot be analysed using the panel structure of our data,

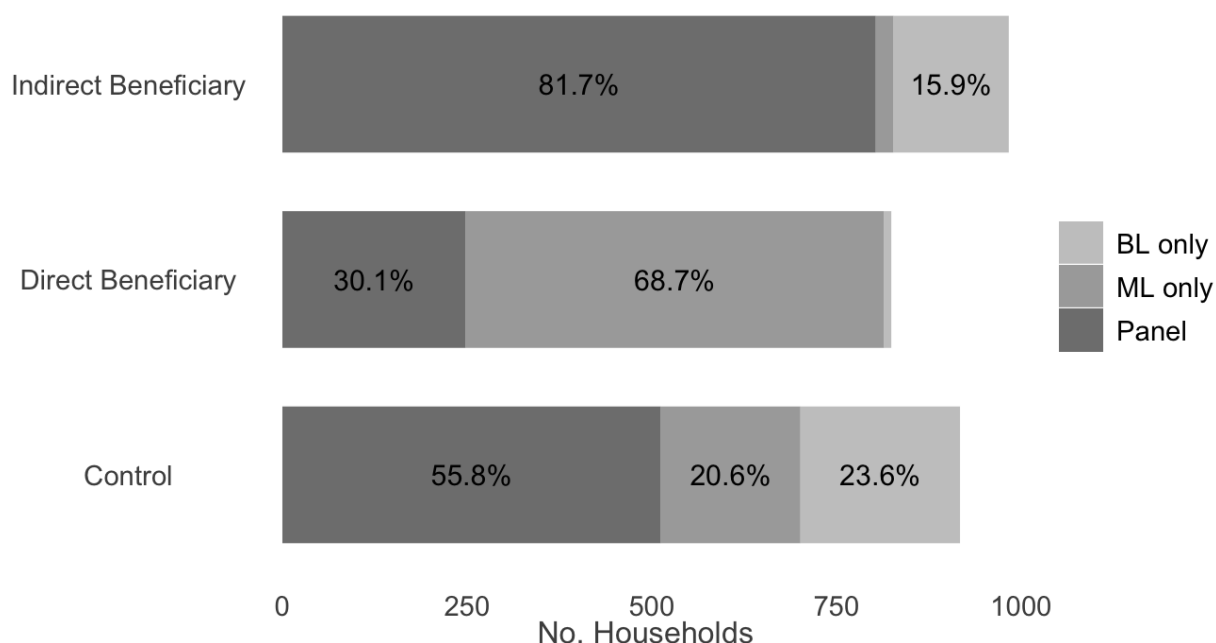
particularly if we want to measure the intervention-specific impacts. Third, certain areas in Syria became inaccessible during the past two years, and hence we were not able to follow up with households residing there, which has implications on the drop-out rate between the two waves.

To overcome these challenges, we decided to do the following adjustments before the start of the midline data collection. First, we increased the sample size of the beneficiary group at midline to cover as many interventions as possible. We added 566 new beneficiary households to our study sample. The main challenge of this approach is that we are not able to fully make use of the panel design as we do not have baseline data from these households. Second, we continued interviewing households who were designated as direct beneficiaries at baseline, but who did not end up receiving support. Households who were planned to be part of the beneficiary group at baseline but did not end up receiving support, were then allocated to either the control group or the indirect beneficiary group. This allocation was based on the village they resided in if it was targeted by FAO.

Figure 1 shows the compact structure of our sample size at midline after these adjustments. We observe that a large proportion of households in the control group (55.8%) and indirect beneficiary group (81.7%) groups were also interviewed at baseline (denoted as panel). Moreover, we observe a dropout rate of 15.9% in the indirect beneficiary group and of 23.6% in the control group (denoted as BL only). These are households who we interviewed at baseline but could not follow up with at midline. We also added new control households at midline in Daraa, which accounts for about 23.6% of the control sample (denoted as EL only in Figure 1).

For the direct beneficiary group at midline (second bar in Figure 1), we observe a different structure, however. Only 30.1% of the direct beneficiary sample from midline were also interviewed at baseline (given the implementation changes that took place). The larger share of households in the direct beneficiary group were included only at midline (68.7%). We added this new sample of direct beneficiaries to mainly ensure that we have enough households within each of the specific intervention components to generate meaningful estimates of the impacts. The dropout rate in the direct beneficiary group is below 2%.

Figure 1. Composition and attrition of the sample size across the three groups.



These changes have direct implications on the study design and analysis. First, 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 midline, which we continued to follow up with, allows us to **match a sub-sample of these control households** to look structurally similar to the direct and indirect beneficiary groups. The matching approach is described in section 3.3 under methods in more detail. Second, we examine the impact evaluation using only midline data to make better use of the additional sample of beneficiaries and to provide a more detailed analysis of the specific interventions provided under SSP. We also analyse the data from the tracked households in a panel structure where we compare differences between these two groups across the two waves (difference-in-difference approach). This additional analysis using the panel data is only meant to serve as a robustness check of the findings from the midline analysis, particularly given the small sample size of this dataset.

3.2 Outcome indicators

In line with the programme theory of change, we focus on the following set of outcomes:

Food Security. We use the Food Consumption Score (FCS) and the Household Dietary Diversity Score (HDDS) to measure food access, diversity and security. The FCS is developed by WFP and 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 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 to deal with a shortage of food. The larger the indicator, the more food insecure households are (and consequently less resilient).

Agricultural production and productivity. We use the quantities of crops harvested as a key determinant of production measured in Kilograms. Moreover, we use yields, measured in tonne per hectare, to assess crop productivity. We focus in this report on three major crops produced by smallholder farmers in our sample: irrigated wheat, rainfed wheat and barley. We wanted initially to also include vegetable crops such as eggplant, cucumber and tomato. However, we have decided to exclude these for the analysis given that we do not have enough households growing these specific vegetable crops, which could lead to statistical errors and bias the impact estimates. [In the appendix of this report, we provide findings on the share of households growing vegetables crops](#) (among other crops) as an indicator of the farming activity. Moreover, we examine the impact of the programme on livestock productivity, including meat and milk from cattle. We decided also to exclude other livestock in the analysis here, such as goats and sheep, given the share of households who produce milk and wool for these animals is too low to have a meaningful statistical comparison and assessment.

Income from farming and value chain activities. We use both household income and income generated from the value chain activities in the past 12 months. Main household income includes the calculated total income based on the economic activities that households engage in (farming, herding, off-farm labour, etc). We also present findings of income that is generated solely from crop farming and herding. Smallholder farmers also reported income from five major agricultural value chain activities. These include sale of own crop produce, sale of seeds, sale of own livestock

products, buying and selling livestock, and trade of crop or livestock products. For the income generated from value chain activities, we focus on income generated from the sales of wheat and barley as well as revenue from the activities related to cattle production. Other less common activities were excluded given the low number of farmers generating income from them. All income and revenue value were converted to USD based on the yearly average of the unofficial exchange rate of the US dollar and the Syrian Pound.

Access to information and services: Farmers are greatly affected by weather shocks and base their planting and harvesting decisions on such information. We include four main sources that farmers use for receiving information: fellow farmers, media, internet and public extension services. We measure the changes in the use of these sources and accordingly we examine the farmers' assessment on their usefulness and impact on cultivation and harvesting decisions. Moreover, we examine changes in the shares of farmers who use agricultural extension services more broadly.

Attitudes and preferences. We assess risk, time and sharing preferences of smallholder farmers. For risk preferences, we use a 10-point scale measure of willingness to take risks; For time preferences, we use a 10-point scale measure of willingness to postpone taking action; and we also use a 10-point scale to measure the farmers willingness to share.

3.3 Data and methods

In this section, we describe the data including the questionnaire, the midline data collection, the sampling strategy as well as the methodological analysis used including the matching procedure used to achieve a balanced sample between the beneficiary and control groups.

Questionnaire. We used the same questionnaire that was implemented at baseline to be able to compare the findings from the two waves more effectively. The questionnaire includes detailed information on location, household profile and characteristics, agricultural holdings, access and activities as well as information on input markets and livestock production. Moreover, we have detailed modules on household food supply and consumption (including dietary diversity), coping strategies, exposure to shocks, and access to Drought Early Warning Systems (DEWS). The questionnaire also includes modules on access and use of agricultural services and risks preferences.

Data collection. Midline data was collected in January 2022. FAO conducted training for the enumerators before the start of the data collection. In comparison, the baseline data was

collected in January and February 2020. Hence, we do not expect to face any challenges that can be driven by seasonality for example, in directly comparing the data and findings from the two waves of data. The trained enumerators conducted the household interviews based on paper-based questionnaires and the data entry was undertaken by the M&E team in FAO Syria using Microsoft Access. ISDC cleaned and merged the data using household sampling identifiers, where applicable, and analysed the data using R software.

Statistical methods. Descriptive statistics are used to compare average trends in the outcome indicators across the two waves. For the midline data impact assessment, we use propensity score matching (PSM) to compare households from the control group that are structurally similar to the beneficiary group. The advantage of the PSM approach is that it selects similar households from the control group that are then compared with the beneficiary group. Any differences beyond the matched variables, are hence likely to be driven by receiving support. In the absence of sufficient baseline data and an experimental design, PSM is the most reliable approach that ensures balance of the sample across the beneficiary and control groups and strengthens the rigour of the causal claims of the impact assessment.

In the first stage of the PSM estimation, we use the following variables to strengthen group comparability: Location, household and household-head characteristics (gender, literacy, age), key agricultural assets, exposure to shocks (e.g., drought), and if the household received any assistance from other organisations. Since we have similar sample sizes in the control, direct and indirect beneficiary groups, we apply “optimal full matching” for analysing the overall impact of the programme. With this matching approach, we guarantee that at least one household from each group is assigned to a similar household from the other group. Afterwards, each household will have a specific weight that will be used in the analysis. For the intervention-specific and panel analyses, we apply one-to-one nearest neighbour matching without replacement instead of “optimal full matching” since we have a larger pool of households from the control group to match with the interventions-specific beneficiaries. Nearest neighbour matching assigns one control household to each beneficiary household. Non-matched control households are then excluded from the analysis.

After matching, we generate weights for each household, which are then included in the regression analysis using ordinary least-squares (OLS). In order to further increase the precision of our impact estimates and reduce potential biases, we control for the same set of variables used for matching in the first stage. We display results from both analyses with and without these control variables. The estimates displayed in coefficient plots include only estimates with controlling for this set of variables.

Finally, for the panel data, we use difference-in-difference estimates. This approach makes use of observations from the same households from baseline and midline. By differencing between the control and the direct beneficiary group and between the baseline and the midline, we account for time-fixed confounders and general differences between the two groups. We increase the robustness by matching between the two groups with nearest neighbour matching based on baseline characteristics. We display the average outcomes for each group at each wave and the programme impact expressed by the double difference.

Statistical power. In order to analyse the impacts of specific interventions as well as to estimate the effects on different subgroups, such as gender and location, we ran several analyses on subsamples of the data. This implies that this set of analyses relies on smaller sample sizes compared to the overall impact assessment. Furthermore, given that we do not have full information on many outcomes from all the households in our sample (for example, the harvest of irrigated wheat is only measured for households who grow this crop), it is crucial to ensure that we have enough statistical power to generate meaningful estimations. We monitor statistical power meticulously through observing degrees of freedom and effect dispersions for each estimation and outcome variable. Hence, we excluded results from underpowered sub-analyses where the likelihood of biases is high.

3.4 Sample Balance

Sample balance between the control and beneficiary groups is a key for estimating an unbiased impact effect. Given the changes in the structure of the overall sample at midline and due to the drop-out of households from the sample, there might exist structural group differences that can bias the estimates and need to be accounted for.

Sample balance before matching. Table 2 displays the midline full sample balance, comparing the control group to the direct beneficiaries. First, we find that the Governorates of Aleppo and Deir-Ez-Zor are more frequently represented in the direct beneficiary group, while As-Sweida and Homs are more frequently represented in the control group. The share of households in Al-Hasakah and Daraa is similarly represented in both groups. Second, we have a higher share of female-headed households in the direct beneficiary group (38%) compared to the control group (26%). Also, the average age of the household in the direct beneficiary is lower than in the control group. This might indicate that households in the direct beneficiary group have higher

vulnerability within compared to the control group. The literacy rate is similar among the household heads in both groups at 77%.

Table 2. Imbalances in the full midline sample balance before matching

	Control Group	Direct Beneficiary Group	p-value
n	701	814	
A. Governorate			
Al-Hasakah	0.21 (0.41)	0.23 (0.42)	0.373
Aleppo	0.18 (0.38)	0.26 (0.44)	<0.001
As-Sweida	0.12 (0.33)	0.06 (0.23)	<0.001
Daraa	0.08 (0.28)	0.07 (0.26)	0.302
Deir-ez-Zor	0.13 (0.33)	0.22 (0.41)	<0.001
Homs	0.28 (0.45)	0.17 (0.37)	<0.001
B. Household (HH) and household head (HHH) profile			
Female HHH	0.26 (0.44)	0.38 (0.49)	<0.001
Age (years) HHH	49.82 (12.96)	45.11 (13.34)	<0.001
Literacy HHH	0.78 (0.41)	0.76 (0.43)	0.224
HH size (mean)	7.68 (4.39)	7.83 (4.22)	0.496
respondent is HHH	0.86 (0.35)	0.87 (0.34)	0.629
C. Shock exposure in the past 12 months			
Illness of income earner	0.09 (0.28)	0.03 (0.18)	<0.001
Drought	0.63 (0.48)	0.51 (0.50)	<0.001
D. Key agricultural assets			
Own irrigated land	0.39 (0.49)	0.46 (0.50)	0.006
Own rainfed land	0.41 (0.49)	0.24 (0.42)	<0.001
Own poultry	0.37 (0.48)	0.30 (0.46)	0.003
Own sheep	0.28 (0.45)	0.29 (0.45)	0.682
Own cattle	0.26 (0.44)	0.44 (0.50)	<0.001
E. Assistance			
HH received other assistance	0.54 (0.50)	0.51 (0.50)	0.238

Notes. Standard deviation in parentheses. If not defined differently, values are expressed in proportions. P-values indicate the significance levels of the difference between the control and direct beneficiary group. A p-value lower than 0.1 implies that differences are statistically significant at the 10% level.

Third, looking at shock exposure, we observe that a higher share of the control group households experienced an illness of an income earner (9% compared to 3% in the direct beneficiary group) and droughts (63% compared to 51% in the direct beneficiary group). Fourth, we observe that direct beneficiaries are more likely to own irrigated land while more control households own

rainfed land. 28-29% of the whole sample own sheep. 37% of the control households own poultry while 30% of the direct beneficiary households own poultry. On the other hand, 44% of the direct beneficiaries own cattle compared to 26% of the control households. Consequently, we observe substantial differences in location, household and farm characteristics and shock experience between the two groups, which can affect the comparability and therefore bias the results. Lastly, 54% of the control households and 51% of the treatment households received assistance from other organisations. Even though this variable is not statistically different between the groups, it is essential to account for it in the analysis since it might affect the outcomes.

Sample balance after matching. Table 3 shows the overall sample balance between direct beneficiaries and non-beneficiaries at midline after matching. In comparison to Table 2, it clearly shows that the relevant characteristics are much similar on average between the direct beneficiary and control group, which implies that we can be more confident with results estimated from the impact analysis.

First, 17% of the matched sample resides in Al-Hasakah, 26% in Aleppo, 4% in As- Sweida, 7% in Daraa, 25% in Deir-ez-Zor and 21% in Homs. The sample is now balanced across the governorates. Achieving balance on a local level is particularly important because it covers a high degree of unobservable differences mediated through the local level, such as agro-climatic institutional and political conditions. Second, 36% of the household heads in the matched sample are female, their average age is 45.5 years and 79% are literate. The mean household size is 8, and 88% of the respondents are the household heads. Regarding exposure to shocks, 3% of the households experienced an illness of an income earner in the past 12 months and 46% were affected by droughts. Third, looking at the key agricultural assets, 48% of the households in the matched sample own irrigated land while 22% own rainfed land. 30% own poultry, 28% own sheep and 42% own cattle. We do not observe any significant differences between the groups for these variables. Lastly, 50% of the beneficiary households and 60% of the control households received assistance from other organisations. Given that the difference becomes statistically different after matching, It is crucial to account for this variable in the analysis and the interpretation of the results.

Table 3. Midline sample balance after propensity score matching

	Overall Sample	Control Group	Direct Beneficiary Group	p-value
A. Governorate				
Al-Hasakah	0.17 (0.38)	0.15 (0.36)	0.18 (0.39)	0.234
Aleppo	0.26 (0.44)	0.24 (0.43)	0.28 (0.45)	0.299
As-Sweida	0.04 (0.21)	0.05 (0.22)	0.04 (0.20)	0.515
Daraa	0.07 (0.25)	0.06 (0.23)	0.08 (0.27)	0.169
Deir-ez-Zor	0.25 (0.43)	0.28 (0.45)	0.23 (0.42)	0.268
Homs	0.21 (0.41)	0.23 (0.42)	0.19 (0.39)	0.231
B. Household (HH) and household head (HHH) profile				
Female HHH	0.36 (0.48)	0.36 (0.48)	0.36 (0.48)	0.994
Age (years) HHH	45.46 (13.28)	45.13 (13.12)	45.78 (13.43)	0.560
Literacy HHH	0.79 (0.41)	0.81 (0.39)	0.77 (0.42)	0.175
HH size (mean)	8.04 (4.42)	8.08 (4.63)	8.01 (4.22)	0.850
respondent is HHH	0.88 (0.32)	0.89 (0.32)	0.88 (0.32)	0.817
C. Shock exposure in the past 12 months				
Illness of income earner	0.03 (0.17)	0.02 (0.16)	0.03 (0.18)	0.336
Drought	0.46 (0.50)	0.44 (0.50)	0.48 (0.50)	0.284
D. Key agricultural assets				
Own irrigated land	0.48 (0.50)	0.47 (0.50)	0.48 (0.50)	0.844
Own rainfed land	0.22 (0.42)	0.21 (0.41)	0.23 (0.42)	0.629
Own poultry	0.30 (0.46)	0.29 (0.45)	0.31 (0.46)	0.528
Own sheep	0.28 (0.45)	0.27 (0.44)	0.29 (0.45)	0.566
Own cattle	0.42 (0.49)	0.41 (0.49)	0.43 (0.50)	0.585
E. Assistance				
HH received other assistance	0.55 (0.50)	0.60 (0.49)	0.50 (0.50)	0.011

Notes. Standard deviation in parentheses. If not defined differently, values are expressed in proportions. P-values indicate the significance levels of the difference between the control and direct beneficiary group. A p-value lower than 0.1 implies that differences are statistically significant at the 10% level.

4. Trend analysis

In this section, we examine the overall trends in household food security and coping with shocks (FCS, HDDS, rCSI), access to essential food items (bread, milk, chicken and olive oil), exposure to shocks (food shortage, drought, and high input costs), access to agricultural land and water, and agricultural input prices and quality (agricultural tools, seeds, agrochemicals and livestock feed). We also explore the overall trends in baseline and midline for the access to drought early

warning system information from fellow farmers. Finally, we assess the usefulness of the MAAR extension services at baseline and midline as well as their impact on farming productivity and market access. In this trend analysis, we do not differentiate between beneficiary (direct or indirect) and control households, as the aim is to provide an overview of the changes that took place in Syria at large over the past two years.

4.1 Food security and coping with shocks

Figure 2. Overall reduction in the Food Consumption Score (FCS) at midline

Figure 2a. FCS for the overall sample

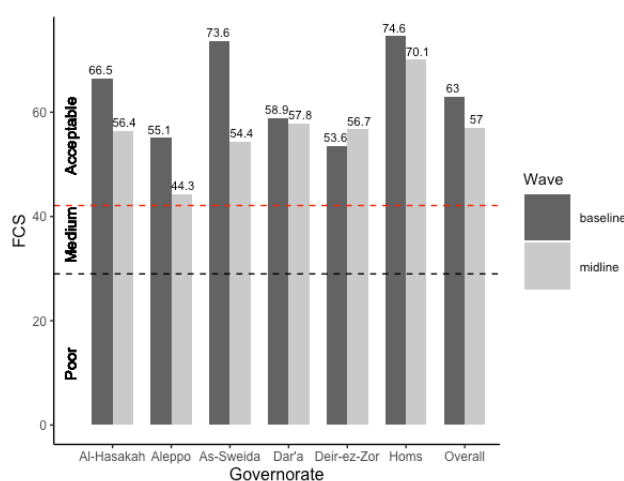


Figure 2b. FCS for the control group

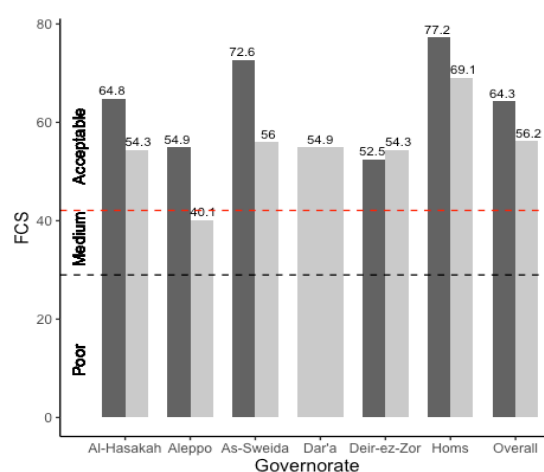


Figure 2c. FCS direct the beneficiary group

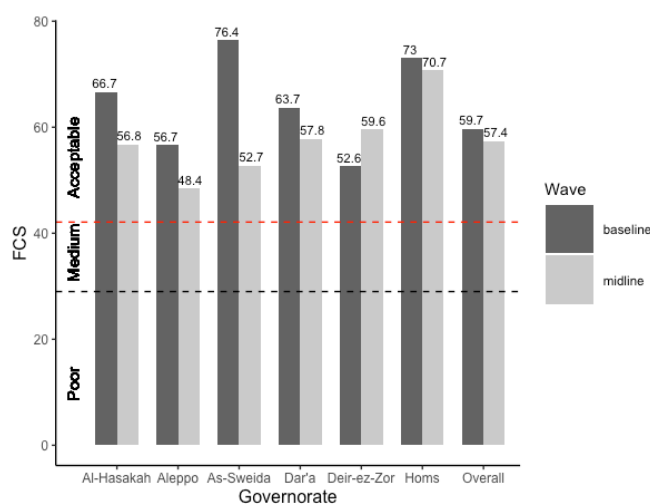


Figure 2d. FCS for the indirect beneficiary

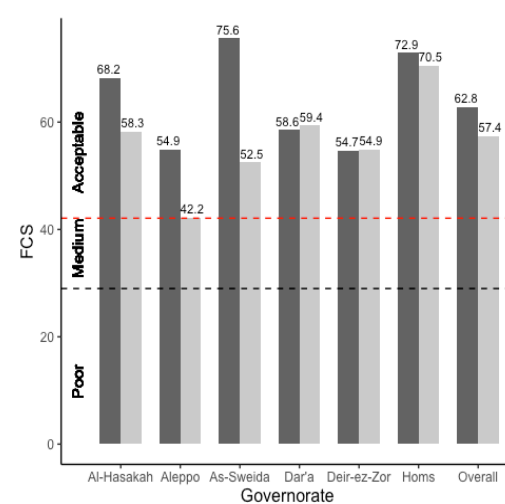


Figure 2 displays the changes between baseline and midline in the average Food Consumption Score (FCS) for all the households (panel a), and separately for the control group (panel b), for the direct beneficiary group (panel c) and the indirect beneficiary group (panel d). Within each figure, we show both the FCS averages at the country and governorate levels.

The average FCS has dropped by 5 points from 63 to 57. However, as clearly shown in Figure 2a, the mean score remains well above the borderline value of 42, which indicates that, on average, the food security status in Syria at midline is acceptable. Moreover, we observe a strong decline in the mean FCS in Aleppo, Al-Hasakah and As-Sweida. In Aleppo, the FCS decreased by more than 10 points from 55.1 to 44.3, which is very close to the borderline threshold. The largest decline in FCS was in As-Sweida, which decreased on average by 19 points. With an average of 70 points, Homs has the highest food security at midline, but which also slightly dropped by 4 points from baseline values. As for the control group, the overall FCS score decreased by 8 points on average, with a notable decrease in Aleppo, bringing the FCS score below acceptable levels (Figure 2b). In contrast, the overall FCS scores only slightly decreased by 2 and 5 points in the direct and indirect beneficiary groups, respectively. The most notable decrease in both beneficiary groups was observed in As-Swaيدا, followed by Aleppo, which dropped to 42.2 among the indirect beneficiary group, reaching borderline levels.

In contrast to the FCS, the Household Dietary Diversity Score (HDDS) did not decrease at midline. Figure 3a shows that the overall score has a mean of 7.3 points at midline, with similar levels to that of baseline. Moreover, we do not observe any notable changes at the Governorate levels. At midline, Homs has the highest score at 7.9 and As-Sweida has the lowest score at 6.5, which decreased by almost a full point from baseline value (This means that households in As-Sweida consume on average one less food group than at baseline). In Aleppo, the dietary diversity slightly increased, in contrast to the FCS, which generally implies that households there are still maintaining a balanced diet despite lower food security levels. In the control group (Figure 3b), the HDDS slightly decreased from 7.4 to 7.1 points, remaining above the acceptable level for the overall sample and by governorate. In the beneficiary groups, the HDDS remained almost the same for the overall sample, except for As-Sweida where HDDS score dropped to 5.9 at midline, falling below the recommended level of 6.

Figure 3. No overall notable changes in the dietary diversity at midline

Figure 3a. HDDS for the overall sample

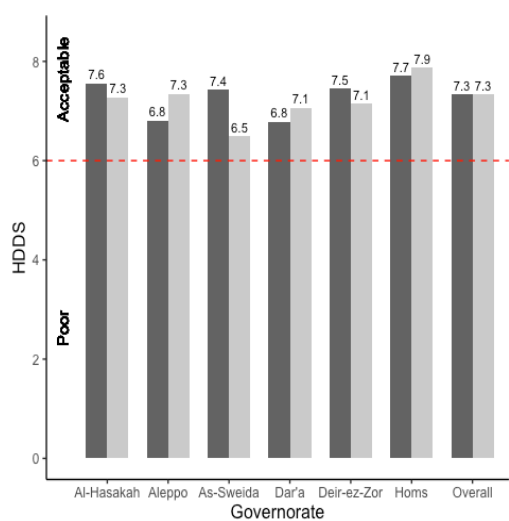


Figure 3b. HDDS for the control group

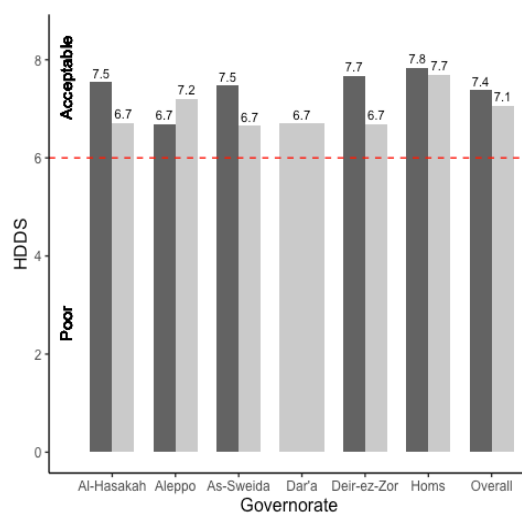


Figure 3c. HDDS for the direct beneficiary group

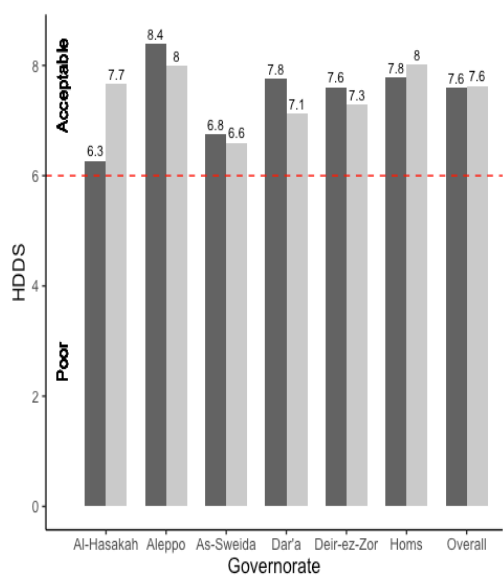


Figure 3d. HDDS for the indirect beneficiary group

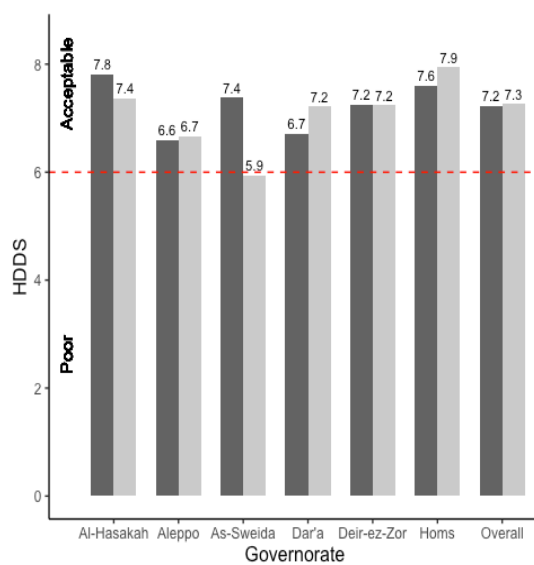


Figure 4. Use of harmful coping strategies to deal with food shortages is increasing

Figure 4a. rCSI for the overall sample

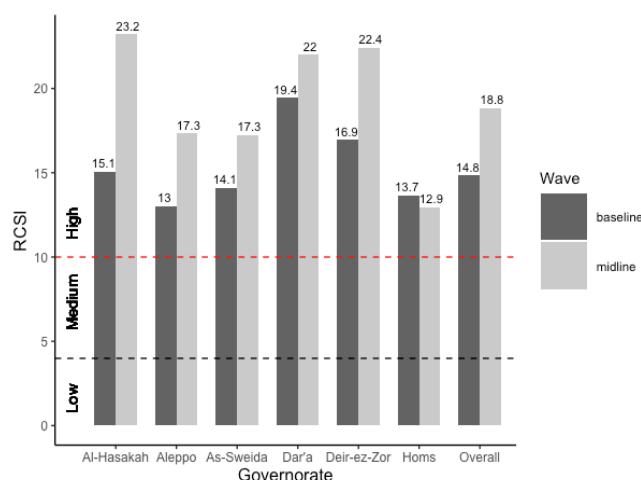


Figure 4b. rCSI for the control group

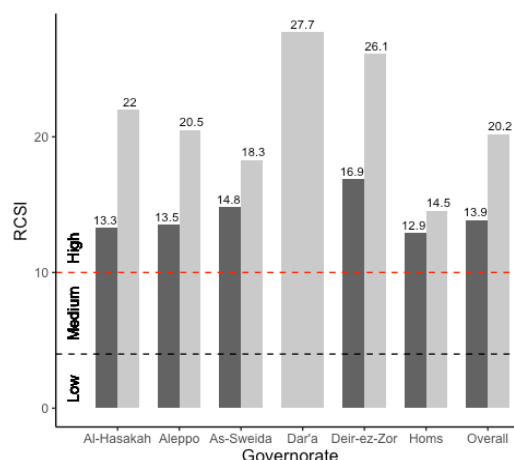


Figure 4c. rCSI for the direct beneficiary group

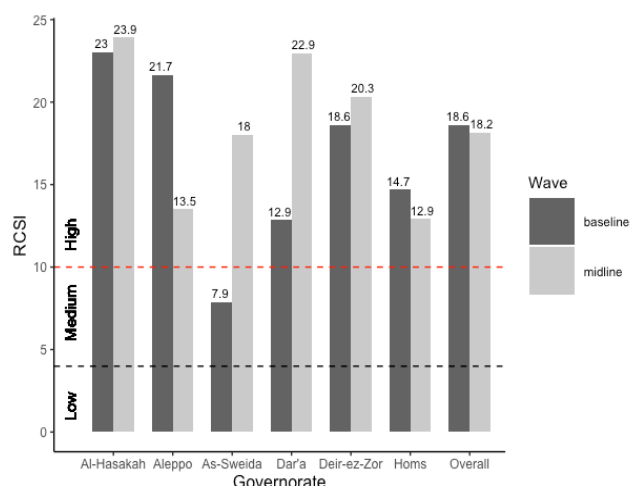
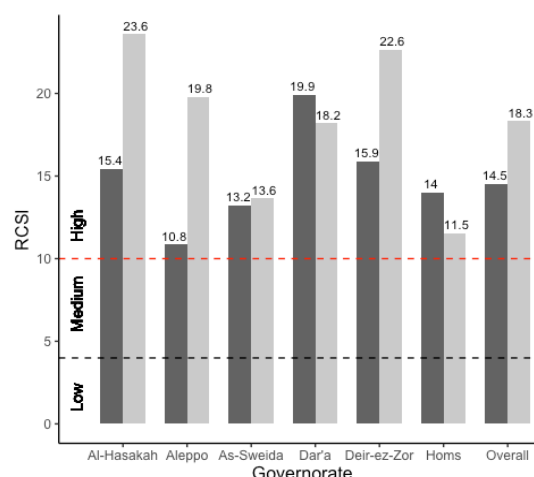


Figure 4d. rCSI for the indirect beneficiary



The average Reduced Coping Strategy Index (rCSI) is shown in Figure 4a for the overall sample. The overall average rCSI score notably increased by 4 points from baseline to midline, reaching an average score of 18.8. It is worth noting that the increase of the score in all governorates did not change the pre-existing fact that the results were already above the borderline threshold of 10. In other words, households at midline are relying even more on harmful coping strategies to deal with food shortages. This is a worrying trend that has increased significantly in the past two years. We only observe a small reduction in the rCSI in Homs by about 1 point. However, in other governorates, we observe a very concerning increase, such as in Al-Hasakah, where the average rCSI score at midline reached 23.2 - a drastic increase from 15.1 at baseline. After Al-Hasakah,

Deir-Ez-Zor and Daraa have the highest rCSI scores at midline. Among the control group (Figure 3b), the overall rCSI score of the overall sample increased by 6.3 points. A significant increase was observed in Deir-Ez-Zor, followed by Al-Hasakah and Aleppo. In the direct beneficiary group (Figure 3c), the rCSI score increased by 10 points in As-Sweida at midline, where the score shifts from medium to high. However, the rCSI score remained almost constant for the overall sample in the direct beneficiary group. As for the indirect beneficiary group, the rCSI score increased by almost 4 points. A notable increase was observed in Al-Hasakah, followed by Aleppo and Deir-Ez-Zor.

Figure 5. Access to essential food items

Figure 5a. Access to chicken over time in baseline and midline

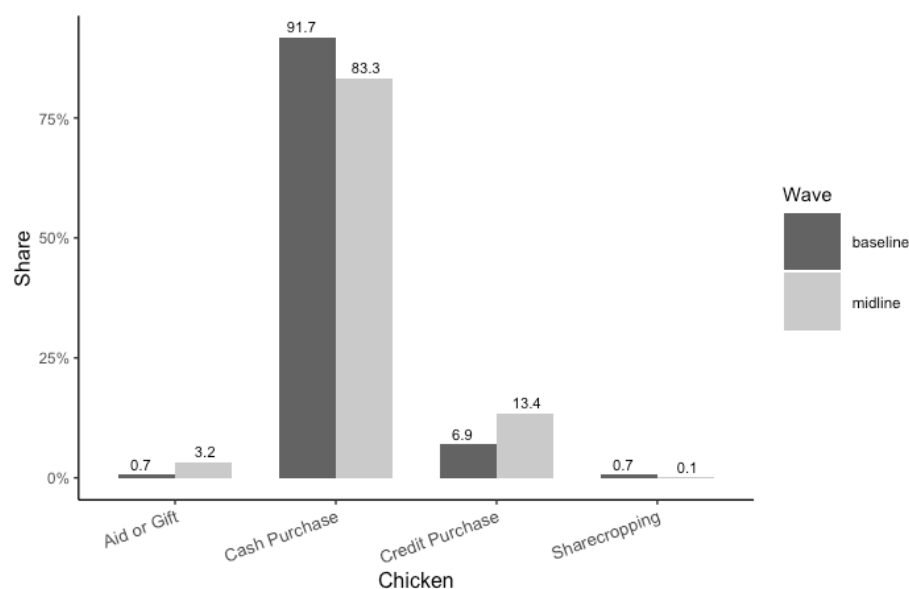


Figure 5b. Access to bread over time in baseline and midline

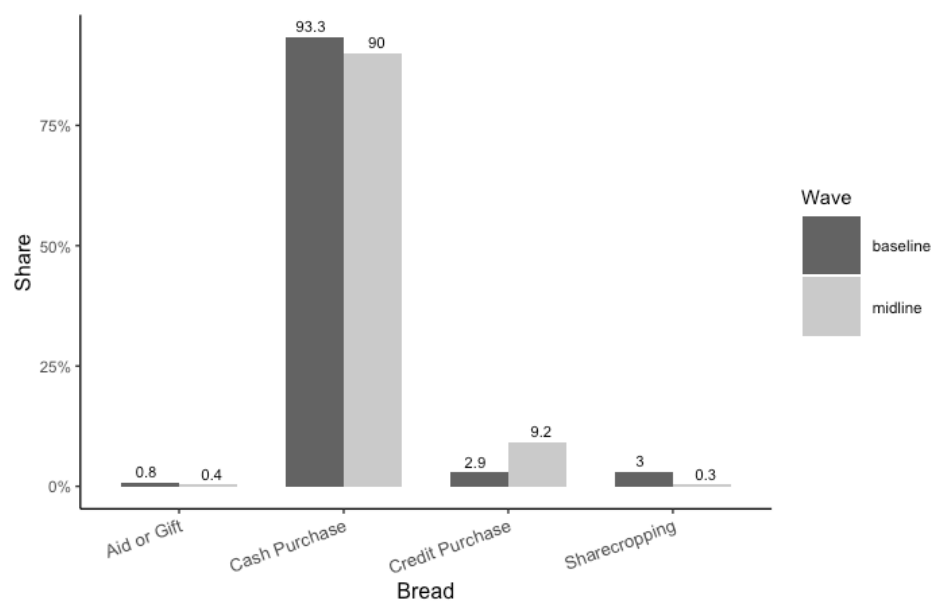


Figure 5c. Access to milk over time in baseline and midline

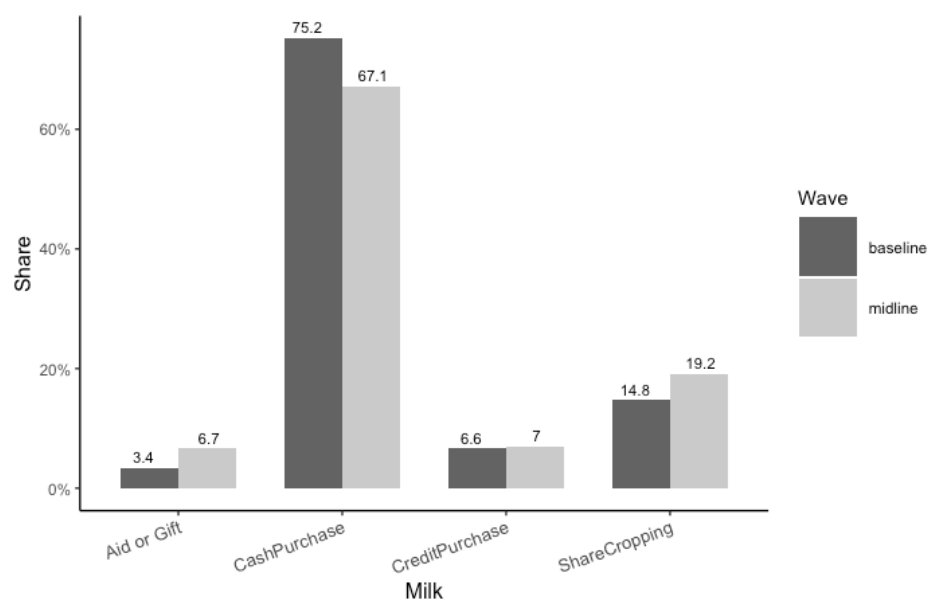


Figure 5d. Access to olive oil over time in baseline and midline

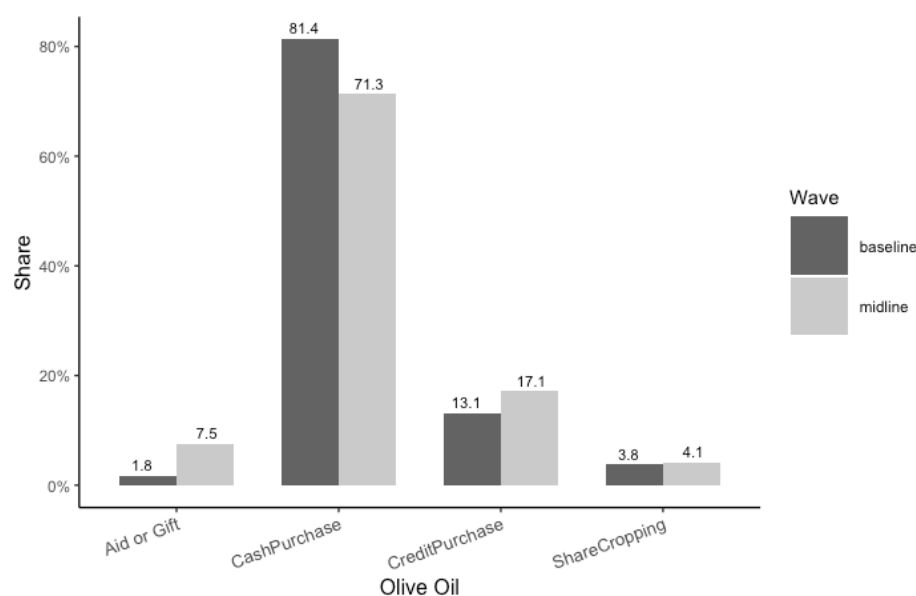


Figure 5 shows the change in the percentage share of four methods used for obtaining essential food items between baseline and midline. Each figure presents a separate food item: Chicken meat, bread, milk and olive oil. Overall, cash purchases remain the most common method used despite the notable decline over time. As shown in Figure 5b, 90% of households paid for bread in cash at midline, a decrease from 93.3 % at baseline. However, the decrease in cash purchases as a method of payment was replaced by an increase in credit purchases over time. We find that about 17% of households purchase olive oil on credit, compared to 13 % at baseline (Figure 5d); and 13% of households now purchase chicken meat on credit compared to 7 % baseline (Figure 5a). Compared to baseline, there has been a slight increase in reliance on aid or gifts for obtaining essential food items. 7.5% of households have received olive oil in the form of aid or gifts at baseline compared to just 1.8% at baseline (Figure 5d).

Interestingly, we observe that households are relying more on their own produce and sharecropping for milk. Only 67% of households buy milk with cash, while about 20% obtain it through sharing or through own production at midline, which was 14.8% at baseline (Figure 5c). These changes underscore the overall challenges in purchasing power of essential food items that households, specifically smallholder farmers, are facing currently in Syria. This trend reflects the continuing inflation of prices of essential food items in the region at large. Taken together with the findings from food security scores, we find that although households are obtaining sufficient access and intake of diverse food, where it is not possible to consume from own production, they are relying more on purchasing them using credits.

Figure 6. Increased worry among households about future food shortages

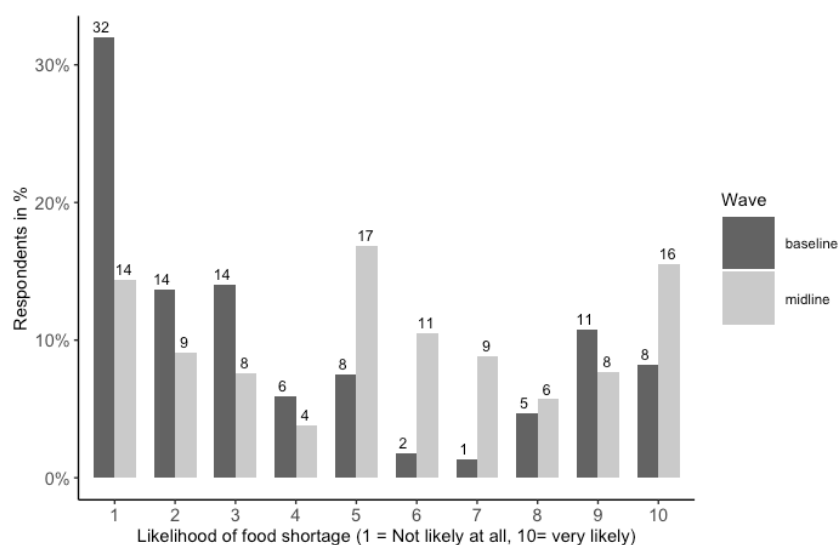


Figure 6 shows the share of the responses of households regarding the likelihood of facing food shortages in the next 12 months, where a value of 1 denotes that food shortage is not likely to happen at all and 10 denotes that it is very likely to take place. Here, we see a clear shift in the distribution of the responses between baseline and midline. A considerable share of households reported at midline that food shortages are very likely to take place in the upcoming 12 months (16%) compared to baseline (8%). On average, these scores have increased from 4 to 5.5, indicating that the households are more worried today about facing constraints in accessing food than they were two years ago.

Figure 7. Overall lower exposure to shocks apart from drought at midline

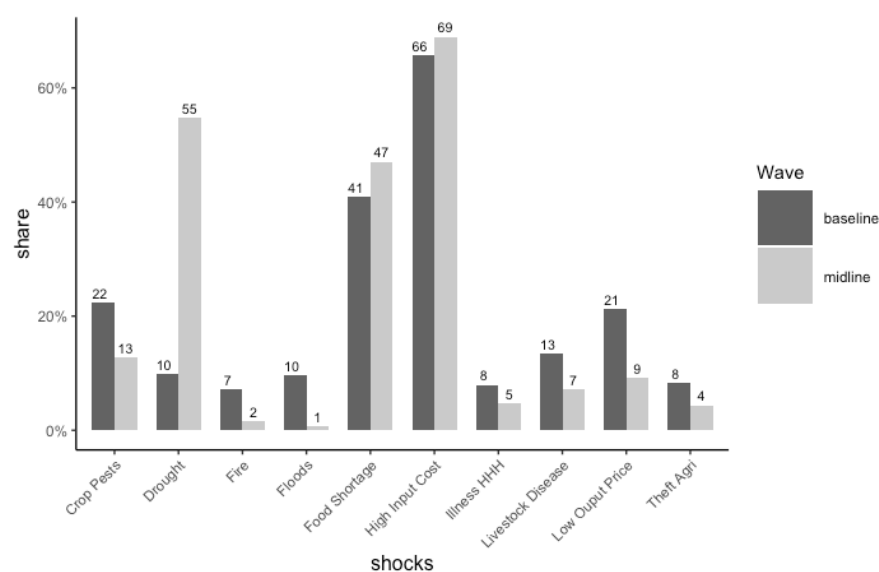


Figure 7 shows the share of households who reported facing shocks in the past 12 months. Apart from drought, food shortage, and high input cost, we find a drop in the share of households who experienced shocks at midline compared to baseline. Only 13% of households reported crop pests at midline compared to 22% at baseline. We also observe a slight decrease in the share of households who reported low output prices, although it remains relatively high at 9% at midline. Livestock disease also dropped from 13% to 7%, and floods decreased from 10% to 1%. 47% of households face food shortages, which is relatively high in comparison to the other shocks, this share remarkably increased from its baseline values, which was already high at 41%. We observe that in 2022, 55% households are facing drought compared to 10% of households in 2020.

Figure 8. Increased concern of drought episodes in the future

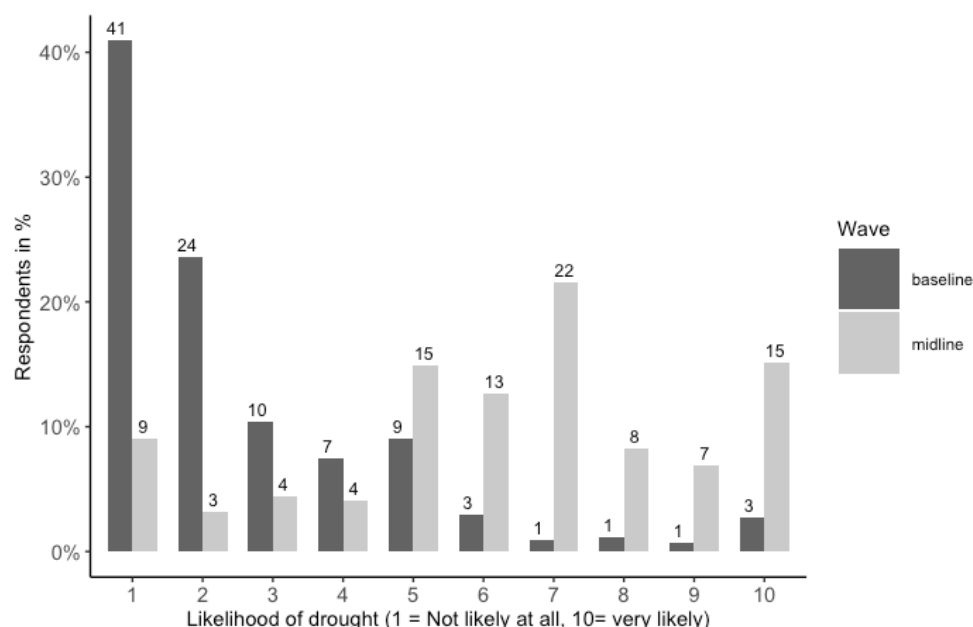


Figure 8 shows the response of households on the likelihood that episodes of drought will occur in the next 12 months. We clearly see a strong relationship here between experiences of drought and farmers prediction of drought occurring in the future. At baseline, only 41% of households said that a drought is not likely at all to occur and only 9% said that it is very likely to take place. This is strongly correlated with experiences of drought at baseline as reported in Figure 7. However, these shares changed considerably at midline, where only 9% of households now report that drought is unlikely to happen, while 15% of farmers believe that it is very likely to take place. Overall, the average of these scores sharply increased from 2.6 to 6.4, indicating that the households are more worried today about facing droughts than they were two years ago.

Figure 9. Improved access to water and land at midline

Figure 9a. Difficulty of access to land over time at baseline and midline

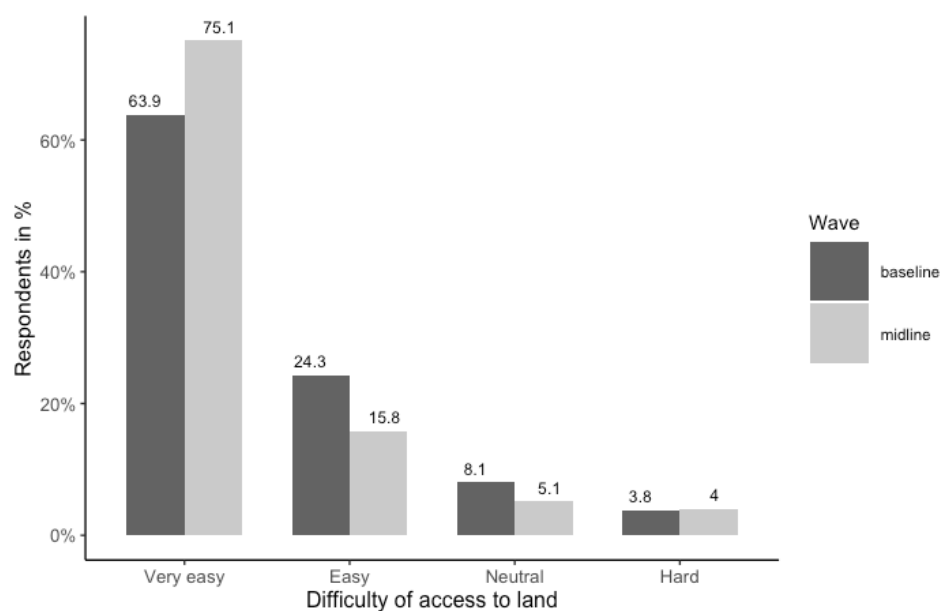


Figure 9b. Improve access to water over time at baseline and midline

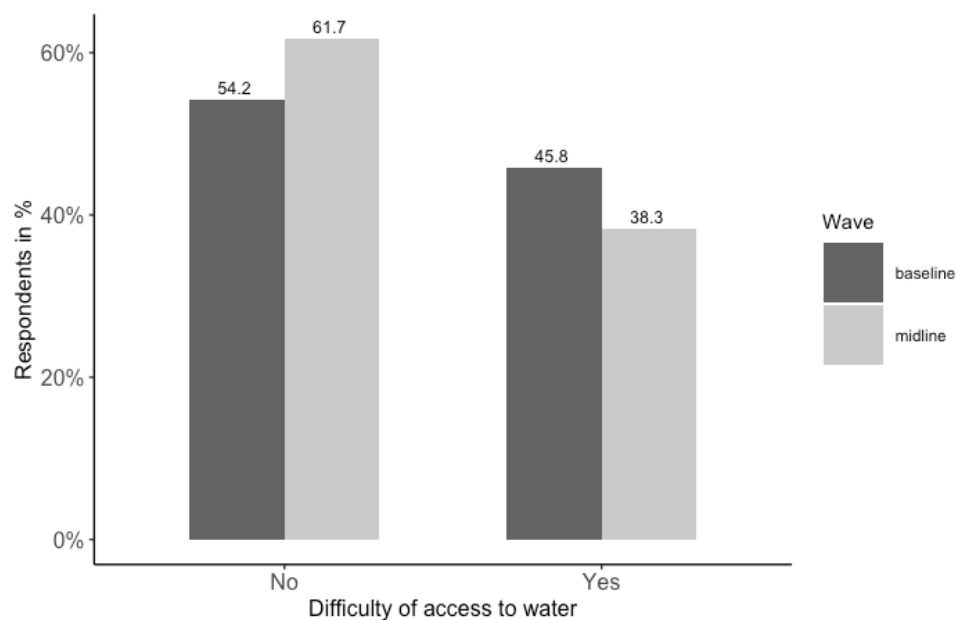


Figure 9a shows that accessing land is becoming less of a challenge over time. At midline, 75.1% of households reported that accessing land is very easy and does not pose any challenges. This share was almost 64% at baseline. On the other hand, only 4% find it difficult to access land at baseline and midline. Similarly, we find that households have less difficulty accessing water,

where 38.3 % of households still face challenges in water access at midline, a reduction from almost 46% at baseline (Figure 9b). This is a notable improvement for Syrian farmers at large, yet more than one third of smallholder farmers still face issues in ensuring access to water today.

4.2 Agricultural input prices and quality

Figure 10. Farmers continue to report excessive prices for agricultural inputs

Figure 10a. Increase in prices of agricultural tools

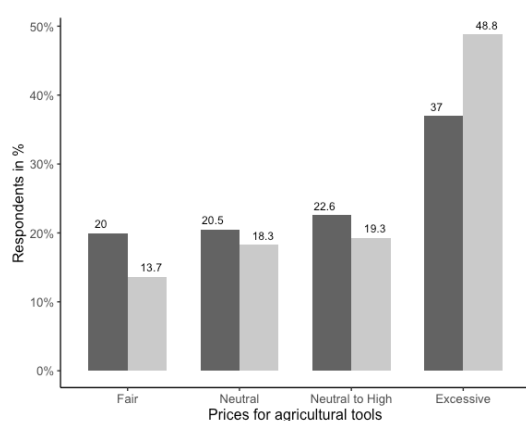


Figure 10b. Increase in prices of seeds

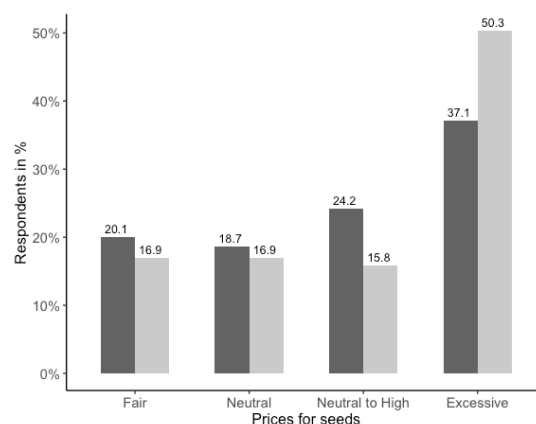


Figure 10c. Slight decrease in prices of agrochemicals

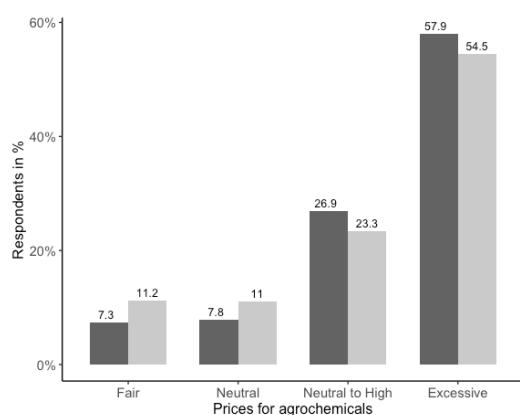


Figure 10d. Increase in prices of livestock feed

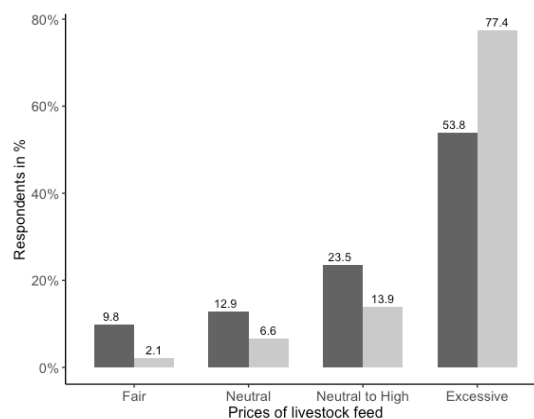


Figure 10 shows the smallholder farmers' assessment of the prices of four agricultural inputs (agricultural tools, seeds, agrochemicals and livestock feed) separately. In the first instance we find that for all four inputs at least 50% of farmers reported excessive prices. With exception to the price for agrochemicals, the results indicate a sharp increase of price perception amongst smallholders over time. At baseline, 37.1% and 53.8% of the sample perceived an excessive price

of agricultural seeds and livestock feed, respectively. These shares increased by almost 13% and 24% reaching 50.3 % and 77.4%, respectively (Figure 10b and d).

Figure 11. Quality of agricultural inputs remains acceptable at midline

Figure 11a. Decrease in quality of agricultural tools

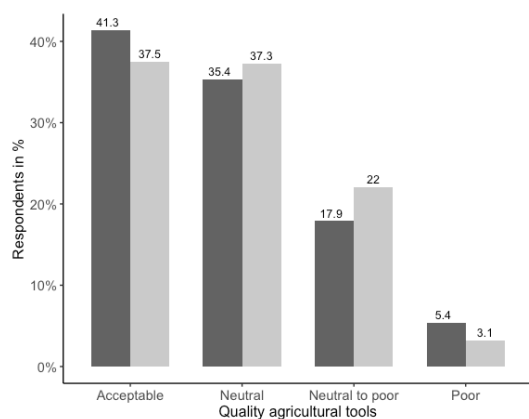


Figure 11b. Increase in quality of seeds

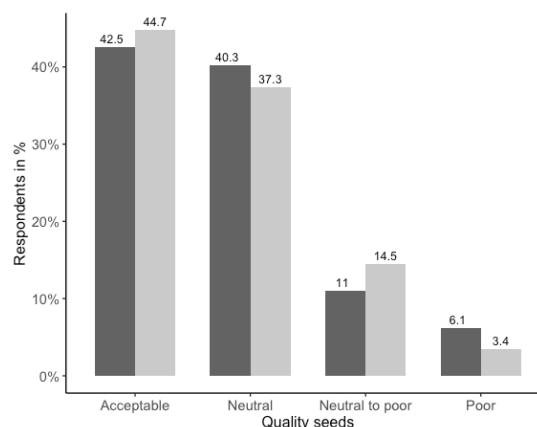


Figure 11c. Increase in quality of agrochemicals

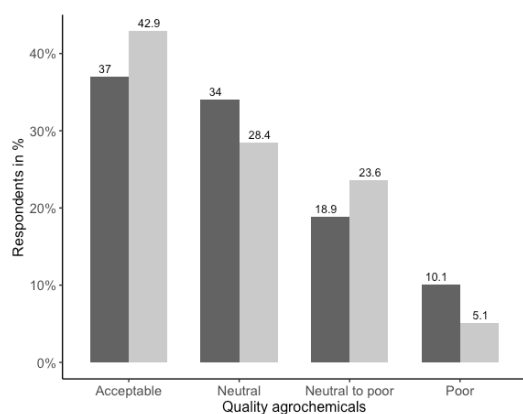
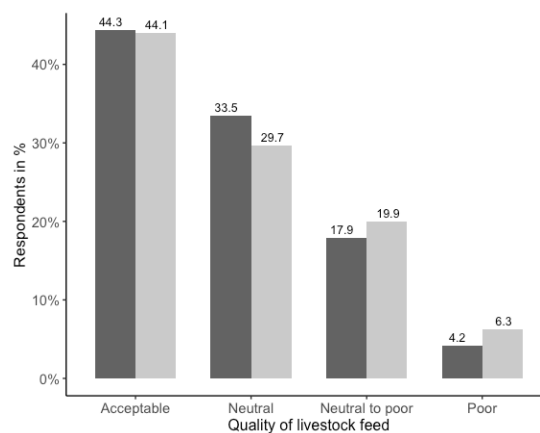


Figure 11d. Decrease in quality of livestock feed



Despite the rise in price over time, Figure 11 shows an overall quality satisfaction of the four different agricultural inputs offered at the local market. Less than half of the participants reported an 'acceptable' quality about all agricultural inputs. The most notable increase in product satisfaction was with regards to the quality of agrochemicals (Figure 11c). We also find a 2% increase of 'acceptable' perception for the quality of seeds and a 6% increase of 'acceptable' perception towards the quality of agrochemicals (Figure 11b and c).

Figure 12. High anticipation of unusually high costs of agricultural inputs in the future

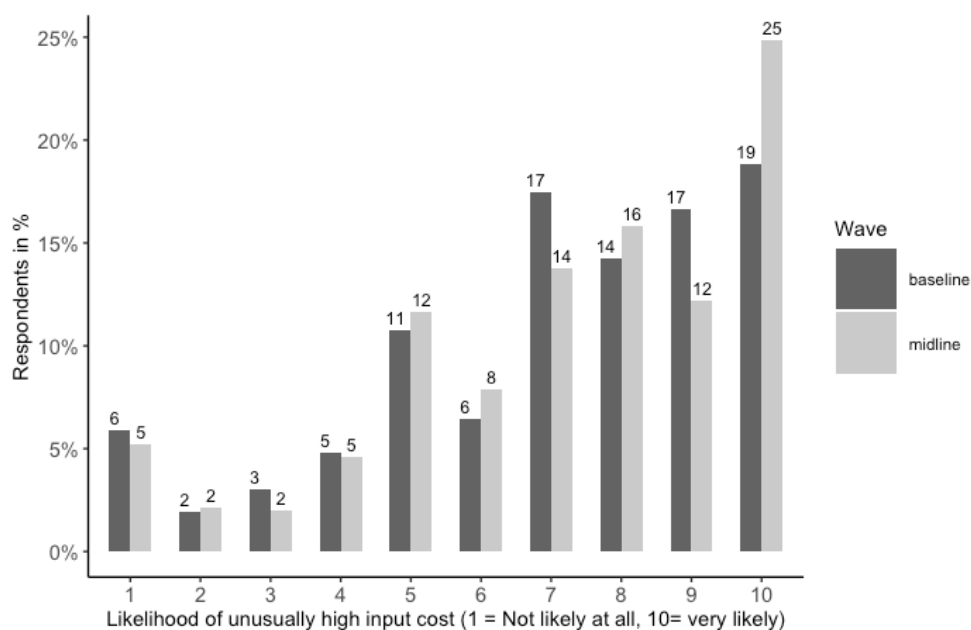


Figure 12 shows an increase in the smallholder's expectancy for an increase in agricultural input cost over time. The extreme likelihood of high input cost increased from 19% from baseline to 25% at midline. The overall average of these scores has increased from 7 to 7.2, indicating a notable increase in the expectation of more price inflation of agricultural inputs in the next 12 months.

4.3 Access to Drought Early Warning System (DEWS) Information

Figure 13a. Improvement in the frequency of using information from other farmers

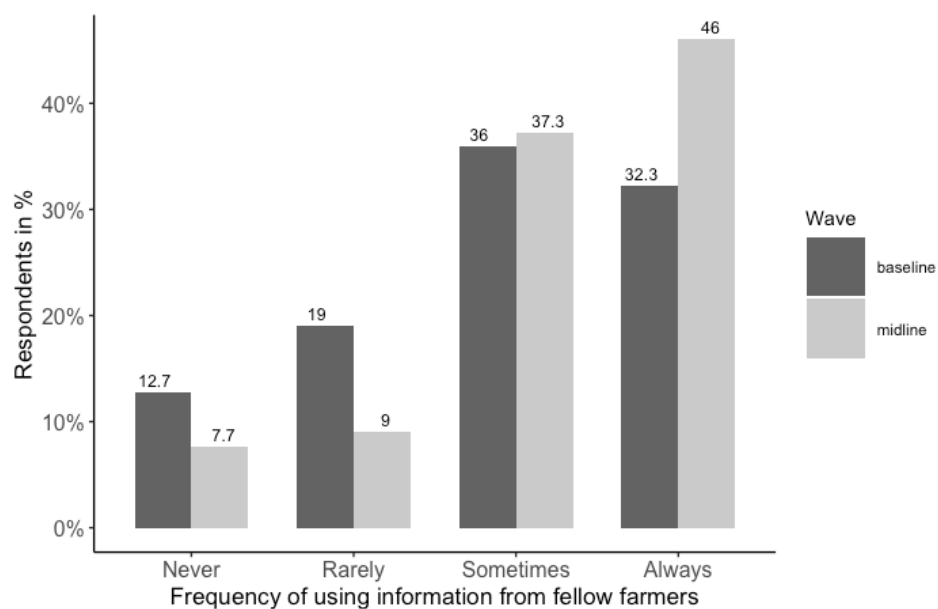


Figure 13b. Increase in reliance of forecasts from fellow farmers for cultivation

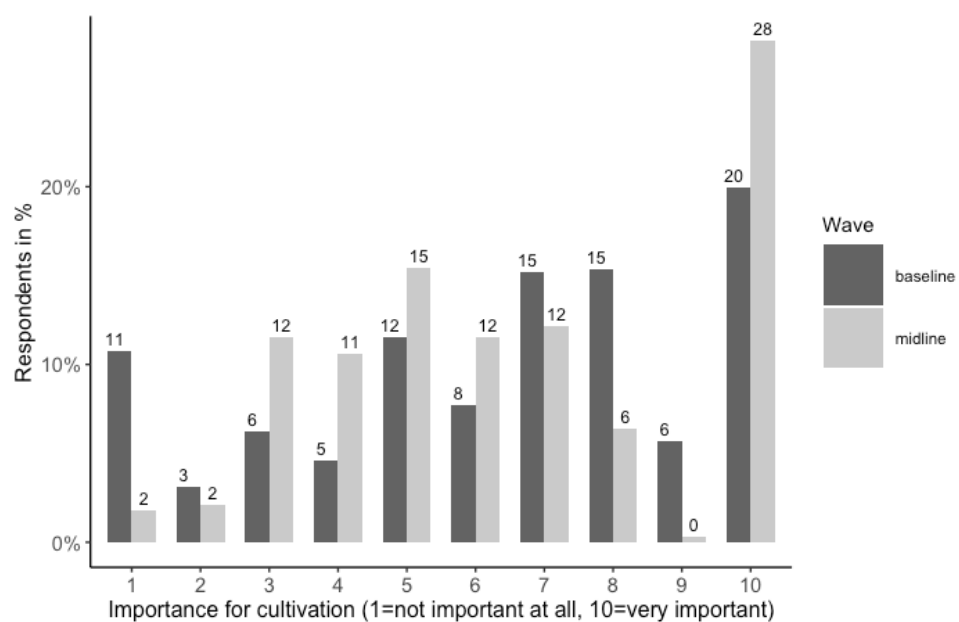


Figure 13c. Decrease in reliance on forecast information from fellow farmers for harvesting

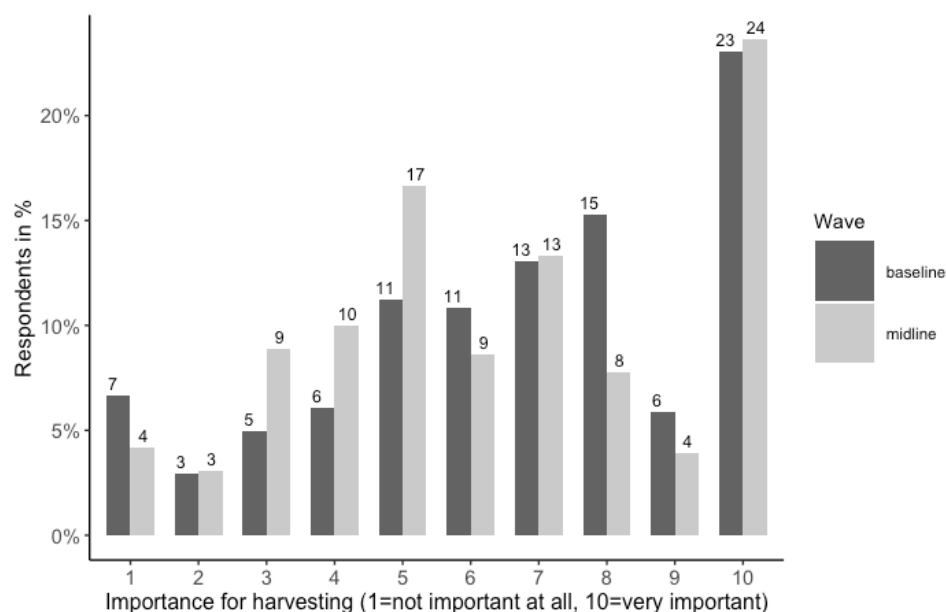


Figure 13a shows an increase in the reliance of farmers on each other for obtaining information regarding upcoming climatic shocks. Over time, the increase of 15 % of farmers who reported that they always depend on information from fellow farmers was also met with a decrease of 5% of farmers who had previously stated that they never use information from fellow farmers regarding DEWS.

The access to drought early warning system via fellow farmers was originally considered by some farmers as extremely vital for cultivation with the highest percentage of 28 % ranking this access as very important (Figure 13b). Moreover, there was a significant decrease from 11 % to only 2 % of farmers who had previously stated that they do not consider the access to drought early warning system via fellow farmers is important for cultivation. However, the average scores remained almost similar at 6.4 between baseline and midline.

Figure 13c shows that there is an overall positive sense of importance by farmers regarding the access to drought early warning systems through fellow farmers. This assumption is supported by baseline and midline contents both having over two-thirds of respondents claiming a certain positive importance of information shared for harvesting. Despite the overall consideration of importance by farmers remaining high, it should be noted that there was a decrease of 7% of farmers who had previously considered shared information as important for harvesting. On average, the scores have decreased from 6.7 to 6.4, indicating a decrease in farmer's reliance on fellow farmers for harvesting after two years.

Overall, it is revealed that most farmers have a certain level of dependency and consideration for information shared regarding access to drought early warning systems through fellow farmers. While this sense of importance to information remained almost unchanged about cultivation, it has decreased about harvesting. Perhaps, the farmers might in their expertise define another sense of value than each other when it comes to their end goal being the actual cultivation and harvest. What is certain beyond doubt is that most farmers are involved and dependent on one another for information. There was a notable increase from respondents who claim to either sometimes or always use information from one another.

4.4 MAAR extension services

Figure 14a. MAAR extension centre for marketing: usefulness of service/training provided

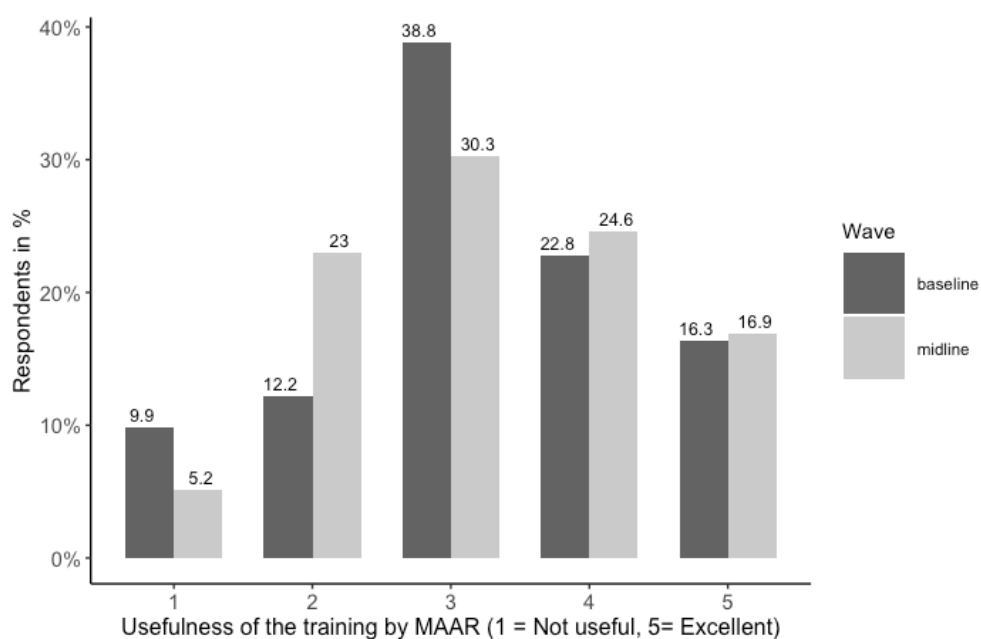


Figure 14b. MAAR extension centres for marketing: impact on farming productivity

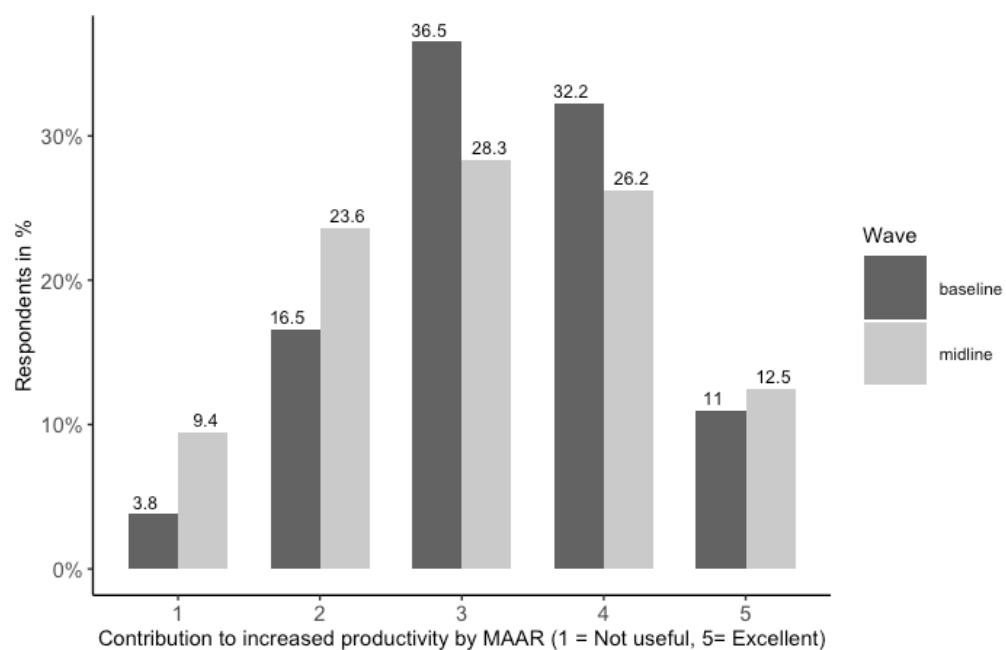


Figure 14c. MAAR extension centres for marketing: impact on access to markets

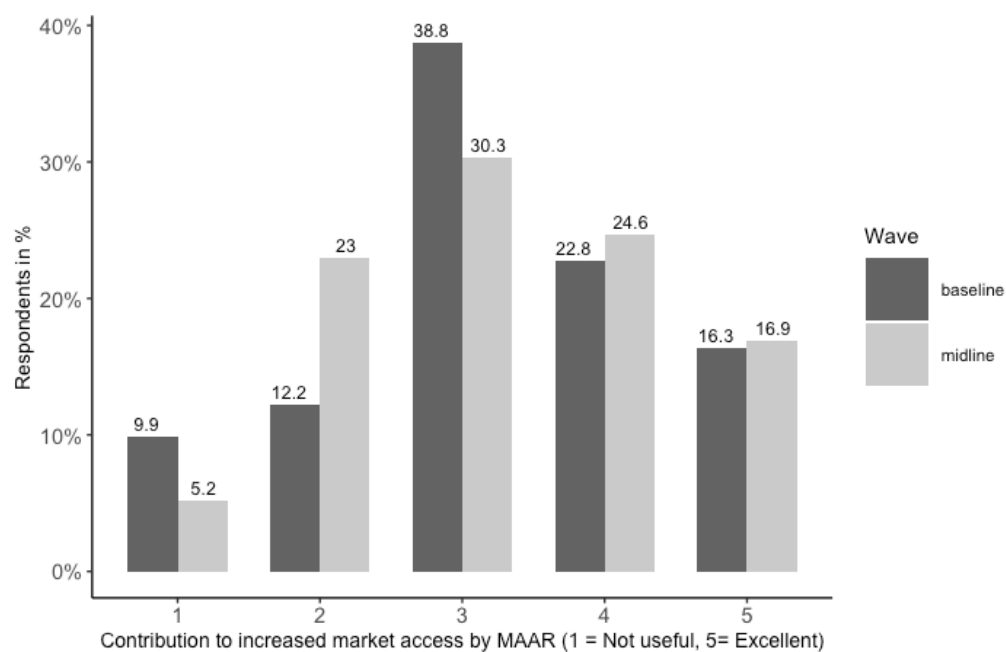


Figure 14a shows the changes in farmers rating of the training by the MAAR extension centre. Almost 10 percent who had expressed the most disapproval of the training's effectiveness at baseline has decreased by half at midline. The results of graph 14b shows an increase in both extremities regarding the participants' approval on training in improving agricultural productivity. There is a slight increase of participants who have claimed that the training increased their agricultural productivity. Figure 14c shows a sharp decline in participants who had previously claimed that the training was insufficient to assist with better market access. As a result, we find that two percent of respondents report that the training had increased their market access. In general, it can be concluded that the training had increased the respondents' ability to access the market and simultaneously contribute to increasing productivity.

4.5 General attitudes and risks

Figure 15a. Increase in willingness to take risks over time

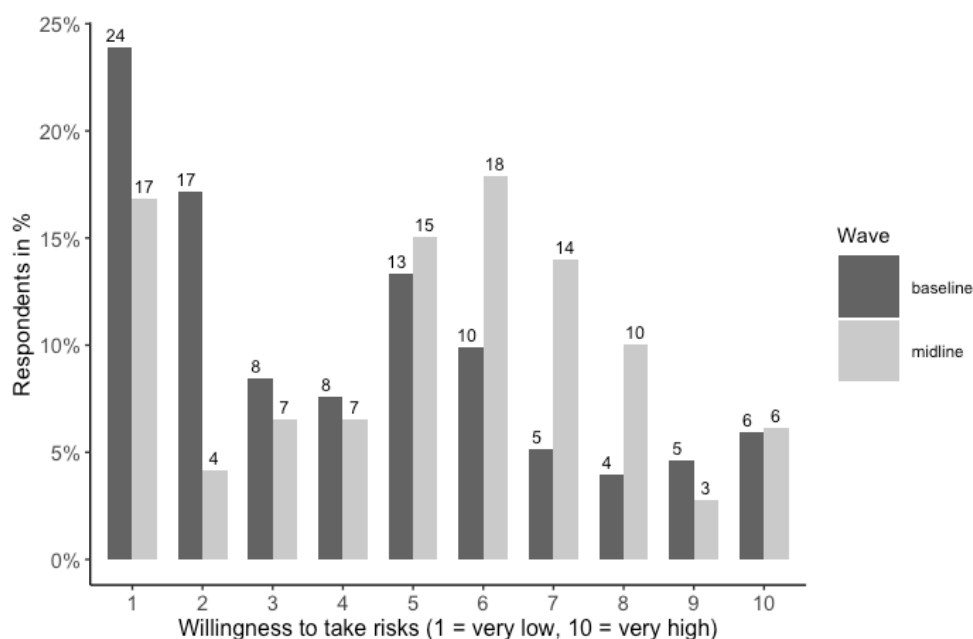


Figure 15b. Decrease in willingness to postpone taking action over time

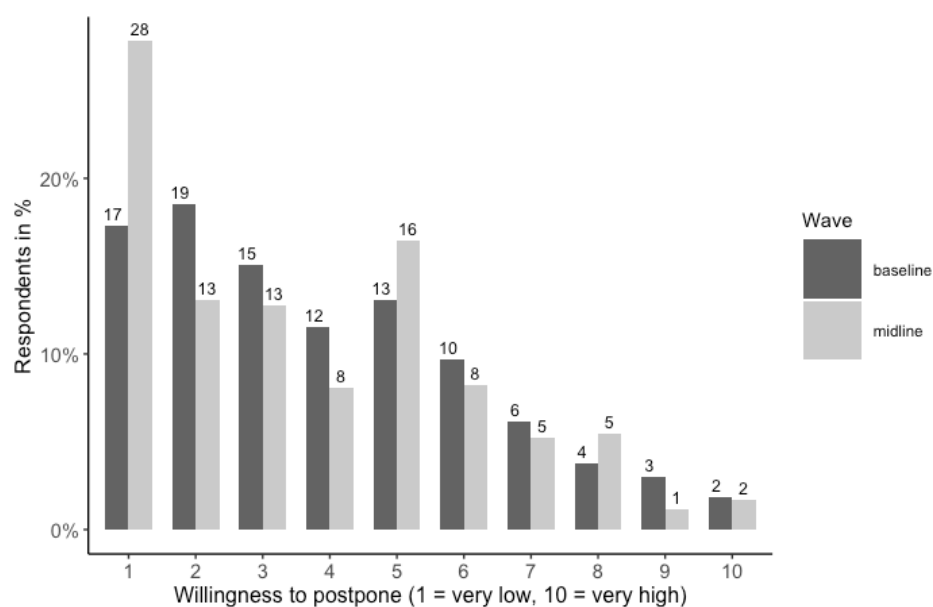


Figure 15c. Decrease in willingness to share over time

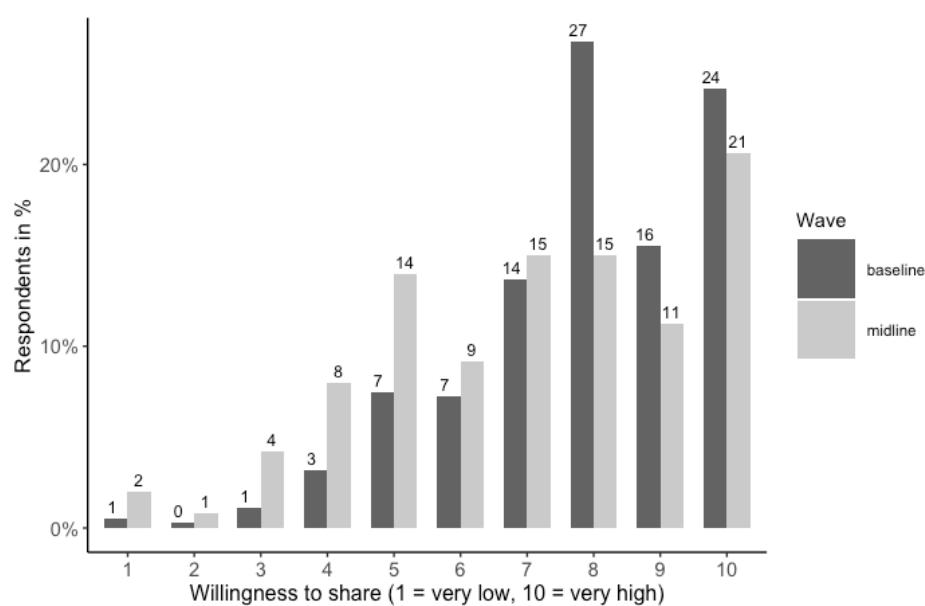


Figure 15a shows farmers risk preferences over time. Overall, more respondents at baseline were unwilling to take risks with regards to agricultural decisions (24% and 17%) compared to midline (17% and 4%). While the number of participants unwilling to take risks significantly decreased by 7% and 13% in midline, the percentage of high-risk taking participants remained constant over time. Overall, the average of these scores has increased from 4.08 to 5.1, indicating a notable increase in farmer's willingness to take risks from 2020 to 2022. Moreover,

Figure 15b shows an increased number of households who are unwilling to postpone taking action. Although the share of respondents unwilling to engage in risky decisions decreased from baseline to midline, participants unwilling to postpone important agriculture related decisions increased over time. On average, these scores have decreased from 3.8 to 3.6, indicating a slight decrease in taking risks by farmers over time. Figure 15c. shows the changes in the share of farmers who are willing to share with their communities without expecting anything in return. Compared to baseline, the number of participants who were initially very willing to share decreased from 24% to 21%. On average, the scores decreased from 7.9 in 2020 to 7.1 in 2022.

5. Midline impact analysis

In this section, we present programme impacts for direct and indirect beneficiary households. First, in subsection 5.1 we provide the impact estimates for the overall programme on direct beneficiary households. In subsection 5.2, we examine the intervention-specific impacts of direct beneficiary households. Lastly, in subsection 5.3, we present indirect impacts of the overall programme and of selected programme components.

5.1 Overall impact of the programme

In this subsection, we present findings on the direct impacts of the overall programme. We present the tables based on the set of outcome indicators including food security, income generation, vegetable cultivation, crop production and yields, livestock production, the use of extension services and drought early warning systems, and the farmers attitude towards risk taking. Then, we present the programme effect for a subsample including only female-headed households. In the tables, we show the mean value of the control group and the direct beneficiary group at midline separately (after matching) and the estimated difference between the two groups (impact) with and without controlling for the set of matching variables. The estimations with the control variables are the most precise impact estimates (bolded). Moreover, we present coefficient plots assessing the programme impacts for each governorate separately. The graphs show the average programme impact (circle) and the corresponding 90% confidence interval (lines). If the confidence interval does not cross the zero-line, the effect can be attributed to be significant at the 10% level. Significant effects are coloured in yellow. Finally, we cross check our results with a panel analysis. The table displays the baseline and midline means for both the direct beneficiary and the control group, as well as the estimated programme impact.

Table 4 displays the programme impact on FCS, HDDS and rCSI. **Overall, households that received support by FAO significantly improved their food security status, as captured by all three indicators.** On average, direct beneficiary households improved their FCS by 2.4 points ($p < 0.01$). Looking at HDDS, the direct beneficiary group shows an improvement of 0.57 points compared to the control group ($p < 0.01$). This indicates that more than every second direct beneficiary household consumes one more food group than the control group per day on average. Control households have an extremely high rCSI of 20.22, while the direct beneficiaries have an rCSI of 18.28 at midline. Hence, FAO's support decreased the rCSI by 2.3 points ($p < 0.01$), which indicates that beneficiaries need to use fewer harmful coping strategies to access food. However, the score remains worrying.

Table 4. Direct beneficiary households show significant improvements in food security

	Control	Direct beneficiary	Impact	
FCS	55.96 (18.60)	57.78 (16.64)	1.83* (0.97)	2.4*** (0.78)
HDDS	7.11 (1.54)	7.69 (1.74)	0.58*** (0.09)	0.57*** (0.08)
rCSI	20.22 (13.80)	18.28 (12.18)	-1.95*** (0.71)	-2.27*** (0.65)
Control variables	-	-	no	yes

Notes. Control variables include the Governorate, household and individual characteristics, experience of shocks, agricultural key assets and if the households received any assistance from other organisations other than FAO. Standard deviations and errors in parenthesis. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$. Matching method: "optimal full matching".

Table 5. Positive programme impacts on income from crop farming and livestock (in USD)

Income in USD in the past 12 months	Control	Direct beneficiary	Impact	
Total	728.82 (572.37)	843.86 (698.57)	115.03*** (36.86)	95.49*** (29.87)
Crop farming	518.02 (558.64)	579.28 (570.40)	61.26 (43.37)	79.06** (37.91)

Herding	550.16 (406.73)	719.42 (577.14)	169.26*** (43.46)	150*** (36.9)
Cattle Products	233.05 (361.16)	551.85 (1184.57)	318.79*** (62.15)	263.48*** (57.26)
Wheat income from value chains	408.18 (367.91)	464.52 (386.00)	56.34 (35.84)	60.79* (32.72)
Control variables	-	-	no	yes

Notes. Control variables include the Governorate level, household and household head characteristics, the experience of exogenous shocks, agricultural key figures and if the households received any assistance from other organisations than FAO. Standard deviations and errors in parenthesis. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$. Matching method: "optimal full matching".

Table 5 displays the average programme impact on household income. **FAO's programme significantly increased the overall household income by 95 USD ($p < 0.01$)**. This can be translated into an income increase by 11%. Also, income from crop farming increased for the direct beneficiary group by 79 USD ($p < 0.05$). From herding, direct beneficiaries earn 719 USD on average, compared to control households who earn 550 USD. Therefore, the support increased this income source by 250 USD. Direct beneficiary households generate on average 552 USD from selling cattle products, while control households only generate 233 USD ($p < 0.01$). Accordingly, **FAO's programme can be attributed to a duplication of income from cattle products**. For income generated for engaging in value chain activities related to wheat, direct beneficiary households earned on average additional 61 USD through receiving support ($p < 0.1$).

Table 6. Programme increased the share of households who cultivate cucurbits and vegetables.

	Control	Direct Beneficiary	Impact	
Cucurbits	0.04 (0.19)	0.10 (0.30)	0.06*** (0.01)	0.07*** (0.01)
Legumes	0.13 (0.34)	0.04 (0.21)	-0.09*** (0.02)	-0.08*** (0.01)
Other crops	0.20 (0.40)	0.17 (0.37)	-0.03 (0.02)	-0.01 (0.02)
Other vegetables	0.13 (0.34)	0.24 (0.43)	0.11*** (0.02)	0.11*** (0.02)

Barley	0.06 (0.24)	0.06 (0.24)	-	-
Wheat (irrigated)	0.31 (0.46)	0.36 (0.48)	0.05* (0.03)	0.05** (0.02)
Wheat (rainfed)	0.06 (0.24)	0.06 (0.23)	-	-
Control variables	-	-	no	yes

Notes. Control variables include the Governorate level, household and household head characteristics, the experience of exogenous shocks, agricultural key figures and if the households received any assistance from other organisations than FAO. Standard deviations and errors in parenthesis. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$. Matching method: "optimal full matching". Vegetable grouping:

Cucurbits: cauliflower, cucumber, eggplant and zucchini; **Legumes:** beans, broad beans, chickpeas, cowpeas, flat peas, green beans, lentils, medicago, peas, soybeans; **Other crops:** almond, anise, black cumin, caraway, clover, coriander, corn, cotton, cress, cumin, dandelion, fodder crops, garlic, maize, mint, nigella, olive, parsley, pistachio, potato, roselle, sesame, sorghum, stavia, sunflower, vetch and watermelon; **Other vegetables:** Cabbage, cauliflower, chard, corchorus, fennel, lettuce, onion, peppers, radish, rocca, shamra, spinach and tomato.

Table 6 displays the programme impact on households cultivating different crop and vegetable types expressed in shares. First, we find a reduction in the share of households in beneficiary groups who grow legumes. At midline, only 4% of households in the beneficiary group grow legumes compared to 13% in the control group. This is more than a threefold reduction. Second, we find that the programme increased the share of households who cultivate cucurbits (10%) and other vegetables (24%) compared to control households with 4% and 13% respectively ($p < 0.01$). Taken together, these findings show that the programme has impacted the type of crops farmers grow. There is a shift from cultivating legumes to cucurbits and to other vegetables. **The share of households that cultivate irrigated wheat in the treatment group is 36%, which is significantly higher than the 31% in the control group ($p < 0.05$).** We find no significant programme impact in the share of households cultivating barley or rainfed wheat.

Table 7. Programme increased wheat yields

	Control	Direct Beneficiary	Impact	
Crop production in t.				
Wheat (irrigated)	2.15 (1.75)	2.07 (1.36)	-0.09 (0.15)	0.01 (0.14)
Wheat (Rainfed)	1.49 (0.97)	1.78 (0.81)	0.29* (0.15)	0.42** (0.16)
Barley	0.89 (0.87)	0.95 (0.78)	0.06 (0.16)	-0.03 (0.17)
Crop yield in t/ha.				
Wheat (irrigated)	2.71 (0.63)	2.79 (0.75)	0.08 (0.07)	0.11* (0.06)
Wheat (Rainfed)	1.23 (0.26)	1.38 (0.36)	0.16*** (0.05)	0.13** (0.06)
Barley	1.40 (0.52)	1.68 (0.48)	0.29*** (0.1)	0.08 (0.11)
Control variables	-	-	no	yes

Notes. Control variables include the Governorate level, household and household head characteristics, the experience of exogenous shocks, agricultural key figures and if the households received any assistance from other organisations than FAO. Standard deviations and errors in parenthesis. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$. Matching method: "optimal full matching".

Table 7 displays the programme impact on production and yield of wheat and barley in the past season. The mean production of irrigated wheat and barley is similar for both groups at around 2,1 and 0.9 tons, respectively. **In contrast, FAO's support increased the harvests of rainfed wheat by 0.4 on average, an increase by 24% ($p < 0.05$). Furthermore, the programme households increased the yield of irrigated wheat by 4% ($p < 0.1$) and of rainfed wheat by 9% ($p < 0.05$). There is no significant effect on barley yield.**

Table 8. Programme increased cow milk productivity

	Control	Direct Beneficiary	Impact	
Cow Milk (l/day/cow)	14.30 (14.02)	18.16 (19.64)	3.86** (1.69)	3.27* (1.74)
Poultry Eggs (per day)	4.55 (2.60)	4.35 (2.61)	-0.19 (0.28)	-0.23 (0.3)
Control variables	-	-	no	yes

Notes. Control variables include the Governorate level, household and household head characteristics, the experience of exogenous shocks, agricultural key figures and if the households received any assistance from other organisations than FAO. Standard deviations and errors in parenthesis. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$. Matching method: "optimal full matching".

Table 8 highlights the intervention impacts on household outputs in livestock products. **Direct beneficiary households produce on average more than 3 litre more milk per day per cow due to the intervention with 18 litres compared to the control households with 14 litres ($p < 0.1$).** Both groups produce on average 4-5 eggs per day. The absence of a significant programme impact in the latter outcome is reasonable since FAO's intervention did not target poultry production.

Table 9. Programme increased the share of households receiving support from extension centres

	Control	Direct Beneficiary	Impact	
MAAR services	0.59 (0.49)	0.68 (0.47)	0.09*** (0.03)	0.12*** (0.02)
Agricultural Association	0.43 (0.50)	0.41 (0.49)	-0.03 (0.03)	0.01 (0.02)
Other Centres	0.15 (0.36)	0.18 (0.38)	0.03 (0.02)	0.02 (0.02)
Control variables	-	-	no	yes

Notes. Control variables include the Governorate level, household and household head characteristics, the experience of exogenous shocks, agricultural key figures and if the households received any assistance from other organisations than FAO. Standard deviations and errors in parenthesis. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$. Matching method: "optimal full matching".

Table 9 displays the programme impact on the household's use of extension centres in the past year. The results are displayed in shares of households who used this support. 68% of the direct beneficiary households and 59% of the control households received support from MAAR extension centres. **Accordingly, the support increased the share of households using MAAR services by 12% points ($p < 0.01$).** This result also indicates that public services are well accessible and accepted by the sampled households. Around 42% of all households used extension services through agricultural organisations. 15-18% of the matched households received extension services from other places. There is no significant programme impact observable for these outcomes.

Table 10. Programme increased the use of some of the drought early warning systems

	Control	Direct Beneficiary	Impact	
Fellow farmers	1.17 (1.34)	1.17 (1.32)	0 (0.07)	0.02 (0.06)
Public Extension	0.55 (1.11)	0.67 (1.22)	0.12* (0.06)	0.15*** (0.05)
News/Media	0.93 (1.31)	0.78 (1.23)	-0.15** (0.07)	-0.16** (0.06)
Internet	0.64 (1.20)	0.99 (1.33)	0.35*** (0.07)	0.36*** (0.06)
Control variables	-	-	no	yes

Notes. Control variables include the Governorate level, household and household head characteristics, the experience of exogenous shocks, agricultural key figures and if the households received any assistance from other organisations than FAO. Standard deviations and errors in parenthesis. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$. Outcomes expressed by an indicator from 0 (never used) to 3 (always used). Matching method: "optimal full matching".

Table 10 emphasises the programme impact on the frequency of the use of different information channels for drought early warning. Overall, Table 10 implies that the households barely take advantage of available drought information. The most common source of information are fellow farmers. Still, this information channel is with 1.17/3 points rarely used on average in both groups. There is no programme impact observable. **However, the programme increased the likelihood to retrieve information from public extension services and the internet by 22% and 36%, respectively ($p < 0.01$).** On the contrary, direct beneficiary households are less likely to use information about drought risk from news or the media ($p < 0.05$).

Table 11. Programme increased postponing and willingness to share

	Control	Direct Beneficiary	Impact	
Taking risks	3.92 (2.83)	4.14 (2.58)	0.23 (0.16)	0.19 (0.15)
Postpone taking action	2.19 (2.27)	2.66 (2.42)	0.47*** (0.14)	0.3** (0.12)
Willingness to share	5.91 (2.39)	6.17 (2.18)	0.26* (0.14)	0.42*** (0.12)
Control variables	-	-	no	yes

Notes. Control variables include the Governorate level, household and household head characteristics, the experience of exogenous shocks, agricultural key figures and if the households received any assistance from other organisations than FAO. Standard deviations and errors in parenthesis. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$. Outcomes expressed by indicators from 0 (very unlikely) to 10 (very likely). Matching method: "optimal full matching".

Table 11 shows the impact of the programme on farmers' risk and time preference, and their willingness to share. We find a positive strong effect on time preferences ($p < 0.05$) and willingness to share ($p < 0.01$). In other words, farmers value the future more than the present when it comes into taking action and making decisions. The positive effect on the willingness to share implies that beneficiary farmers are feeling better off, which increases their altruism. On the other hand, we find no significant effect of the programme in changing risk preferences of farmers in the short-term.

Table 12 displays the intervention impacts for female-headed households in the direct beneficiary group compared to female-headed households in the control group. First, **the programme increased the food consumption score by 3.92 points ($p < 0.01$)**. In comparison, this estimate is remarkably larger than for the full sample with 2.4 points (see Table 4). Moreover, we find a strong and significant effect on the reduction in the use of coping strategies as captured by rCSI, which decreased by **4.36 points ($p < 0.01$)**. **This impact is again substantially larger than that for the overall sample (-2.3 points, Table 4)**. In other words, **female-headed households benefited on average more in food security outcomes compared to male-headed households**. These improvements are crucial, especially given that the absolute average food security scores for female-headed households are significantly lower compared to male-headed households.

Table 12. Positive programme impacts on female-headed households

	Control	Direct Beneficiary	Impact	
FCS	50.56 (16.33)	54.91 (15.99)	4.36*** (1.51)	3.92*** (1.32)
rCSI	24.88 (12.84)	19.95 (12.00)	-4.93*** (1.15)	-4.36*** (1.11)
Income from Crop Farming (USD)	424.98 (501.21)	434.52 (471.14)	9.54 (64.79)	3.49 (61.23)
Wheat income from value chains (USD)	404.86 (375.55)	394.78 (321.52)	-10.08 (61.32)	-36.55 (67.59)
Income from Cattle Products	114.14 (238.33)	436.23 (950.36)	322.09*** (111.41)	256.38** (107.52)
Use MAAR services (prop.)	0.49 (0.50)	0.61 (0.49)	0.12** (0.05)	0.13*** (0.04)
Public Extension drought early warning (0-3)	0.18 (0.69)	0.55 (1.14)	0.37*** (0.1)	0.31*** (0.08)
Control variables	-	-	no	yes

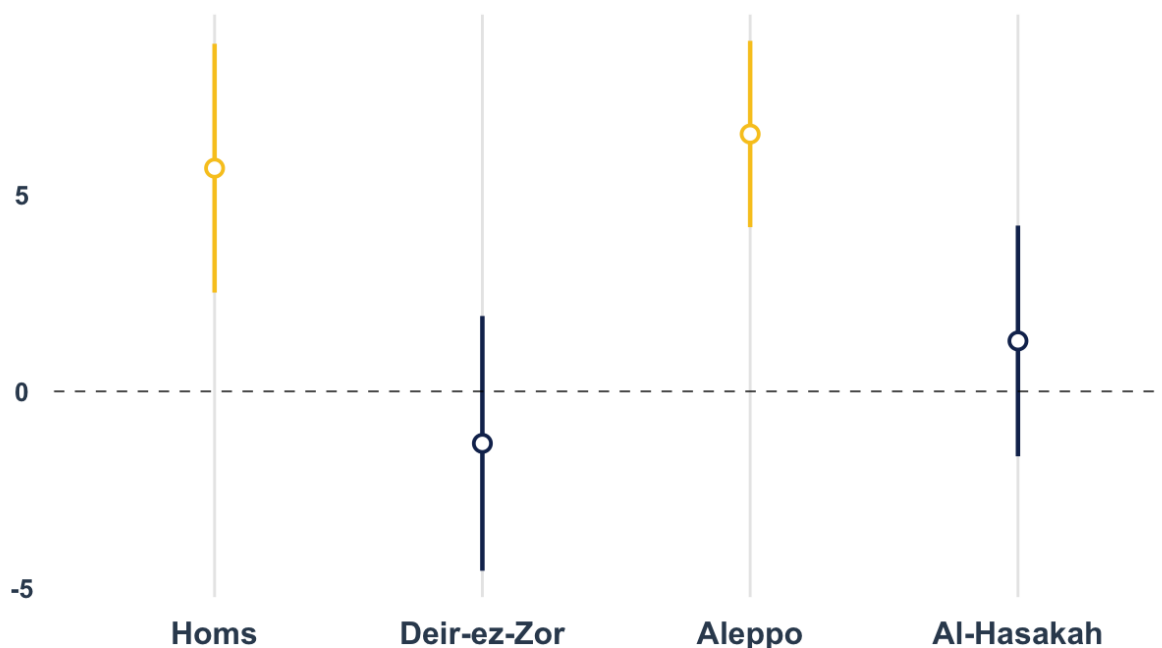
Notes. Subset of female-headed households. Control variables include the Governorate level, household and household head characteristics, the experience of exogenous shocks, agricultural key figures and if the households received any assistance from other organisations than FAO. Standard deviations and errors in parenthesis. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$. Outcome for Public Extension drought early warning expressed by an indicator from 0 (never used) to 3 (always used). Matching method: "optimal full matching".

Second, we do not find a significant programme impact on income generated from crop farming or income from engaging in value chain activities. However, **income generated from cattle products increased notably by 256 USD ($p < 0.05$) compared to female-headed households in the control group**. Female direct beneficiaries earned on average 436 USD from cattle products in the last season, which is a significant fourfold increase. **Moreover, the programme increased the access for female-headed households in the use of MAAR extension services and drought early warning systems for female-headed beneficiaries. We observe a notable increase by 21% and 56%, respectively ($p < 0.01$).**

In the next part, we break down the direct treatment impacts on relevant outcomes by governorate. Since only 6% and 7% of the direct beneficiary households are located in As-Sweida

and Daraa, respectively, we are not able to include observations from these governorates in this analysis because of a lack of statistical power.

Figure 16. Largest improvement of FCS in Aleppo and Homs



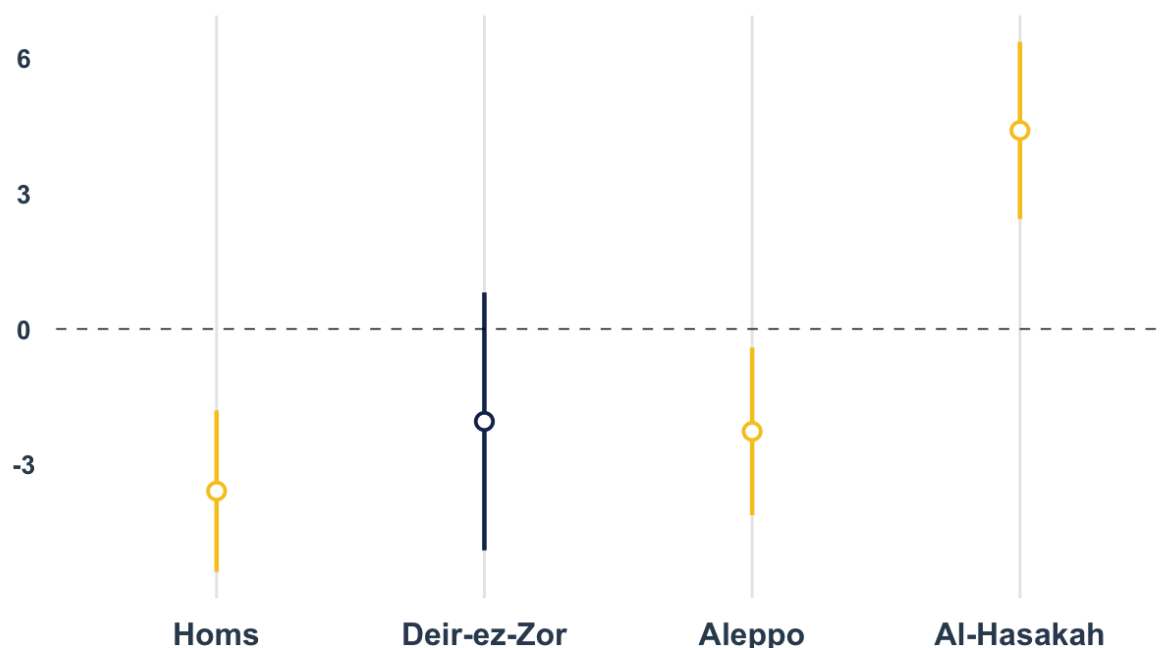
Notes. Average treatment effects with 90%-Confidence intervals (CI). The dots indicate the average treatment effects, the lines display the CIs. If the CI does not cross the line at zero, we can attribute an effect to be significant at the 10% level. Matching method: "optimal full matching". Control variables include the Governorate level, household and household head characteristics, the experience of exogenous shocks, agricultural key figures and if the households received any assistance from other organisations than FAO.

Figure 16 shows the programme impact on FCS by governorate. We find a strong positive impact on FCS of 6.6 points in Aleppo and in Homs with 5.7 points. However, we find no significant impact in Al-Hasakah and Deir-ez-Zor. This implies that the overall effect of the programme on food security is mainly driven by positive changes in Aleppo and Homs.

Figure 17 displays the programme impact on reduced coping strategy index by governorate. Here, we observe that the **largest programme impacts are in Aleppo and Homs with a decrease of 2.3 and 3.6 points**, respectively. We do not, however, find any significant programme impact in Deir-ez-Zor. In Al-Hasakah, we find that direct beneficiary households rely significantly more on the use of coping strategies compared to control households. Taking into account the general time trend from Figure 4, the use of coping strategies increased substantially for the control households in Al-Hasakah, while it remained relatively stable for the beneficiaries. Therefore,

this negative result can be attributed to the substantial baseline differences in the control group. Similarly to the results on FCS, we find a strong heterogeneous impact when it comes to the location of small farmers, where households in Aleppo and Homs exhibit strong improvements and benefits from the programme.

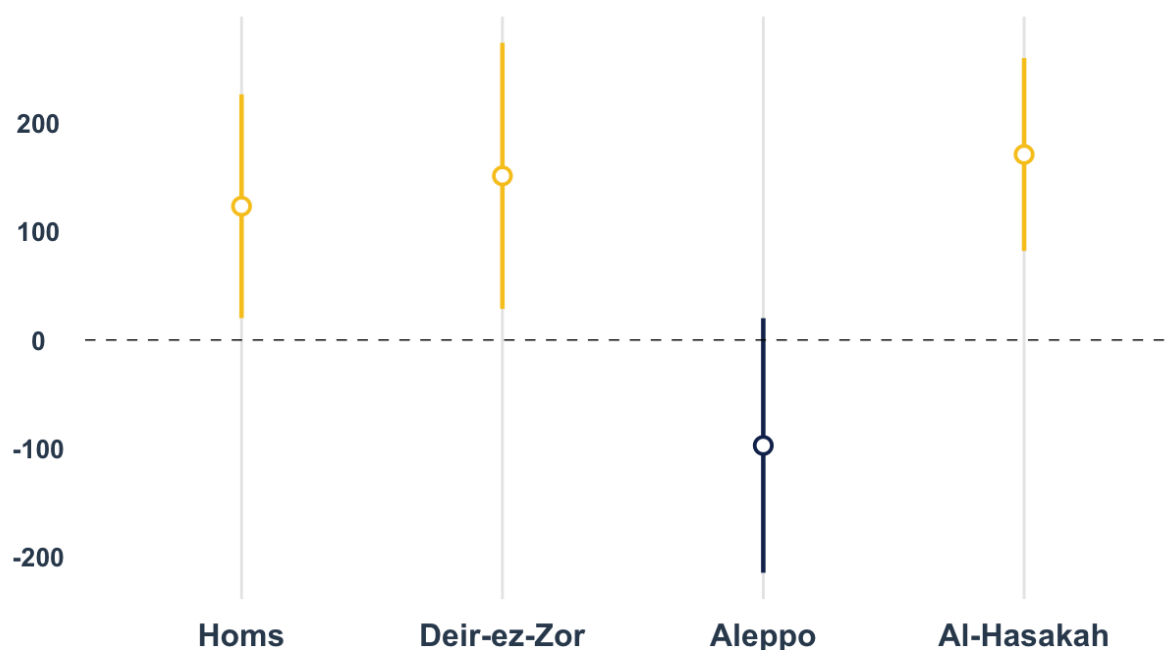
Figure 17. Reduced application of coping strategies in Aleppo and Homs



Notes. Average treatment effects with 90%-Confidence intervals (CI). The dots indicate the average treatment effects, the lines display the CIs. If the CI does not cross the line at zero, we can attribute an effect to be significant at the 10% level. Matching method: "optimal full matching". Control variables include the Governorate level, household and household head characteristics, the experience of exogenous shocks, agricultural key figures and if the households received any assistance from other organisations than FAO.

Figure 18 shows the programme impact on overall household income for each governorate. Households in **Al-Hasakah, Deir-ez-Zor and Homs increased their yearly income by approximately 123-171 USD on average** through FAO's programme. However, there is no significant effect on overall income for beneficiaries in Aleppo.

Figure 18. Positive programme impacts on yearly household income in Al-Hasakah, Deir-ez-Zor and Homs



Notes. Average treatment effects with 90%-Confidence intervals (CI). The dots indicate the average treatment effects, the lines display the CIs. If the CI does not cross the line at zero, we can attribute an effect to be significant at the 10% level. Matching method: "optimal full matching". Control variables include the Governorate level, household and household head characteristics, the experience of exogenous shocks, agricultural key figures and if the households received any assistance from other organisations than FAO.

Table 13 displays the results from the panel analysis, which we use as a robustness check. For this analysis, we select the most relevant outcomes and only show results that have sufficient statistical power. **We find significant programme impacts on food security indicators measured by FCS by 6.7 points ($p < 0.01$).** This effect is remarkably larger than just using the matching approach in the midline analysis. On the contrary, we find a small decrease in the rCSI but this effect is not statistically significant. Total **household income increased by 122 USD** on average due to FAO's programme ($p < 0.1$), but we find no significant impacts on income generated from crop farming. The overall effect is driven by the increase in income generated from livestock keeping and sales, which is **147 USD on average ($p < 0.1$)**. These income effects are larger than those estimated from the main analysis. Similarly, to the main findings, we observe a significant programme impact on the use of MAAR extension services. All in all, the findings from panel analysis are largely similar in magnitude and significance to our main results.

Table 13. Panel analysis: Direct programme impact on selected outcomes

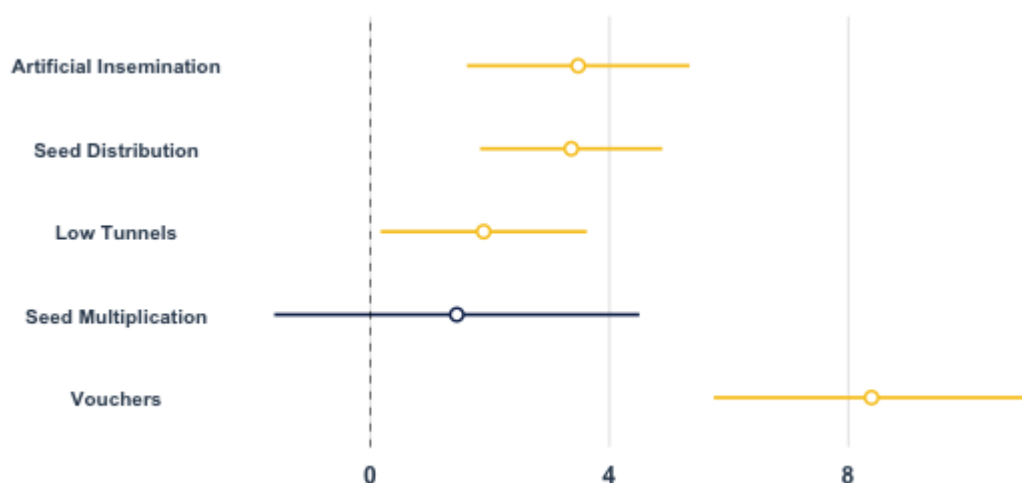
	Baseline		Midline		Impact
	Control	Beneficiary	Control	Beneficiary	
FCS	62.54 (18.12)	60.05 (15.31)	56.47 (19.54)	60.69 (15.37)	6.70*** (2.25)
rCSI	16.45 (11.22)	18.43 (10.73)	18.15 (13.19)	18.17 (13.31)	-1.96 (1.60)
Total income (USD)	427.71 (295.07)	393.28 (255.48)	745.60 (584.45)	833.64 (649.40)	122.48* (64.10)
Income from Crop Farming (USD)	296.05 (269.59)	262.84 (272.46)	567.78 (585.20)	570.97 (510.94)	36.40 (64.56)
Income from Herding (USD)	277.40 (243.10)	203.94 (184.62)	471.28 (382.42)	544.43 (494.14)	146.61* (80.84)
Use MAAR services (prop.)	0.76 (0.43)	0.81 (0.40)	0.70 (0.46)	0.88 (0.32)	0.13** (0.05)

Notes: Standard deviations and errors in parenthesis. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$. Matching method: one-to-one nearest neighbour-matching without replacement.

5.2 Intervention-specific impact analysis

In this section, we present the intervention-specific programme impacts on food security outcomes, income and livestock production. We only display programme components where we theorise to find a direct impact on the selected outcomes. Since this subgroup analysis has a smaller sample size, we only display outcomes for which we can analyse with sufficient power as not all households cultivate wheat or produce cattle products, for example.

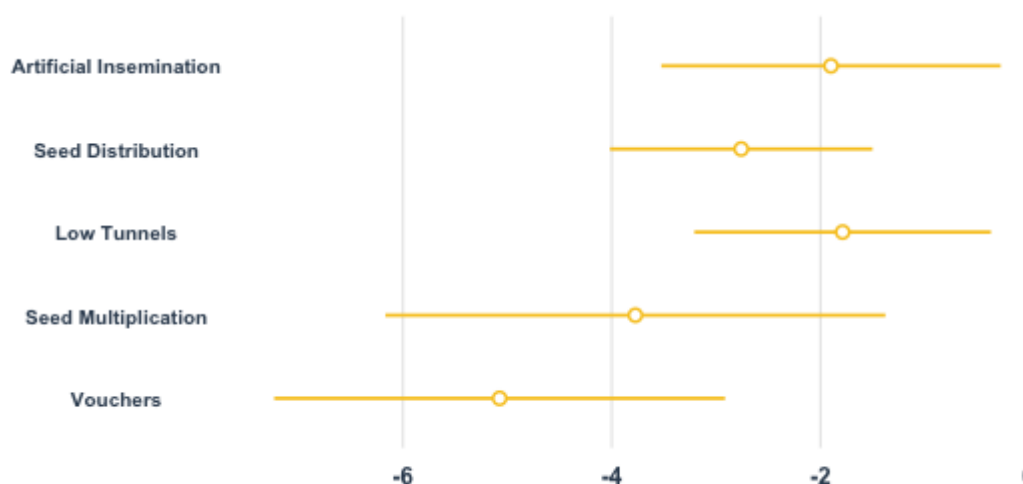
Figure 19. Large impacts of vouchers on the Food Consumption Score (FCS)



Notes. Average treatment effects with 90%-Confidence intervals (CI). The dots indicate the average treatment effects, the lines display the CIs. If the CI does not cross the line at zero, we can attribute an effect to be significant at the 10% level. Matching method: one-to-one nearest neighbour-matching without replacement. Control variables include the Governorate level, household and household head characteristics, the experience of exogenous shocks, agricultural key figures and if the households received any assistance from other organisations than FAO.

Figure 19 shows intervention-specific impacts on FCS. **Vouchers yield the highest programme impact on the FCS with 8.4 points.** Therefore, a large part of the overall intervention impact on FCS is attributed to vouchers. Artificial insemination, seed distribution and low seed tunnels increased the FCS for beneficiary households by 1.9-3.5 points on average. Seed multiplication did not lead to significant increases in FCS at midline.

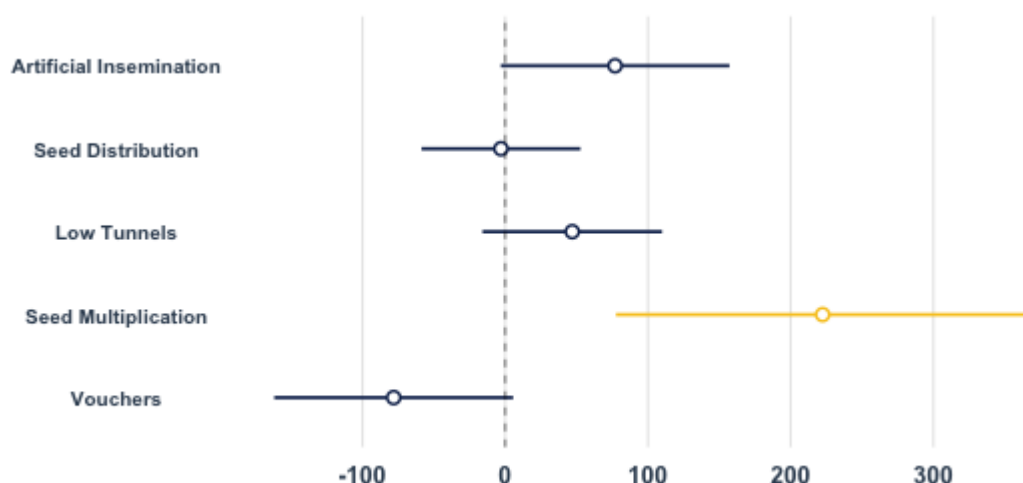
Figure 20. Large impacts of vouchers on the Reduced Coping Strategy Index (rCSI)



Notes. Average treatment effects with 90%-Confidence intervals (CI). The dots indicate the average treatment effects, the lines display the CIs. If the CI does not cross the line at zero, we can attribute an effect to be significant at the 10% level. Matching method: one-to-one nearest neighbour-matching without replacement. Control variables include the Governorate level, household and household head characteristics, the experience of exogenous shocks, agricultural key figures and if the households received any assistance from other organisations than FAO.

Figure 20 displays the programme-specific effects on rCSI. Artificial insemination, seed distribution, low tunnels and seed multiplication lead to improvements in rCSI decreasing the scale by 1.8-3.8 points. Again, the **largest effect is observable for vouchers decreasing the rCSI by 5.1 points on average.**

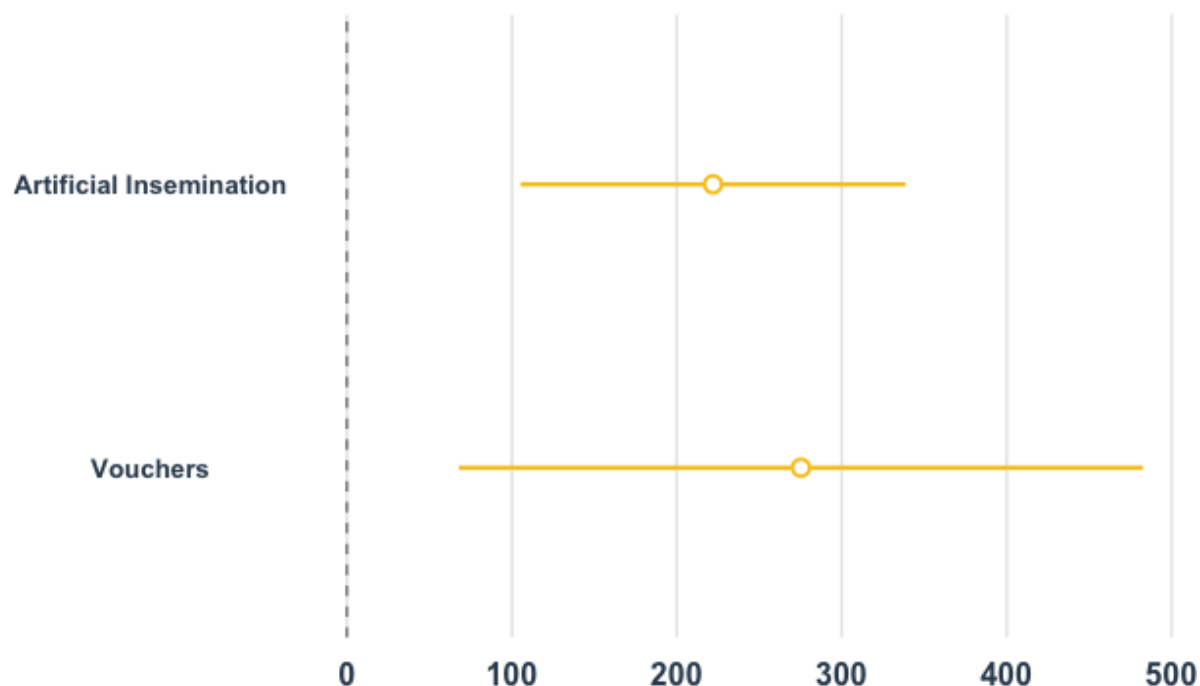
Figure 21. Seed multiplication increases total income by more than 200 USD



Notes. Average treatment effects with 90%-Confidence intervals (CI). The dots indicate the average treatment effects, the lines display the CIs. If the CI does not cross the line at zero, we can attribute an effect to be significant at the 10% level. Matching method: one-to-one nearest neighbour-matching without replacement. Control variables include the Governorate level, household and household head characteristics, the experience of exogenous shocks, agricultural key figures and if the households received any assistance from other organisations than FAO.

Figure 21 shows the intervention-specific impacts on total household income in USD. **None of the intervention arms could significantly raise household income.** These non-findings are probably partially explained by a lack of statistical power. We observe tendencies of a positive programme impact from artificial insemination and low tunnels. These non-findings are probably explained by a trade-off between intervention impacts.

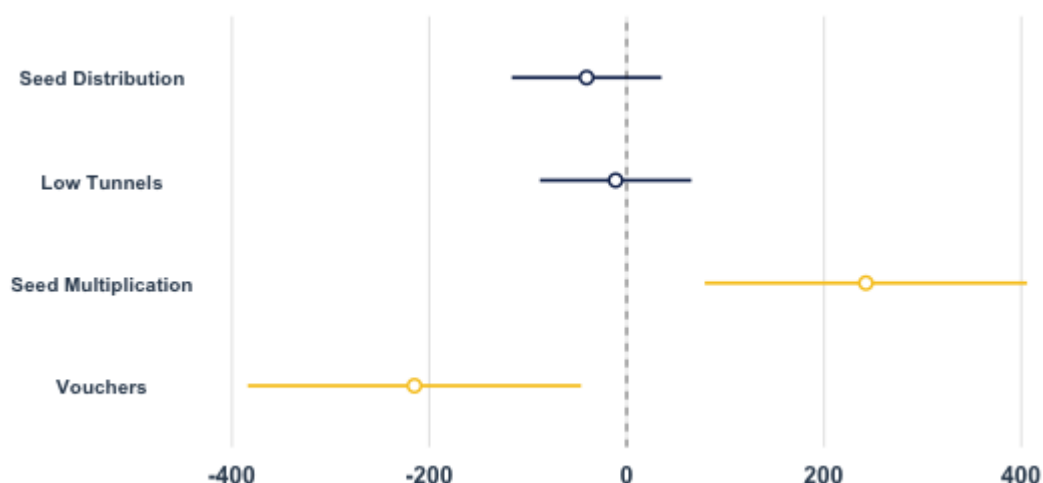
Figure 22. Artificial insemination and vouchers increased income generated from cattle products (in USD)



Notes. Average treatment effects with 90%-Confidence intervals (CI). The dots indicate the average treatment effects, the lines display the CIs. If the CI does not cross the line at zero, we can attribute an effect to be significant at the 10% level. Matching method: one-to-one nearest neighbour-matching without replacement. Control variables include the Governorate level, household and household head characteristics, the experience of exogenous shocks, agricultural key figures and if the households received any assistance from other organisations than FAO.

Figure 22 emphasises that the **artificial insemination campaign and receiving vouchers increase household income from cattle products of about 222 USD and 275 USD, respectively.**

Figure 23. Seed multiplication increased income from crop farming (in USD)

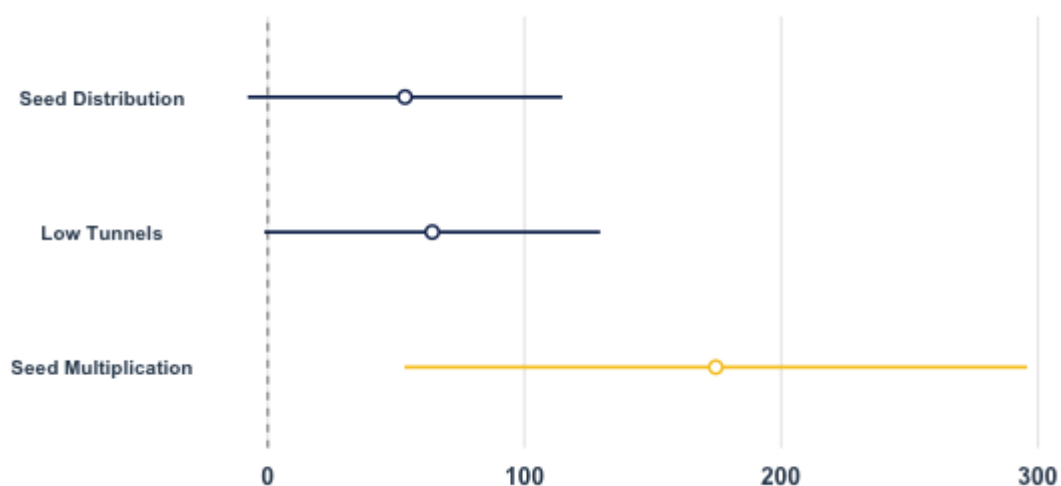


Notes. Average treatment effects with 90%-Confidence intervals (CI). The dots indicate the average treatment effects, the lines display the CIs. If the CI does not cross the line at zero, we can attribute an effect to be significant at the 10% level. Matching method: one-to-one nearest neighbour-matching without replacement. Control variables include the Governorate level, household and household head characteristics, the experience of exogenous shocks, agricultural key figures and if the households received any assistance from other organisations than FAO.

Figure 23 emphasises that **seed distribution and low tunnels do not show a significant impact on income generated from crop farming, while seed multiplication increased income from crop farming by nearly 250 USD**. Interestingly, vouchers show a significantly negative impact on income from crop farming by 215 USD. Combined with the increased income from cattle products (Figure 22), these findings stress that voucher receivers shift in their occupation from crop farming to cattle farming. This development is possibly explained by the severe droughts that affected crop production substantially³ and by the scope of the voucher campaign.

³ FAO. 2021. Special report: 2021 FAO Crop and Food Supply Assessment Mission to the Syrian Arab Republic – December 2021. Rome. <https://doi.org/10.4060/cb8039en>

Figure 24. Seed multiplication increased income from wheat value chains (in USD)



Notes. Average treatment effects with 90%-Confidence intervals (CI). The dots indicate the average treatment effects, the lines display the CIs. If the CI does not cross the line at zero, we can attribute an effect to be significant at the 10% level. Matching method: one-to-one nearest neighbour-matching without replacement. Control variables include the Governorate level, household and household head characteristics, the experience of exogenous shocks, agricultural key figures and if the households received any assistance from other organisations than FAO.

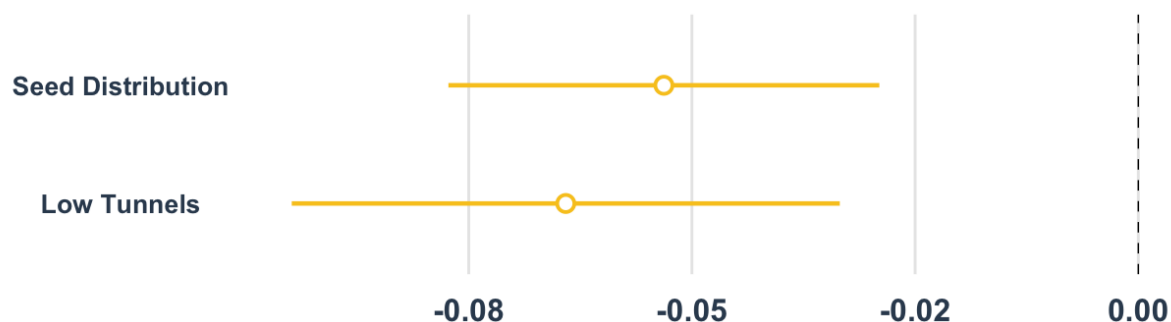
Figure 24 displays the impacts on income from wheat value chains from interventions related to crop farming. Since seed multiplication directly targets crop farming, **seed multiplication increased income from wheat value chains by 175 USD. There is no statistically significant impact of seed distributions and low tunnels on income from wheat value chains.** However, there is a tendency of a positive programme impact observable. These non-findings are mainly explained by the scope of seedling distribution and low tunnels since these intervention arms target home gardening.

Figure 25. Seed distribution and low tunnels increase the cultivation of cucurbits and other vegetables.

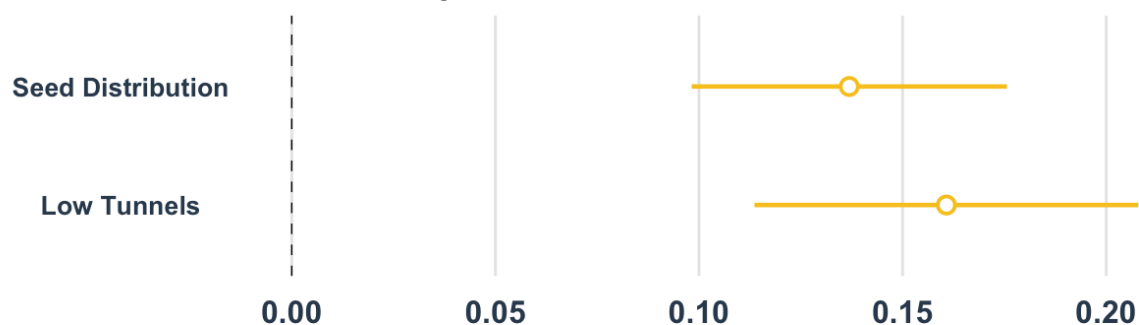
*Increase in the cultivation of **cucurbits***



*Decrease in the cultivation of **legumes***



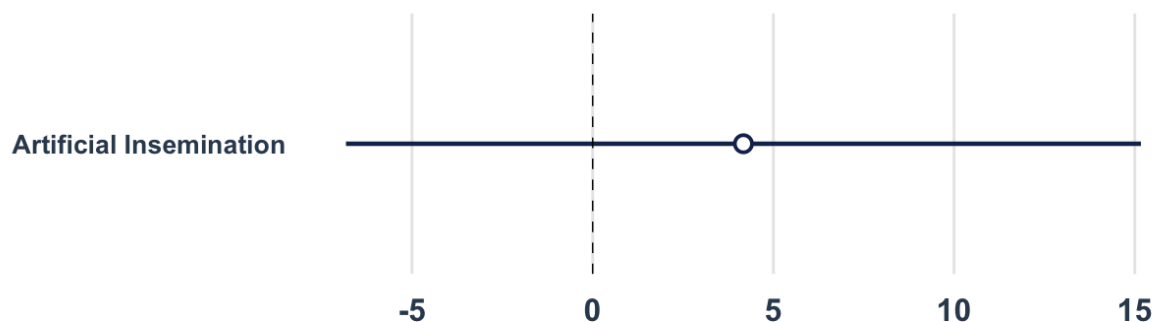
*Increase in the cultivation of **other vegetables***



Notes. Average treatment effects with 90%-Confidence intervals (CI). The dots indicate the average treatment effects, the lines display the CIs. If the CI does not cross the line at zero, we can attribute an effect to be significant at the 10% level. Matching method: one-to-one nearest neighbour-matching without replacement. Control variables include the Governorate level, household and household head characteristics, the experience of exogenous shocks, agricultural key figures and if the households received any assistance from other organisations than FAO. Vegetable grouping: **cucurbits**: cauliflower, cucumber, eggplant and zucchini; **legumes**: beans, broad beans, chickpeas, cowpeas, flat peas, green beans, lentils, medicago, peas, soybeans; **other vegetables**: Cabbage, cauliflower, chard, corchorus, fennel, lettuce, onion, peppers, potato, radish, rocca, shamra, spinach and tomato.

Figure 25 shows the impacts of seedling distribution and low tunnels on the likelihood of cultivating cucurbits, legumes and other vegetables. **The share of households cultivating cucurbits increased by 6.9% points through seed distribution and by 7.5% points through low tunnels.** On the contrary, both intervention-arms decreased the shares of households cultivating legumes by 5.3% points and 6.4% points, respectively. The two programme components increased the shares of households **growing other vegetables by 13.7% points and 16.1% points, respectively.** These numbers underline that first, the treatment effect from the overall intervention on garden crops is mainly driven by seed distribution and low tunnels and second that we confirm the households' switch from growing legumes to growing cucurbits and other vegetables.

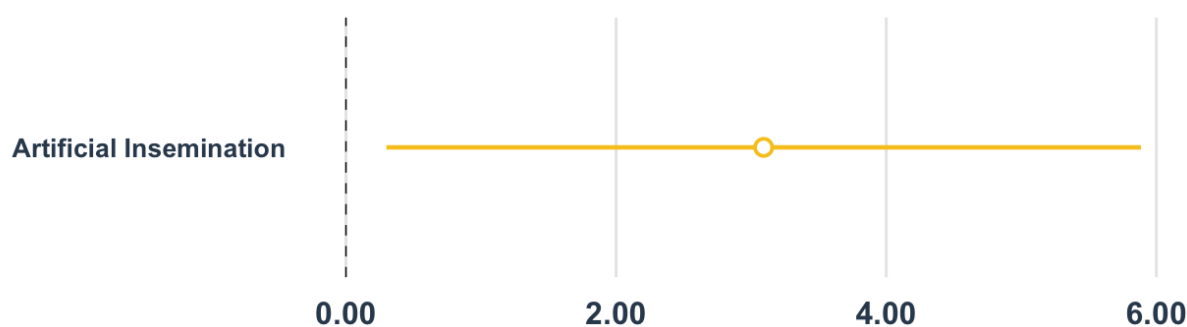
Figure 26. No significant impact of artificial insemination on cattle meat production (in kg)



Notes. Average treatment effects with 90%-Confidence intervals (CI). The dots indicate the average treatment effects, the lines display the CIs. If the CI does not cross the line at zero, we can attribute an effect to be significant at the 10% level. Matching method: one-to-one nearest neighbour-matching without replacement. Control variables include the Governorate level, household and household head characteristics, the experience of exogenous shocks, agricultural key figures and if the households received any assistance from other organisations than FAO.

Figure 26 indicates that artificial insemination does not significantly impact meat production even though income from livestock significantly increased (Figure 22). This is likely to be explained by a substitution effect: **Households who receive artificial insemination switch from meat production to milk production.**

Figure 27. Positive impact of artificial insemination on milk production (Litre/cow/day)



Notes. Average treatment effects with 90%-Confidence intervals (CI). The dots indicate the average treatment effects, the lines display the CIs. If the CI does not cross the line at zero, we can attribute an effect to be significant at the 10% level. Matching method: one-to-one nearest neighbour-matching without replacement. Control variables include the Governorate level, household and household head characteristics, the experience of exogenous shocks, agricultural key figures and if the households received any assistance from other organisations than FAO.

Figure 27 supports the results of Figure 22. **Artificial insemination increased milk production on average by 3.1 more litres of milk per day per cow.** Cows that recently gave birth produce higher amounts of milk. Therefore, this effect probably disappears on the medium run if the insemination is not repeated.

5.3 Indirect impacts of the programme

In this section, we concentrate on the programme impacts of households who live in the same targeted village of direct beneficiary households but did not receive support directly from FAO. Again, we only present outcomes we theorise to lead to an indirect effect. Furthermore, we will assess the indirect impacts of the low tunnel programme.

Table 14. Positive indirect impacts of the overall programme on food security

	Control	Indirect Beneficiary	Impact	
FCS	56.55 (19.71)	57.76 (17.86)	1.21 (1)	2.16*** (0.78)
RCSI	19.95 (12.79)	18.33 (12.08)	-1.62** (0.67)	-2.04*** (0.6)
Total income (USD)	840.59 (652.54)	753.84 (583.04)	-86.75** (34.2)	-33.15 (27.76)
Income from Crop Farming (USD)	637.90 (594.19)	580.09 (516.28)	-57.81 (38.47)	-37.08 (32.96)
Income from Herding (USD)	608.16 (477.34)	566.96 (480.95)	-41.2 (44.7)	3.63 (38.93)
Drought early warning information from fellow farmers	1.01 (1.29)	0.99 (1.25)	-0.02 (0.07)	-0.01 (0.06)
MAAR services (prop.)	0.58 (0.49)	0.56 (0.50)	-0.02 (0.03)	0.01 (0.02)
Taking risks	3.98 (2.89)	4.16 (2.65)	0.18 (0.15)	0.24* (0.14)
Postpone taking action	2.41 (2.43)	2.63 (2.41)	0.22 (0.14)	0.15 (0.12)
Willingness to share	5.97 (2.46)	6.04 (2.35)	0.07 (0.13)	0.32*** (0.12)
Control variables	-	-	no	yes

Notes. Control variables include the Governorate level, household and household head characteristics, the experience of exogenous shocks, agricultural key figures and if the households received any assistance from other organisations than FAO. Standard deviations and errors in parenthesis. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$. Matching method: "optimal full matching". Outcome for drought early warning information from fellow farmers expressed by an indicator from 0 (never used) to 3 (always used). Outcomes for taking risks, postpone taking action, willingness to share expressed by indicators from 0 (very unlikely) to 10 (very likely).

In Table 14, we show results on the indirect programme impact from all intervention together. We observe positive indirect treatment effects on food security as measured by the FCS and rCSI on fellow farmers in the same targeted villages ($p < 0.01$). We observe a negative programme impact on the indirect beneficiaries' total income through FAO's agricultural support. However, including control variables, there is no significant impact on income accessible, neither for overall income, nor for income from crop farming or herding.

Furthermore, the programme did not significantly affect the use of drought information from fellow farmers or the use of MAAR extension services of the indirect beneficiary group. Interestingly, the indirect beneficiary group is more likely to take risk compared to the control group ($p < 0.1$) and more willing to share ($p < 0.01$). This might be explained by an overall regional impact on trust and confidence, even though there was no significant impact on risk taking of the direct beneficiary group observable. There is no significant indirect programme impact on postponing taking action.

Table 15. Positive indirect impacts of low tunnels on food security

	<i>Control</i>	<i>Indirect Beneficiary</i>	<i>Impact</i>	
FCS	53.60 (18.21)	60.35 (17.68)	6.74*** (1.29)	4.01*** (1.11)
rCSI	20.98 (13.70)	18.49 (12.53)	-2.49*** (0.95)	-1.52* (0.91)
Income from Crop Farming (USD)	594.91 (610.11)	571.80 (500.86)	-23.11 (49.42)	-24.71 (41.36)
Respondents' perception of seeds access, availability, quality and costs				
Access to seeds (0-3)	2.73 (0.63)	2.63 (0.66)	-0.1* (0.06)	-0.08 (0.05)
Availability of seeds (0-3)	2.53 (0.73)	2.54 (0.71)	0.01 (0.06)	-0.01 (0.06)
Quality of seeds (0-3)	1.09 (1.21)	1.39 (1.19)	0.3*** (0.11)	0.21** (0.1)
Cost of seeds (0-3)	2.46 (0.78)	2.35 (0.77)	-0.11 (0.07)	-0.14** (0.07)
Control variables	-	-	no	yes

Notes. Control variables include the Governorate level, household and household head characteristics, the experience of exogenous shocks, agricultural key figures and if the households received any assistance from other organisations than FAO. Standard deviations and errors in parenthesis. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$. The variables for seeds are presented in a scale from 0-3, where 0 implies no access/no availability/very bad quality and extremely high costs and 3 implies perfect access, availability, quality and fair costs. Matching method: one-to-one nearest neighbour-matching without replacement.

Table 15 displays impacts of the low seed tunnel programme on indirect beneficiary households. Our results highlight that the low tunnel programme improved the indirect beneficiaries' food security. **The FCS increased by 4 points ($p < 0.01$) and the rCSI decreased by 1.5 points ($p < 0.1$) on the village level.** Again, we do not observe an indirect treatment effect on overall household income. Additionally, we display the impact on the respondents' perception on seed access, availability, quality and cost on the village level. While we do not observe any significant indirect programme impact on seed access and availability, we find that indirect beneficiary households perceive the quality of available seedlings as significantly higher due to the programme ($p < 0.05$). Furthermore, the households in target villages perceive the seed costs as significantly lower due to the low tunnel campaign ($p < 0.05$). These results highlight that also households that do not directly receive low seed tunnels benefit from the programme through overall regional development.

Table 16. Seed multiplication increased wheat income for indirect beneficiaries

	Control	Indirect Beneficiary	Impact	
FCS	56.16 (20.63)	54.95 (19.88)	-1.2 (2.08)	-0.47 (1.87)
rCSI	20.14 (13.89)	17.27 (9.46)	-2.87** (1.23)	-2.97*** (1.13)
Income from Crop Farming (USD)	639.79 (609.85)	718.30 (533.78)	78.51 (70.62)	104.17 (64.73)
Wheat income (USD)	436.52 (377.88)	539.02 (426.35)	102.5 (66.63)	155.37*** (51.38)
Crop yield (t/ha)				
Wheat (irrigated)	2.89 (0.72)	2.66 (0.84)	-0.23* (0.13)	-0.21 (0.13)
Wheat (Rainfed)	1.32 (0.33)	1.39 (0.29)	0.07 (0.09)	0.03 (0.11)
Barley	1.21 (0.71)	1.90 (0.44)	0.69*** (0.25)	0.47 (0.28)
Control variables	-	-	no	yes

Notes. Control variables include the Governorate level, household and household head characteristics, the experience of exogenous shocks, key agricultural assets and if the households received any assistance from other organisations than FAO. Standard deviations and errors in parenthesis. Matching method: one-to-one nearest neighbour-matching without replacement.

Table 16 displays the indirect treatment impacts of seed multiplication. **We find a decrease of nearly 3 points on the rCSI for indirect beneficiaries of seed multiplication ($p < 0.01$),** while there is no significant impact on FCS. We do not observe any significant indirect programme effect on overall income from crop farming, however, **income from wheat value chains increased for indirect beneficiaries by 155 USD on average through FAO's programme ($p < 0.01$).** Conversely, we do not observe any significant programme impacts on crop yield. We find a positive tendency for barley yield. For irrigated wheat, the tendency is even negative. This implies that improved wheat quality might have driven the increased wheat income so that prices increased.

Table 17. More income from wheat value chains through irrigation

	Control	Indirect Beneficiary	Impact	
FCS	70.22 (16.79)	67.90 (15.77)	-2.32 (1.6)	-1.91 (1.47)
rCSI	12.61 (9.35)	11.12 (8.05)	-1.49* (0.88)	-2.11*** (0.79)
Income from Crop Farming (USD)	748.72 (560.36)	735.71 (514.50)	-13.02 (64)	34.25 (57.1)
Wheat income (USD)	347.81 (221.83)	472.15 (344.96)	124.34*** (35.91)	135.59*** (37.84)
Crop yield (t/ha)				
Wheat (irrigated)	2.59 (0.77)	3.04 (0.81)	0.45*** (0.12)	0.18 (0.13)
Wheat (Rainfed)	1.41 (0.39)	1.46 (0.31)	0.04 (0.09)	-0.01 (0.08)
Barley	1.27 (0.46)	1.50 (0.38)	0.24 (0.2)	0.23 (0.16)
Water shortage in past year				
Share of respondents who faced constraints to water	0.53 (0.50)	0.45 (0.50)	-0.08* (0.05)	-0.08* (0.04)
Drought impact (1-4)	2.61 (1.14)	2.12 (1.00)	-0.48*** (0.15)	-0.65*** (0.14)
Control variables	-	-	no	yes

Notes. Control variables include the household and household head characteristics, the experience of exogenous shocks, key agricultural assets and if the households received any assistance from other organisations than FAO. Standard deviations and errors in parenthesis. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$. The variable for drought impact is presented only for households who faced drought in the past year where 1 means that the drought impact was not severe and 4 implies a very severe impact. Matching method: "optimal full matching".

Table 17 displays indirect treatment effects from the irrigation rehabilitation in Ar-Rastan. We do not find a significant treatment effect on FCS, while **households that live in villages where the irrigation was rehabilitated apply less harmful coping strategies ($p < 0.01$)**. Again, there is no significant impact on overall income from crop farming while income from wheat value chains increased by 136 USD for indirect beneficiaries of the irrigation campaign. As expected, there are no significant treatment impacts on rainfed wheat yield observable, neither there is for

barley yield. We find a positive impact on irrigated wheat yield without applying control variables, which implies that the renovated systems seem to work more efficiently than older irrigation systems. When controlling for covariates, this effect becomes insignificant. To be specific, support from other organisations absorbs the significant positive treatment effect. This implies that the impact through the irrigation campaign is not large enough to improve wheat yields significantly. The irrigation campaign protects the households from challenges concerning water access: the share of households facing constraints to water decreased by 8% points and the severity of drought impacts by nearly 20% due to the irrigation campaign.

6. Conclusion

The Smallholder Support Programme for Agricultural Transformation is a large-scale and complex agricultural programme run by FAO and funded by EU and BMZ, which has been implemented in multiple Governorates across Syria since 2019. The key objective of this programme is to contribute to the transformation of the agriculture sector in Syria by empowering vulnerable smallholder farmers and livestock keepers to become more productive and profitable - and to provide support to increase risk-awareness and access to information. The programme delivers more than ten different types of agricultural interventions, which include artificial insemination, silage distribution, seedling and low tunnel distribution, seed multiplication, provision of vouchers, the setup of irrigation systems, as well as multiple training and capacity building activities.

In this study, we conducted a rigorous midline impact evaluation of the programme, focusing on both the direct and indirect impacts of the programme, as well as intervention-specific impacts. The design of the study compares direct and indirect beneficiary households with control households to estimate the impact of receiving support on increasing crop and livestock production & productivity, increasing income from value chain activities, strengthening food security, reducing the use of harmful livelihood strategies, increasing access to information and positively influencing the attitudes and preferences of farmers.

At the start of the programme, Syria witnessed macroeconomic shocks which led to price inflation of agricultural inputs and essential food items and a strong depreciation of the Syrian pound against the US dollar. At the same time, a long period of drought was ending by 2020 and the outlook was positive for farmers at baseline. Two years later, we find that households are again facing severe episodes of drought and the macroeconomic situation in Syria at large continues to pose serious challenges. Our trend analysis shows that households in general are

relying more on using credit to purchase food and inputs. We also observe that household food security, while remaining at acceptable levels, has declined.

Against this backdrop, the impact analysis at midline shows that the overall programme was successful in reaching smallholder farmers and in achieving immediate impacts. Specifically, the programme strengthened the overall food security status of beneficiary households which, in the absence of the intervention, would have been clearly worse off. Beneficiary households also are relying on average on fewer harmful coping strategies to deal with food shortages. Moreover, we find that households increased their income from engaging in livestock and crop production, and we find a positive impact on wheat yields. We particularly find strong evidence of livestock support through artificial insemination on milk productivity and on increase in the sales of livestock products. Finally, our results show that the SSP programme did not just have a positive impact on direct beneficiaries, but also benefited households living in targeted villages, particularly in strengthening their food security.