Food and Agriculture Organization of the United Nations

LEARNING BRIEF

Resilient agricultural livelihoods

Palestine

Inclusive resilience-building investments for vulnerable farmers, herders and fishers in the Gaza Strip

Promoting structural transformation and resilience of the agriculture sector through sustainable energy solutions

Funded by the European Union

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Preparation of this document

This learning brief was developed at the beginning of 2023 before the escalation of hostilities in Israel and Palestine. The Food and Agriculture Organization of the United Nations (FAO) is conscious that the people and achievements showcased in this product may have suffered terrible loss and damage from the current hostilities. The complete blockade of the Gaza Strip, as of 9 October 2023, has disrupted the supply of water, food and fuel, and the lack of electricity has disrupted all economic activities, including in agriculture, fisheries, food processing and distribution, with the poultry and livestock sectors risking complete collapse.[i] The relevance of equipping farmers, herders and fishers across the Gaza Strip with solar energy systems thus appears as a critical life- and livelihood-saving approach to help them operate some of their activities under such hardship conditions.

This learning brief was developed by Liali Jaraei and Rana Hanoun, FAO Office in the West Bank and Gaza Strip, and Charlotte Masselot and Frédérique Matras, Knowledge Platform on Emergencies and Resilience (KORE) in FAO's Office of Emergencies and Resilience (OER), with inputs from Rafael De La Sota, Adham Al Khatib and Nader Abu Sada, FAO Office in the West Bank and Gaza Strip; Zsuzsanna Kacso, OER Conflict and Peace Unit; Erin O'Brien, OER Monitoring, Evaluation, Accountability and Learning Team; and Hannan Alghamdi, OER KORE. The testimonies presented in this brief were gathered by FAO's Monitoring and Evaluation assistant in the Gaza Strip. Graphic design support was provided by Anneta Bou Saleh, OER Resource Mobilization and Communication Team.

[i] World Food Programme and FAO. 2023. *Hunger Hotspots. FAO–WFP early warnings on acute food insecurity: November 2023 to April 2024 Outlook*. Rome. https://doi.org/10.4060/cc8419en

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Executive summary

The European Commission, in cooperation with the Food and Agriculture Organization of the United Nations (FAO) and the World Food Programme (WFP), launched the Global Network Against Food Crises (GNAFC) at the World Humanitarian Summit in 2016. As part of the Global Network, the European Union has been supporting FAO since 2018 through a joint FAO-European Union Partnership Programme. This programme was designed to facilitate a catalytic effect on the humanitarian–development–peace (HDP) nexus by forming strategic partnerships and conducting evidence-based, context-specific and innovative country investment interventions throughout Africa, Asia, Latin America and the Near East.

Country-level monitoring, evaluation, accountability and learning (MEAL) plans were developed to track changes in resilience and food security indicators resulting from country investments. Within this framework, country-specific learning agendas have been designed to understand the enabling and/or limiting factors behind these changes and the conditions for replication and scale up of potential solutions to food crises.

A learning brief documents how learning happened and what learning emerged from promising programme approaches promoting sustainable solutions to food crises, in order to support future programming, decision-making and resource allocation.

This learning brief documents the main lessons drawn from the West Bank and Gaza Strip country investment implemented from 2018 to 2022 by FAO and its partners. It provides an overview of the role of solar energy solutions in promoting structural transformations in the agriculture sector. This learning brief showcases key learning on the programmatic approach supporting the adoption and expansion of solar energy solutions to enhance the food security and livelihoods resilience of vulnerable farming, herding and fishing households in the Gaza Strip.

A learning agenda is an engaging tool to mobilize various experiences and knowledge, building on relevant quantitative and qualitative data, analysis and information generated throughout the programme and project cycle, to support evidence-based learning and informed conclusions and recommendations.

The collaborative and forward-looking approach of this project was achieved by bringing together a diverse range of stakeholders from the local and national levels, and actively fostering ownership from all parties. The project's approach paved the way to more sustainably tackling the energy crisis in the Gaza Strip and building a resilient and thriving agriculture sector by:

- addressing shorter- and longer-term needs and priorities across the sector; and
- combining a range of support modalities, from technical assistance for the operationalization of solar energy systems, to policy dialogue for the institutionalization of the technology.

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Context

Nearly **2 in 7 Palestinians** (**1.54 million people** or 28 percent of the population) are acutely food insecure and in need of food security and livelihoods assistance (FSIN and GNAFC, 2023)

The Gaza Strip itself accounts for **nearly 78 percent** of the total acutely food-insecure population in Palestine – representing **1.2 million people** in the Gaza Strip (WFP and FAO, 2023)

Up to 98.2 percent of surveyed households connected to the public networks in the Gaza Strip experience daily interruptions of electricity supply (FAO, 2022a)

The energy sector in Palestine is unique: it is profoundly associated with political considerations since Palestinians are highly reliant on electricity purchased from Israel, with only 9 percent of the electricity that fuels the local power plant being produced in the Gaza Strip. The deficit in power supply imposes a considerable constraint on the residents of the Gaza Strip (UNDP, 2019).

While agriculture is vital to Palestine's economy by providing its population with food, employment and dignity through productive livelihoods, **the worsening electricity deficit, combined with the devastating effects of recurrent conflict spikes and the decade-long blockade, has considerably impacted all agricultural value chains as well as household incomes and food security**. Due to the protracted crisis situation and unfavourable conditions in the Gaza Strip (such as water scarcity, limited access to land, inputs and markets), farming and fishing households are particularly vulnerable to food insecurity. Moreover, with the lack of adequate investments in livelihood protection and resilience building, vulnerable farmers and fishers in the Gaza Strip are forced to resort to negative coping strategies, which reduce their assets base and income-generating potential, and further increase their dependence on food aid and humanitarian assistance. The chronic energy crisis in the Gaza Strip affects all aspects of life and threatens the sustainability of agricultural livelihoods. Regular escalation of violence further impacts the agriculture sector with full or partial destruction of physical assets, as well as losses of crops and livestock. This is exacerbated by major disruptions in electricity and water supply by public networks affecting agricultural activities and livelihoods and leading to higher levels of food insecurity.

Consequently, interventions addressing the electricity crisis by supporting renewable energy sources, including solar energy, have become critical to protect lives, sustain livelihoods and strengthen food security and resilience.

Focus on the electricity situation in the Gaza Strip and its impact on agricultural livelihoods

For more than a decade, the Gaza Strip has suffered an acute lack of electricity, with domestic and industrial consumers surviving on a daily quota of 7 to 15 hours of power followed by hours-long outages. In 2017, the situation worsened with a reduction in electricity supply to a mere 4 hours, which severely affected the daily lives of the Gaza Strip's residents and the local economy.

Given the need for approximately 10 hours of electricity per day, farmers cannot fully operate their water pumps for irrigation and other essential farming equipment, hence can barely sustain agricultural production.

During prolonged periods of political tension and electricity outages, farmers face the choice of either substantially reducing the scale of agricultural production, changing their planting patterns to field crops of lower yield and value, or investing in costly alternative energy sources, including diesel-powered generators and water pumps, thus drastically increasing their production, post-harvest and storage costs. This situation makes it impossible for them to realize reasonable margins and compromises their market competitiveness.

Fisheries have also been affected significantly, as the lack of a stable source of electricity hampers the development of the nascent in-land aquaculture industry characterized by low labour productivity and minimal incomes. Fishing households, comprised of a poor and ageing workforce that continues to apply traditional fishing methods, thus find themselves among the most vulnerable and food-insecure in the Gaza Strip. Such disruptions to agricultural production reduce the availability of locally produced, low-cost food items and further diminish household incomes and food security levels.

About the project

From 2018 to 2022, the Food and Agriculture Organization of the United Nations (FAO) implemented a four-year project funded by the European Union titled "Inclusive resilience building investments for vulnerable farmers, herders and fishers in the Gaza Strip" within the framework of the joint FAO-European Union Global Network Against Food Crises (GNAFC) Partnership Programme. The main objective of this country investment was to contribute to sustainable improvements in food security and livelihoods resilience of farmers and fishers in the Gaza Strip affected by the protracted humanitarian crisis, with two main outcomes:

1. **Protection and improvement of agricultural incomes of vulnerable farmers and fishers, through:**
   - solar energy equipment installation for both women and men farmers to be trained on the usage and maintenance of these units;
   - solar energy equipment installation in public laboratories; and
   - provision of in-kind and technical support to fishers.

2. **Promotion of wider solar energy technology adoption within the agriculture sector, including:**
   - development of a road map to stimulate solar energy use in the long term, based on identified needs; and
   - promotion of sector-wide good practices and lessons learned to support the road map.

> Fully functioning solar energy access contributed to the diversification of livelihoods and the expansion of income-generating activities, thereby improving the capacity of households to bounce back after a shock affecting their primary source of livelihood.

The proposed interventions were designed to tap into the unrealized potential of the agriculture sector, safeguard agricultural value chains and food production, and improve household resilience capacity by promoting the use of renewable solar energy. In addition to providing direct technical assistance to the project's stakeholders, the formulation of a longer-term road map constituted a lever to bring about transformation towards sustainable energy supply and management for the agriculture sector in Palestine.

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Geographical coverage

North Gaza, Gaza, Deir Al-Balah, Khan Younis and Rafah governorates in the Gaza Strip

Beneficiaries

- **1 945 crop and livestock farming households**
- **529 fishing households**
- **8 fishing and farmers cooperatives**, including **2 women cooperatives**
- **13 groundwater extracting wells** and water irrigation ponds, indirectly benefiting **350 users' households**
- **5 public laboratories** providing agricultural value chains and food safety services for Gaza's producers and consumers

Resource partner

- European Union

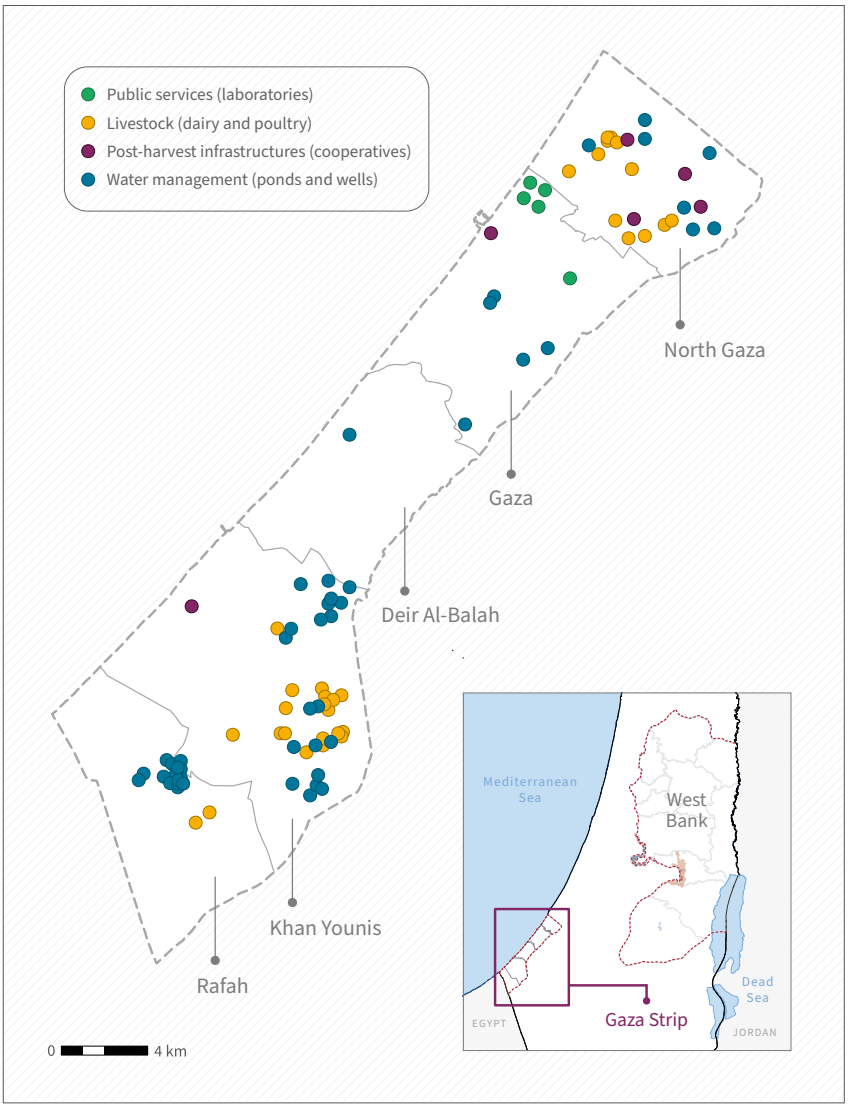
Technical and institutional partners

- Ministry of Agriculture
- Ministry of Health
- Ministry of National Economy
- Environment Quality Authority
- Renewable Energy Working Group

Type of shock/crisis

- Protracted crisis
- Chronic food insecurity
- Conflict

Figure 1. Geographical coverage of the project



Source: Map adapted from United Nations Office for the Coordination of Humanitarian Affairs. 2023. Gaza Strip access and movement | September 2023. In: *OCHA*. [Cited 29 September 2023]. https://www.ochaopt.org/content/gaza-strip-access-and-movement-september-2023

Methodological approach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The most important advantages of solar energy systems are the predictable availability and increased reliability of power supply to operate farming activities.

The project recognized the need to build agricultural livelihoods resilience by promoting the structural transformation of the agriculture sector to better withstand recurring shocks and stresses related to electricity outages, notably through more sustainable energy solutions. Its design and implementation revolved around an approach that:

- **built on lessons and experiences from previous interventions and studies** on solar energy in agriculture in the Gaza Strip's specific context, to inform the design and delivery of the project, and contribute to the refinement of the technology. For example, a study commissioned by FAO at early stages of the country investment gave an overview of the usage, challenges and opportunities of solar water pumps for irrigation in the Gaza Strip (FAO, 2018);

- **started with quick-impact interventions** able to rapidly stimulate income, employment and capture existing market opportunities, thus generating interest and engagement, while creating a long-term enabling environment for the wider adoption of sustainable solar energy solutions, by demonstrating their positive impact for producers and consumers;

- **incrementally targeted and diversified beneficiaries and business profiles,** starting with water users for crops, moving to animal production, then expanding to laboratories and food safety service providers, alongside increasing provision of equipment and support to farming, herding and fishing households. This approach ensured a sector-wide adoption of solar energy solutions, with a view to both strengthening local agriculture production and households' livelihoods, thereby fulfilling more strategic developmental orientations serving a wider catchment population with higher quality and cheaper food products and services; and

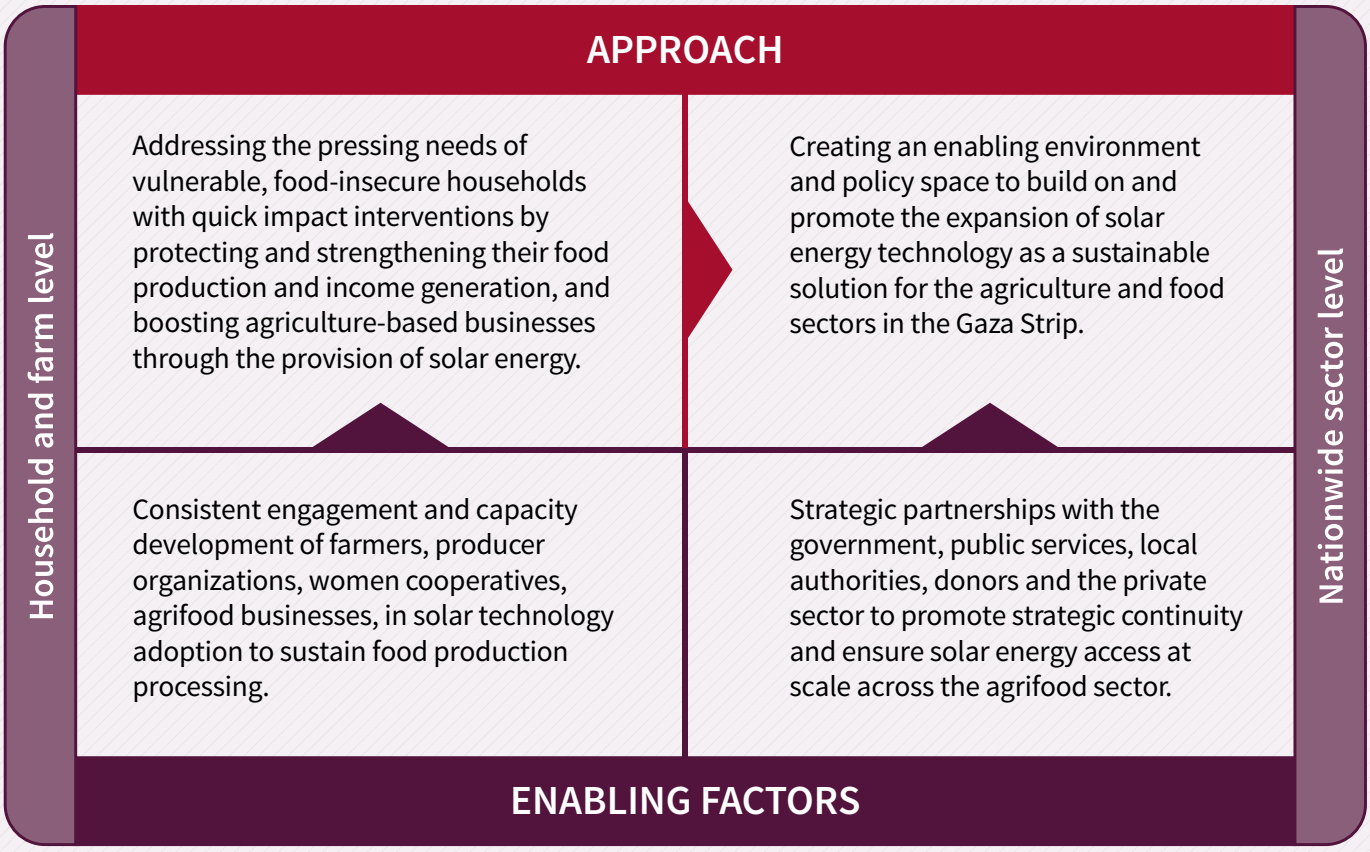
- **generated information, bridged the evidence gap and informed public policy.** A technical framework of analysis was put in place for the project to perform a sector-wide survey and produce a unique database for each value chain segment and business profile, feeding a road map and national strategy for solar electrification of the agriculture sector. Three workshops allowed to disseminate key information on the profitability and investments requirements of solar energy systems, and foster multistakeholder coordination, planning and mobilization of funds for the road map implementation.

Enhancing the electrification of the agriculture sector in the Gaza Strip: a multilevel, multigear change process

Since 2007 with the deepening of the electricity crisis in the Gaza Strip, FAO has seen an increasing potential and interest in solar energy to mitigate exposure to shocks and stresses induced by the prevailing political situation and acute power shortage. The installation and use of solar energy systems for agriculture thus constituted an innovative and sustainable solution. The implementation of the project was based on a holistic and inclusive approach, and performed activities in an integrated manner to deliver lasting changes, as shown in Figure 2.

The project conducted a socioeconomic sector survey of agricultural livelihoods in the Gaza Strip in early 2021 to gain a better understanding of the prevailing environment and assess the potential for wider adoption of solar energy technology in farming and fishing, including post-harvest, activities. More than 2 700 food producers and processors and 58 institutions participated in this survey. It provided a unique sector-wide database across all profiles and value chain segments, including data on business size, equipment and capacities, patterns of energy consumption, space availability to install solar systems, and an assessment of technical and financial feasibility, return on investment and profitability. On that basis, the project developed a longer-term road map for the solar electrification of the agriculture sector, intended to provide guidance for national and international actors to integrate solar energy in their programmes and plans and to inform the National Agriculture Sector Strategy 2017–2022. Finally, FAO and the Ministry of Agriculture established and facilitated a dialogue to promote strategic continuity and scale up of investments in solar energy.

Figure 2. Project implementation approach



Source: Authors' own elaboration.

The learning agenda within the MEAL approach

A dedicated MEAL plan was designed to create a body of evidence to systematically assess the progress and achievements toward the desired objectives and impacts, through a set of indicators and processes involving stakeholders of the intervention. This approach ensures that the information produced through project activities (e.g. the socioeconomic sector survey) and monitoring and evaluation activities (e.g. baseline and endline studies) supports adaptive management while the intervention is being implemented, and serves the generation of learning. The country investment MEAL plan was developed through a consultative process with the aim to track changes in the resilience and food security indicators during implementation and at the end of the intervention.

Complementary to the MEAL plan, a learning agenda was developed to ensure that the learning generated from this experience and gathered from MEAL processes would support the production of evidence-based knowledge and would be documented, applied in the lifetime of the project and taken up in future projects. Therefore, the country investment learning agenda was defined around three learning questions. Answers to these questions are presented later in the document.

Overview of the learning generation process

The learning generated and documented in this brief results from a collaborative process between the FAO Office in the West Bank and Gaza Strip and the Knowledge Platform on Emergencies and Resilience (KORE) and MEAL teams within the FAO Office of Emergencies and Resilience (OER). The KORE team guided and advised the learning process and had a brokering role in strengthening and documenting the linkages between the programming approach and the learning agenda implementation. The FAO team in the West Bank and Gaza Strip, especially the MEAL officers, actively engaged in KORE-guided processes of unpacking the learning questions to assess information and evidence requirements and take actions to address identified gaps, to the extent possible in the intervention's contextual challenges.

The methodology followed a mixed-method approach, combining econometric analysis of quantitative monitoring and evaluation (M&E) data and qualitative data, collected through household surveys, focus groups discussions (FGD) and key informants interviews (KII). In addition, several FGDs were carried out with beneficiaries from previous FAO interventions to gather insights on the intended/unintended, positive/negative impacts of solar energy interventions on their agricultural production. These M&E-related activities were complemented by a socioeconomic survey of agricultural livelihoods conducted by a contracted company in the Gaza Strip to inform the sector-wide needs assessment and development of a road map for solar electrification.

Beyond the production of this learning brief, the FAO Office in the West Bank and Gaza Strip and the KORE team worked closely to organize information sources and materials (including a lessons learned paper about the cumulative experience of solar energy interventions in agriculture in the Gaza Strip, and a photobook with human interest stories). Under the leadership of the MEAL team, the questionnaires for collecting data and the production of evidence were developed jointly in a collaborative effort towards the learning agenda delivery. The testimonies presented in this brief were gathered by FAO's M&E assistant in the Gaza Strip.

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Addressing the learning questions

Three learning questions were formulated for the country investment learning agenda. They aimed at exploring specific approaches undertaken by the intervention, as follows:

1. **Transformational change approach**
   How does the programme contribute to promoting structural transformation as a tool for building resilience?
2. **Humanitarian–development–peace nexus approach**
   To what extent is the programme addressing the HDP nexus in the Gaza Strip's unique context?
3. **Participatory evidence generation and learning approach**
   How does the programme promote participatory approaches, learning processes and capture evidence from M&E?

How does the programme contribute to promoting structural transformation as a tool for building resilience?

This learning question seeks to understand the extent and enabling factors of solar energy solutions adoption and integration across the agriculture sector. It also looks at the effect of solar electrification on agricultural livelihoods and resilience capacities.

According to the intervention's stakeholders, the most important advantages of solar energy systems are the predictable availability

The share of beneficiary households facing severe food insecurity decreased significantly from 11 to 2.73 percent.

and increased reliability of power supply to operate farming activities (e.g. water pumping and irrigation, food post-harvest processing, cold storage, etc.) on regular and suitable hours, the reduction in production costs, followed by reduced environmental pollution. Over the project duration, there was an increase from 18 to 103 surveyed households reporting that they use alternative energy sources to the public network, with 91 percent of the latter using a solar energy system.

Despite a general environment that does not support farmers in producing food and generating revenues (e.g. lack of essential and good quality inputs and equipment resulting from the blockade, electricity outages, low purchasing power of local consumers) evidence collected suggests that food producers who benefited the installation of a solar energy system for their agricultural activities and businesses have:

- **Improved their food security:** The share of beneficiary households with moderate and severe food insecurity reduced from 53 to 30 percent over the duration of the project, while it stagnated at 50 percent of moderately and severely food insecure households among the non-beneficiary population surveyed. The share of households with severe food insecurity also decreased more significantly for beneficiaries (from 11 to 2.73 percent) than for non-beneficiaries (from 8 to 4.47 percent). In addition, although beneficiary households still have an insufficiently diversified diet, they experience less anxiety with respect to accessing food than non-beneficiary households do.

- **Strengthened their livelihoods and income:** Crop farming households have diversified their cultivated crops (for 39 percent of them) and expanded their cultivated areas (for 32 percent), notably because of increased water availability to irrigate lands. Additionally, 91.8 percent of farmers reported lower production costs at endline. The decrease in electricity and energy bills for users of solar energy has motivated farmers to expand their production.

- **Increased their resilience:** Fully functioning solar energy access contributed to the diversification of livelihoods and the expansion of income-generating activities, thereby improving the capacity of households to bounce back after a shock affecting their primary source of livelihood. The subjective self-evaluated resilience score collected at endline shows that beneficiary households are slightly less worried about their capacity to bounce back a severe electric power cut. In fact, the Resilience Capacity Index (RCI) of beneficiary households has increased from 38.41 to 43.8 over the duration of the project.

- **Enjoyed a secured economic environment:** Farmers of crops, poultry and dairy surveyed have not only seen an immediate drop in production costs as a result of no longer having to pay for generators and fuel or reducing their electricity bills. They also felt motivated and secure enough to take on calculated economic risks, through diversifying and changing their production into higher-value crops, investing in expanding their cultivated area, or employing their families and neighbours as permanent and seasonal workers.


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Enhancing women's full participation for a stronger transformative approach

Although the participation of women was strongly encouraged, female participation was rather low due to the difficulty in overcoming sociocultural norms related to gender roles, entitlements and division of labour. A notable limitation faced by the project revolved around the nature of the intervention requiring ownership of, or control over, agricultural assets for provision of solar energy systems. In this regard, a significant number of women could not be identified and targeted as beneficiaries. This limitation sheds light on the need for resilience-building programmes to systematically incorporate participatory mechanisms to ensure interventions adopt a whole-of-society approach, especially when transformational change is at the heart of these programmes. Regardless, the experience has shown that solar energy systems have contributed to greater cohesion at household level, for example by contributing to reconcile the strategic needs of women as independent workers and entrepreneurs who make an income, while reducing burdens that allowed fulfilling domestic care work in households. Some lessons drawn from this project are that:

- **Identification, design and targeting stages are crucial steps for a fair engagement of women as participants and beneficiaries of the intervention.** Some upgrades of approaches and tools (e.g. community engagement processes, sampling methodology, assessment questions and scores, etc.) may be required to gather a comprehensive understanding of women's status and needs, distribution of labour and roles in decision-making, and to better identify eligible female-headed households – or male-headed households where women are carrying out a significant proportion of the farm work. The selection and verification process must be done by engaging a local community committee representative of the population.

- **It is essential to document and follow up on women's successful solar energy experiences.** This could be enhanced through available tools and processes (e.g. post-distribution monitoring, dedicated surveys through FGDs and KIIs) with questions to address and highlight women's experiences, needs and challenges, and to explore women empowerment and gender justice dimensions with regards to solar energy and its intended impacts on livelihoods, food security and resilience.

- **It is critical to raise awareness and advocate among local communities to enhance the role of women in the implementation of agricultural activities and decision-making.** The creation and publication of good gender-sensitive practices and success stories of solar energy would likely increase awareness and engagement among women and men.

- **Exchange visits for women farmers and cooperative members should be introduced to increase knowledge sharing and skills transfer among women.** Learning from other women's experiences would encourage more peers to engage in social and business networks, acquire new techniques, upgrade their agribusinesses, etc.

To what extent is the programme addressing the humanitarian–development–peace nexus in the Gaza Strip's unique context?

This learning question explores the ways in which the project incorporates an HDP nexus approach and intends to examine changes in reported conflict and dispute cases around water resources. It also explores what specificities to consider for this type of intervention in the Gaza Strip.

Considering the need to urgently address energy shortage-related stresses threatening the agriculture- and fishery-based livelihoods in the Gaza Strip, the project was designed to incorporate two complementary processes linking the humanitarian and development dimensions:

- undertaking interventions with quick impact for the safeguarding of agricultural livelihoods; and
- formulating an evidence-based longer-term road map for the agriculture sector, to be rolled out and monitored through follow-up phases.

> By stabilizing access to energy and enhancing access to water resources, solar energy systems contribute to greater cohesion among water suppliers and users.

Consistently with the evolution of the operating environment, this approach allowed to promote the transition from "emergency and humanitarian" type of assistance towards more "development" interventions.

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Regarding the peace dimension, a module on conflict was included in regular M&E activities. This module sought to understand the population's exposure to and perceptions of conflict and violence, the drivers of and attitudes towards disputes. This module was intended to inform conflict-sensitive approaches throughout implementation; however, its utilization faced some restrictions from the de facto authorities. Consequently, the module did not offer sufficient information for conflict-sensitive programming and did not allow tracking the impact of the project in terms of conflict sensitivity and peace responsiveness. Nevertheless, useful information was gathered:

- Land appears to be the primary source of disputes expressed by nearly 40 percent of the surveyed households. It is worth mentioning that the high population density and the consequently limited land resources available in the Gaza Strip might have led to the eruption of disputes. A smaller share of respondents attributes the dispute to livestock (almost 17 percent) and water (10 percent).

- More than 90 percent of surveyed households did not wish to answer questions related to their witnessing or experiencing disputes or incidents. Among those willing to respond to the question, 86 percent indicated that such tensions occurred between people within their community, however they would not specify the motives of such dispute.

- When asked about their perceptions of how the quality of their living conditions would evolve in the coming year, 52 percent of all respondents at baseline predicted worsening living conditions (with a higher share of pessimistic view for female-headed households), which dropped to 36 percent at endline. In parallel, the share of respondents foreseeing future improvements in their living conditions rose from 22 to almost 33 percent.

Because the conflict module is a standard tool, thus not designed to establish direct linkages with the use of solar energy, it did not allow to ascertain if and to what extent solar energy contributed to the decrease in disputes around natural resources such as water and land. It is hence difficult to show any causality or prove attribution of the project on the implementation areas' conflict dynamics. Nevertheless, when exploring community dynamics and solar energy use and benefits at the endline study, FAO was able to confirm a number of positive impacts, among which:

- Fishermen–traders and farmer–cooperatives relationship improved as solar energy enabled better storage conditions, the preservation of produce quality and lower prices.
- Laboratories–farmers–traders relationship and trust improved, as solar energy allowed laboratory staff to expedite more reliable analyses in a shorter period of time.
- Well owners–farmers relationship improved, with solar energy ensuring water availability on a more regular basis, at a more stable and reasonable price.
- Vertical and horizontal social cohesion was also improved in different communities, as solar energy contributed to provide efficient meeting spaces for cooperative members to meet and discuss community issues with community leaders.
- Improved working conditions were also reported, with more adapted working hours allowing space for breaks and bonding.
- More projects were initiated at community level, contributing to a stronger social capital creation among community members.
- Cooperatives have become the centre of community engagement and social events (such as workshops and seminars) thanks to available electricity.

The experience has shown that by stabilizing access to energy, solar energy systems contribute to greater social cohesion and peaceful coexistence among various segments of the agriculture and food value chains and in communities.


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Improving water management and reducing risks and vulnerability drivers by overcoming power shortages

Solar energy systems have been provided for 13 agricultural groundwater wells under this project. It enabled owners to have a stable access to energy and operate the water pump daily independently from the public electricity service schedules or outages, or from supplementary fuel generators, with the following impacts:

- a reduction of pumped water costs by 30 to 40 percent;
- the stabilization of water provision, both in the number of operating hours and quantity of water supply; and
- more flexibility and suitability of operating times, which encouraged more farmers to subscribe to the services of the targeted wells.

FAO observed an increasing return per drop of water and a significant reduction of the pressure on water resources. As reported during FGDs, the project has contributed to improve relationships between groundwater well owners and farmers benefiting from the well, and among farmers themselves. This is likely due to the fact that the solar energy system ensures more regular water availability and enhances access to water resources, and at a more affordable price as part of a legally binding commitment for well owners to maintain their solar energy system and regulate the price of water. This allows:

- farmers to cover the cost of water and save money to re-direct towards agricultural production and food security of their families;
- well owners to recover the cost of the system's installation within one to two month's time and maintain it overtime; and
- a stable economic environment for all, that contributes to reduce an important conflict driver in relation to water access.

Solar energy itself does not allow to plan and expand on access to water resources, and competition over such a scarce resource is a reality and a risk driver in the long term. However, by contributing to providing a stable and more equitable access to energy and water, the project has contributed, correlatively, to reducing the likelihood of conflict.


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How does the programme promote learning processes, participatory approaches and capture evidence from M&E?

This learning question focuses on the importance and potential effects of participatory learning processes relying on M&E-generated information, including beneficiary feedback, to help identify and integrate good practices, lessons learned and success stories for more effective and impactful programming.

The following processes were integrated to the intervention's methodological approach and undoubtedly contributed to the positive findings exposed in the answers to the previous learning questions:

- A thorough **lessons-learning exercise** from previous solar energy interventions for agricultural use was undertaken. It provided useful orientations to improve project management, MEAL, as well as technical designs, technologies and functionalities to enhance the efficiency of the solar energy systems. A desk review of FAO's and other international agencies' projects formed the basis to identify good practices, gaps, challenges and lessons learned. A dedicated task force was established to hold recurrent discussions at different stages of the project cycle, supplemented by consultations with senior management at FAO Office in the West Bank and Gaza Strip. The main findings from that exercise were documented in a Lessons learned paper (FAO, 2022b).

- **Beneficiary feedback mechanisms and verification visits** were crucial to support the adoption of solar energy technology. The latter were conducted at design stage to ensure it was tailored to each targeted profile's priorities and needs, then regularly during the intervention for adjustments to the model to enhance suitability and function.

- The conduct of the **sector-wide survey**, the first of its kind in the Gaza Strip, brought unique intel on the characteristics and energy requirements of every player in the agriculture sector, contributing to more adequately serve each of these livelihoods profiles during the project, and to better dimension and target future investments' requirements.

- **Rapid assessments and systematic monitoring** of solar energy systems across multiple projects allowed to compare efficiency of systems installed. It showed that the new system under this country investment provided 25 percent extra operation hours.

- The provision of **training sessions** offered great potential to sensitize farmers about the short- to longer-term economic benefits of maintaining the solar energy units for their agricultural production and prevent negative coping strategies. Training sessions also constituted a well-tested handover of the system with beneficiaries to install and maintain the devices and technology.


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Accountability to affected people

FAO is accountable to the women, men, boys and girls whose lives and livelihoods it aims to improve. Accountability to affected people (AAP) is "an active commitment to use power responsibly by taking account of, giving account to, and being held to account by the people humanitarian organizations seek to assist" (IASC, 2023). By being more accountable to affected people and increasing their participation and feedback in programme identification, design, delivery and learning, FAO can better meet its commitments.

AAP is essential to achieve programmes of higher quality, with more significant and sustainable impact. Throughout the implementation of the country investment in the Gaza Strip, accountability was maintained through several processes, including:

- ensuring compliance with the relevant standard operating procedures on transparent and fair beneficiary selection engaging local communities in the identification and targeting process;
- ensuring timely and appropriate information sharing about the project with participating communities, thus allowing them to shape their recovery and development trajectories; and
- ensuring timely and appropriate utilization of available communication channels to receive grievances and complaints and provide adequate follow-up.

Feedback was consistently sought through post-distribution monitoring surveys and verification visits to gather perceptions of the project's stakeholders on the appropriateness of the intervention and engagement mechanisms.

Effective and inclusive communication mechanisms proved crucial for such project incorporating innovations, new techniques and skills, to have a joint understanding of needs and challenges and to define/refine intended changes, agree on ways to deliver them and track them through M&E activities.

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Results and impacts

The main results and effects of the project to highlight include:

- The project was successful in improving access to electricity and compensating for the electricity shortage for vulnerable farmers in the Gaza Strip through the provision of solar energy equipment.
- The most important advantage of having a solar energy system is the predictable availability of power supply. The most significant changes in economic activity reported by project participants are the improvement in productivity, lower production costs and improved output quality.
- As indicated in the project's endline report, since the installation of the solar energy unit, male- and female-headed households experienced, respectively, a 64.42 and 75 percent productivity increase, 50 and 25 percent improved quality of economic activity, and a drop of around 53 and 50 percent of production costs. In addition, 25 percent of female-headed households diversified their crop production.
- The intervention contributed to supporting the use of fully-operating agricultural equipment and expanding the set of income-generating activities available to households, therefore improving their capacity to bounce back after a shock affecting their main source of livelihood.

> FAO's focus on solar energy access effectively contributed to preserving and diversifying agricultural livelihoods, while strengthening the potential of the agriculture sector and food value chains and reducing dependence on unsustainable energy sources.

- Households using solar energy systems appeared more likely to diversify market channels to sell their products (e.g. covering other areas, doing home delivery, etc.), perhaps because they are generally more inclined to innovation and change or have a more consistent production flow and marketing outputs. They also appeared to sell their productive assets less frequently than households not using solar energy.

- As stated in the country's investment impact evaluation (GNAFC, 2023), beneficiary households experienced an improvement in resilience capacity and food security, with sensible increases in the resilience capacity index from 33 to 42; in the food consumption score from 53 to 57; and a rise in food expenditure from USD 27 to 34 per capita.

- At baseline stage, 52 percent of all respondents predicted worsening living conditions, with a higher share of pessimistic view for female-headed households. This figure dropped to 36 percent at endline. Similarly, the share of respondents foreseeing future improvements in their living conditions rose from 22 percent at baseline to almost 33 percent at the end of the project.

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Testimonies and stakeholders' feedback

The most important advantages of solar energy systems are the predictable availability and increased reliability of power supply to operate farming activities including water pumping and irrigation.


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> *For almost ten years, we suffered from electricity outages in the Gaza Strip, but then FAO built solar energy systems for us, and that allowed us to increase our production by 50 to 60 percent.*

Safwat Abd Al Azeez
Vegetable farmer, Rafah

Improved working conditions were reported and cooperatives have become the centre of social gatherings thanks to available electricity.


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> *The women who work with us sometimes come in the middle of the night. At that time, the power is usually off, and during the day we used to get only six hours of power. With solar energy, the women's lives have become a lot easier and production has doubled.*

Ibtisam Salem
Cooperative Society for Saving and Lending, North Gaza

Sustainability

Institutional sustainability

At national level, the country investment has equipped the Ministry of Agriculture with the sector-wide analysis and the road map for solar electrification of the agriculture sector, two important elements which will inform the national strategy and future investments for highly needed solar electrification. Farmers and fishers in the Gaza Strip require support from the Ministry of Agriculture, whose endorsement of these documents is thus key to guide future sustainable sector-wide solar electrification efforts by all active actors in the Gaza Strip.

Economic sustainability

Creating linkages with local authorities (for example through water price regulation for groundwater wells and pond owners) has enhanced sustainability by supporting beneficiaries of solar energy systems, who may find themselves under stress at certain times, to maintain their assets and avoid compromising their adaptive capacity in the longer term.

Environmental sustainability

There is a need for a solution for the disposal of expired batteries. A project is under discussion to establish a venue for the destruction of expired batteries, however, raising awareness among solar energy beneficiaries (during field visits and training) on expired batteries is critical. There is also a need to conduct a more tailored assessment of the space required for solar energy systems installation that would avoid the misuse of agricultural land or the uprooting of trees as part of removing obstacles to install the solar system unit. Regular monitoring and assessment of the environmental impact of interventions should be incorporated as part of such project's monitoring and evaluation.

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Replicability and upscaling

The country investment built on previous FAO solar energy interventions in the Gaza Strip. Those had fostered sustainability through tailored support modalities, for example by developing co-investment schemes or business plans with farmers to ensure cost recovery and longer-terms benefits. This country investment was the first of FAO's solar energy projects to incorporate a forward-looking vision for the building of a resilient agriculture sector where solar energy constitutes a paradigm shift to mitigate impacts from shocks and adapt to stresses affecting agricultural livelihoods. The sector-wide process of transformational change will continue requiring efforts at all levels to reach sustainable impact at scale, for example:

- **At the household and farm level**, by recognizing and tackling challenges related to the purchase, installation, maintenance of the equipment itself, and accompanying solar energy users to overcome the immediate burden of a high investment cost towards a profitable economic turnout.

- **At the institutional level**, mobilizing other partners to increase support to public laboratories in the Gaza Strip, as this intervention was a demonstration for the potential of replicability to ensure consistent delivery of such vital services to the agricultural and food sectors.

- **At the donor level**, by implementing a cost-sharing modality from multiple donors to enhance and support agricultural investments and innovations at greater scale.

- **In the partnerships landscape level**, by strengthening joint programming embracing solar energy in relevant domains to ensure an adequate-to-full coverage of vulnerable households' basic needs (lighting, water, etc.), as well as their productive and income-generation needs, to support the full spectrum of their lives and livelihoods through a HDP nexus approach. Moreover, it is of crucial importance to maintain coordination as well as information and knowledge-sharing through the Renewable Energy Working Group established under the Food Security Sector, in order to reduce trial and error and promote the application of best practices by all partners.

Key learning and recommendations for programming

Projects aiming at strengthening food security and livelihoods resilience, especially in complex protracted crisis environments such as the Gaza Strip, should incorporate a dual approach. On the one hand, they require agricultural livelihoods-safeguarding interventions to address shorter-term needs and yield quick results; on the other hand, they require interventions designed to tackle long-standing structural challenges and respond to the people and agrifood system's longer-term priorities. Following that approach, FAO's focus on solar energy access effectively contributed to preserving and diversifying agricultural livelihoods, while strengthening the potential of the agriculture sector and food value chains and reducing dependence on unsustainable energy sources.

An inclusive and equitable targeting of female beneficiaries is essential to bring about actual transformation. The project overcame limitations (related to gender roles, entitlements and division of labour) preventing a wider inclusion of female food producers, by targeting women cooperatives at food processing level. It proved that structural transformation can only be fully realized through inclusive change processes addressing structural gender inequalities. Gender analysis and gender mainstreaming approaches are therefore essential, and the road map for the electrification of the agriculture sector in the Gaza Strip could build on those to integrate gender-sensitive markers adapted to women's roles throughout the food value chain to fulfil their specific needs and enhance their food security and resilience.

It is important to strengthen the conflict-sensitive programming approach in the Gaza Strip context, for the full spectrum of FAO interventions. Besides demonstrating that some disputes exist regarding land, water or livestock, assessments and studies should provide information about the causes and drivers of disputes related to these resources and orientate the design of activities to address them. Otherwise, it is difficult to understand and demonstrate any causality or attribution of the project's positive or negative impact on such dynamics in the implementation areas. A customized (i.e. tailored to each project and context) conflict assessment module within projects' baseline and endline studies can provide accurate and useful information to mainstream a conflict-sensitive programming approach, thus intentionally contributing to the mitigation of natural resource-related disputes and fostering community cohesion.

More effectively implementing the peace dimension of the HDP nexus requires stronger awareness raising and advocacy to discuss contextual dynamics more openly. Some questions may indeed be sensitive in some contexts; therefore, the participatory design of adapted conflict assessment modules can provide more accurate information on dispute drivers and community cohesion dynamics. A possibility to reduce reluctance to address sensitive questions may be to spread and paraphrase such questions in survey questionnaires to avoid direct and packed questions that could be perceived as insensitive in complex contexts such as the Gaza Strip.

The delivery of interventions incorporating technological innovation and aiming at structural transformations requires strong coordination and information mechanisms. Such mechanisms contribute to ensuring a joint and continuously refined understanding of needs, progresses and challenges against the theory of change and achievable measurements of the project. This includes the identification of aspects related to behavioural change, how to track them through monitoring and evaluation activities, and learn collectively through participatory processes. The findings and the learning generated will thus provide a richer understanding and appreciation of the transformational change process, which is essential for the replicability, scale up and sustainability of such intervention.

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LEARNING BRIEF SERIES: UNPACKING THE LEARNING

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This work falls under the Global Network Against Food Crises, an alliance which was launched by the European Union, FAO and the World Food Programme at the 2016 World Humanitarian Summit to step up joint efforts to address food crises along the humanitarian–development–peace nexus and continue to raise global awareness and commitment from all relevant actors.

The Global Network offers a coherent coordination framework to promote collective efforts in analysis and strategic programming for a more efficient use of resources to prevent, prepare for and respond to food crises and, ultimately, support collective outcomes related to Sustainable Development Goal 2 for lasting solutions to food crises.

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