FINAL REPORT

Social and Environmental Thematic Evaluation of the Khan Younis Wastewater Treatment Plant (KY WWTP)

Prepared by: General Consulting and training

GENERAL
Consulting & Training
جنرل للاستشارات و التدريب

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Acknowledgment

As we have finalized the "Social and Environmental Thematic Evaluation of the construction of Khan Younis Wastewater Treatment Plant (KY WWTP) and the Solar Energy System", We gratefully acknowledge the invaluable assistance received from numerous individuals and organizations in conducting this evaluation.

We would like to express our deepest gratitude for the partners, stakeholders, consultants, and contractors for their great time, efforts, and cooperation to accomplish this work during all stages of the evaluation.

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We would also like to acknowledge the outstanding support and cooperation of the UNDP team members for their willingness and readiness to answer all our queries, provide guidance to valuable documentation, and other sources of information were instrumental in the success of this evaluation.

Project and evaluation information details:

Project/outcome Information		
Project/outcome title	Construction of Khan Younis Wastewater Treatment Plant (referred to as KY WWTP project) and; Solar Energy System for Khan Younis Waste Water Treatment Plant (referred to as Solar Energy project)	
Atlas ID	Award ID: PAL10 -00041529 & 00121913 Output ID: PAL10- 00047395 & 00117719	
Corporate outcome and output	**UNDAF Outcome 3:** Palestine's infrastructure, and natural and cultural resources are more sustainably used and managed. **Palestine Programme Framework (PPF):** **Outcome 4:** Leaving no one behind: Social Development and Protection **Output 4.3:** Support and build the capacity of PWA, Ministry of Local Government, and related municipalities in wastewater and solid waste management (i.e. wastewater tariff, cost recovery, promote community participation, and raise awareness) and Improve access to wastewater and solid waste services including collection, treatment and reuse/recycling **Output 3.6:** Installation of solar panels and mainstreaming solar energy supported.	
Country	State of Palestine	
Region	Gaza Strip	
Date project document signed	For KY WWTP: August 2005, and 21 February 2014 For Solar Energy for KY WWTP: 02 September 2020	
Project dates	**Start**	**Planned end**
	For KY WWTP: 04 January 2006	30 September 2021 (Extended with IsDB fund to June 2022)
	For Solar Energy for KY WWTP: 01 December 2019	28 February 2022 (Extended with Norway Donor to 31 July 2022)
Project budget	For KY WWTP project: US$ 58,004,549 For Solar Energy project: US$ 2,179,836.51	
Project expenditure at the time of evaluation	For KY WWTP project: US$ 44,612,561 (until 31 March 2022) For Solar Energy project: US$ 621,895.31 (**until 31 March 2022**)	
Funding source	For the KY WWTP project: Kuwait Fund for Arab Economic Development through the Islamic Development Bank: US$ 42 million Government of Japan: US$ 14,829,549 UNDP: US$ 1,175,000 For the Solar Energy project: The Norwegian Ministry of Foreign Affairs: US$ 2,179,836.51	

Implementing party[1]	UNDP/PAPP is the entity responsible and accountable for managing and implementing the projects in coordination with the project partners: - The Palestinian Water Authority (PWA) as sector regulator - The Palestinian Energy and Natural Resources Authority (PENRA) - The Coastal Municipalities Water Utility (CMWU) as service provider and final operator of the projects, and - The Khan Younis Municipality as a direct beneficiary.

Evaluation information		
Evaluation type (project/ outcome/thematic/country programme, etc.)	Thematic Evaluation	
Final/midterm review/ other	Final evaluation	
Period under evaluation	**Start**	**End**
	04.01.2006	31.12.2022
Evaluators	Evaluation expert team of General Consulting and Training (GCT)	
Evaluation dates	**Start**	**Completion**
	01.11.2021	31.12.2022

[1] It is the entity that has overall responsibility for implementation of the project (award), effective use of resources and delivery of outputs in the signed project document and work plan.

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List of acronyms and abbreviations

CMWU	Coastal Municipalities Water Utility
FGD	Focus Group Discussions
GoJ	Government of Japan
IsDB	Islamic Development Bank
KII	Key Informant Interview
KF	Kuwait Fund for Arab Economic Development
KY	Khan Younis
KY WWTP	Khan Younis Wastewater Treatment Plant
MoA	Ministry of Agriculture
MoH	Ministry of Health
MW	Mega Watt
PCBS	Palestine Central Bureau of Statistics
PENRA	Palestinian Energy and Natural Resources Authority
PPF	Palestine Programme Framework
PV	Photovoltaic
PWA	Palestinian Water Authority
RFP	Request for Proposal
SCADA	Supervisory Control and Data Acquisition
TDS	Total Dissolved Solids
TOR	Terms of Reference
UNDAF	United Nations Development Assistance Framework
UNDP	United Nation Development Programme
WASH	Water, Sanitation and Hygiene
WHO	World Health Organization

Executive summary

This report provides an overview of the results of the thematic evaluation conducted for the construction of the Khan Younis Wastewater Treatment Plant (KY WWTP) and Solar Energy system, hereafter referred to as the "Project". The KY WWTP was initiated by the United Nations Development Programme (UNDP) in response to the urgent hygiene and environmental needs of Khan Younis residents. This thematic evaluation has been conducted by General Consulting and Training GCT in the period between Jan and April 2022.

The Project is a crucial intervention that aims to improve access to adequate, inclusive, and equitable sanitation and hygiene for the residents of Khan Younis governorate in the southern area of the Gaza Strip, with special attention to the needs of women. UNDP intervention comprises two major components. The first component involves the construction of the KY WWTP, which is funded by the Government of Japan and the Kuwait Fund for Arab Economic Development through the Islamic Development Bank IsDB. The second component involves the construction of a solar energy system, to guarantee the provision of electricity on a continuous basis for the proper and sustainable operation of the treatment plant, this component is funded by the Norwegian Ministry of Foreign Affairs.

KY WWTP was designed to be constructed into two phases according to available resources with a total capacity of 44,900 cubic metres per day. The construction works of phase one (26,600 cubic metres per day) commenced on 22 January 2017, the work was completed and commissioned in November 2019. KY WWTP was handed over to CMWU in November 2020 after one-year commissioning period.

To ensure a continuous supply of electricity for the plant, the Palestinian Energy and Natural Resources Authority (PENRA) endorsed the proposed intervention for implementing an on-grid solar energy system with a capacity of seven MWp for the KY WWTP. The solar energy system was designed to optimize the operation of the KY WWTP and reduce the overall operating costs. The solar energy system was an essential part for attaining a sustainable operation of the plant, installation of the system was completed in December 2022. The delay to complete this component was mainly related to the restrictions imposed by the Israeli side in accessing the construction materials into Gaza due to the long delay of the Israeli authorities in issuing the approvals to access the materials and equipment into Gaza.

The evaluation was conducted using a participatory and inclusive approach that incorporated the opinions and views of beneficiaries and stakeholders. The data collected were supplemented by observations and findings to determine the extent to which the planned results have been achieved. The evaluation followed international norms and standards, UNDP evaluation guidelines, and UNEG ethical guidelines related to evaluation of development projects and programmes. These guidelines included the “UNDP Handbook on Planning, Monitoring and Evaluating for Development projects”,

and the OECD/DAC criteria. Standard evaluation criteria that were assessed included relevance, coherence, effectiveness, efficiency, likely impact, and likely sustainability.

The findings, evidence-based recommendations, best practices, and lessons learned from this thematic evaluation will serve as valuable inputs for informing UNDP and other key stakeholders in the wastewater treatment sector with regards to their ongoing and future interventions.

In terms of relevancy: According to the evaluation, the Project successfully addressed the priorities and needs of KY residents in accessing sewage services. Over 95% of beneficiaries in targeted communities reported high satisfaction with the establishment of the KY Wastewater Treatment Plant (WWTP), which meets their needs and priorities by improving health conditions, enhancing quality of life, and helping to reduce the spread of diseases and infections. Prior to the construction of the KY WWTP, temporary lagoons in Khan Younis were discharging approximately 15,000 cubic meters per day out of the total 100,000-120,000 cubic meters per day of raw or partially treated sewage into the Mediterranean Sea in the Gaza Strip. The construction of the KY WWTP has played a crucial role in reducing the amount of wastewater infiltrating into the aquifer, thereby improving the quality of drinking water for all communities in the KY governorate.

The construction of the KY WWTP was identified as a strategic environmental intervention that played a critical role in achieving the Palestinian Water Authority's objective for water security and wastewater management in the Gaza Strip. The evaluation confirmed that the Project is consistent with the National Policy Agenda (NPA) 2017-2022, particularly National Priority 9: Quality Health for All and Priority 10: Building Resilient Communities.
The Project is also contributing to achieve Strategic priority 4: Leaving No One Behind: social development and protection in the United Nations Development Assistance Framework (UNDAF) and UNDP's Palestine Programme Framework's related outcomes and outputs (2018 – 2022). The Project is contributing to the realization of the Sustainable Development Goal (SDGs).

Namely with SDG 3 on good health and wellbeing to ensure healthy lives and promote wellbeing for all at all ages, SDG 6 to improve access to water and sanitation, reduce the proportion of untreated wastewater, and substantially increase recycling and safe reuse globally by 2030. The Project is in line with SDG 7 to enhance access to clean energy resources and reliance on clean fuels and technology through the installation of the solar energy system. The Solar Energy system supports the national policies and UNDP's strategy for safeguarding the environment, protecting natural resources, increasing energy efficiency, and reliance on renewable energy.

The Project design and implementation mainstreamed gender aspects and a Human Rights Based Approach to some extent. Women and girls in the Gaza Strip have a leading role in the household and are very much affected by the lack of sufficient wastewater treatment. As women play a critical role in their families, they are disproportionately exposed to unsafe water and wastewater as they are the primary caretakers of domestic water and often use polluted water for household purposes. The majority of women in the targeted communities have reported improved hygiene conditions at the household level due to their access to sanitation services. They are now able to use safe water in adequate quantities to meet their daily needs, thanks to the sewage services. This is a significant

improvement compared to the limitations they faced when their houses were connected to the cesspits. However, despite being greatly affected by the lack of proper wastewater management, women's engagement and participation in the project's decision-making processes related to wastewater management, services, and infrastructures were limited.

In terms of coherence, The Project established successful synergies and leveraged other interventions in the Gaza Strip through information sharing and building effective partnerships towards achieving the outputs. The construction of KY WWTP complements the other three wastewater treatment plants in the Gaza Strip (Rafah, Gaza, and North Gaza), and the integration of lessons learned from previous similar UNDP interventions contributed positively to developing a modern and sophisticated design for KY WWTP compared to other interventions in the area.

In terms of effectiveness, the evaluation team was able to confirm that all planned activities were delivered and most outputs were achieved, as defined in the result framework, through the collection of data from field visits, stakeholder interviews, focus group discussions with targeted communities, and reports provided by UNDP. This was accomplished despite the complex and unstable environment in the Gaza Strip.

The UNDP team successfully completed the construction works, recruited operational staff, and handed over the Project to CMUW. KY WWTP has a capacity of treating up to 5 million cubic meters of raw sewage annually, equivalent to approximately 15,000 cubic meters per day. This capacity will increase to 9.7 million cubic meters per day after connecting the other communities in KY governorate. The solar energy system, which will cover about 1.3 MWp of the plant's energy needs, was also completed. However, the team encountered certain challenges due to the restrictions imposed by the Israeli side on the entry of equipment and materials, in addition to the institutional challenges related to the timely recruitment of WWTP's operational staff by CMWU during the one-year operation phase after the construction of the WWTP. Effectiveness was also confirmed by the Project approach to design the WWTP through a joint venture between local and international firms, which resulted in modern design to build and operate the WWTP at low maintenance costs with limited need for consumables materials or expensive chemicals during the treatment process.

The awareness campaign was effective to some extent and covered different audiences in KY city., local communities were properly engaged during the implementation of the different stages of the interventions; although the campaign was implemented with limited resources and budget.

A capacity building training program was conducted for 25 female fresh graduate engineers on the design and installation of solar energy systems. The evaluation found that this training was an important opportunity to empower women and increase their participation in the energy sector. However, the capacity development for women was limited in terms of conversations and social marketing campaigns aimed at increasing their participation in certain sectors, such as waste recycling and reuse, and comparing industries at the household and community levels.

In terms of efficiency, the execution of the Project has been efficient and cost-effective, despite the challenging political conditions in the Gaza Strip. The Project team used the budget and resources efficiently, ensuring the best value for money in conducting the planned activities during both the design and implementation phases. However, the evaluation found that changes to timelines and budget allocation were necessary after Project approval, mainly due to factors beyond the Project's control, such as the ongoing blockade and restrictions imposed on the Gaza Strip. These factors affected the availability of raw materials and construction tools, as well as the commitment of local contractors to complete the work within the allocated timeframe.

KY WWTP was designed and constructed according to the international standards and best practices with low operational and maintenance costs. The installation of a solar energy system was crucial in ensuring a continuous 24-hour operation of the plant, and connecting it to the local utility system (on-grid system), while taking into consideration the available resources and capacity of the local electrical network in the Gaza Strip, as well as potential expansion of KY WWTP to its full capacity in the future. A SCADA system was also implemented to manage and control the electricity network, and provide proper analysis of the solar plant's performance. This system plays a vital role in enhancing energy efficiency, providing alarming and diagnostic functions, and optimizing energy management.

The project demonstrated flexibility in allocating the necessary resources to support (PWA) and (CMWU) in completing specific infrastructure work related to the operation of the WWTP. This included the rehabilitation of roads and existing pumping stations in KY, which were not initially included in the project's original scope of work. The project's efficiency was validated by allocating the necessary resources to upgrade the WWTP's capacity from 10,000 to 26,600 cubic meters per day, while also taking into account future extensions to reach the plant's full capacity of 44,900 cubic meters per day.

The project's scope of work and design were aimed at ensuring environmentally sound disposal of the treated wastewater through the use of infiltration basins, which allowed for maximum utilization of the treated wastewater to be recharged into the aquifer. The water from the infiltration basins can be used for irrigation purposes, thereby reducing pressure on the water aquifer. However, the accumulation of treated water in the infiltration basins may require additional interventions in the agriculture sector to benefit the residents of Al Fukhari

The UNDP's Monitoring and Evaluation (M&E) systems, combined with efficient time and resource management, facilitated ongoing monitoring and identification of challenges and potential risks associated with the project. This enabled suitable risk mitigation actions to be taken, resulting in a reduction of risks related to delayed project implementation. As a result, the project was able to achieve milestones within the planned timeframe.

In terms of likely impact, the project improved the situation of KY residents by ending the disposal of raw sewage in the environment through cesspits and ad-hoc lagoons, which posed serious health risks, such as infections among children as a result of the flooding and spread of wastewater. KY residents reported during focus group discussions that the situation has significantly improved

compared to previous years, with streets now clean and safe for families and children. They no longer have to pay to discharge cesspits on a weekly basis using trucks outside the city.

Based on PWA data, the construction of KY WWTP is expected to have a long-term positive impact on the water quality in KY governorate by reducing wastewater infiltration to the aquifer. The Project has also contributed to a significant reduction in seawater pollution, with wastewater disposal into the Mediterranean Sea dropping to about 90% less than before. Previously, approximately 15,000 cubic meters of wastewater were disposed into the sea in KY per day, but this has now been reduced to around 2,000 cubic meters per day.

The accumulation of sewage sludge from the WWTP is a serious problem due to the high treatment costs and the risks to environment and human health. Future sludge treatment is important to improve efficiency and environmental sustainability of the process.

The Project's approach of involving local contractors in the design and construction phases of KY WWTP contributed positively to building the capacity of local service providers to implement large-scale projects in the wastewater treatment sector.

Regarding the assessment of sustainability, After the construction and commissioning of KY WWTP, the international contractor carried out one year of operation with the aim of exchanging knowledge and proper codes of practice with CMWU, the recognized national body for municipal services in the Gaza Strip and the final operator of the plant. This was conducted in coordination with PWA, the governing body for water resources management in Palestine. The handing over process of the KY WWTP was carried out with full participation, support, and cooperation from CMWU to equip them with the necessary experience for proper plant operation and ensure long-term sustainability of the project. A clear coordination mechanism was established among PWA, CMWU, KY Municipality, and PENRA, including identification of roles and responsibilities, to ensure the sustainable operation of KY WWTP during the commissioning period and after the project handover to CMWU.

Despite the Palestinian Authority's full endorsement to cover the monthly electricity costs needed to operate the plant through the PA financial system, financial challenges are still jeopardizing the long-term sustainability of the project. CMWU and local municipalities are facing difficulties in covering the operational costs of the WWTP, resulting in a high staff turnover rate due to low salary scales for key staff and technicians. This situation poses a significant challenge to the ongoing operation and maintenance of the KY WWTP.

Sustainability was also ensured through the installation of a solar energy system to complement the electricity needs for the operation of the WWTP. Additionally, a commercial agreement was established with GEDCO through the two-way meters which will enhance self-sufficiency and efficiency.

The Project was developed with a human rights-based approach that addresses the vulnerability of women, especially those who head households and face additional obstacles in accessing sufficient sanitation and healthcare for themselves and their children. In addition, the reduction of infections and the spread of diseases in KY city have resulted in less burden and workload in households.

However, women in the targeted communities expressed the need for increased participation in future consultations, training, and decision-making related to improving water and sanitation solutions.

The technical training provided to female engineers not only contributed to their empowerment and increased their opportunities in the labor force, but also helped promote gender equality by ensuring that access to rights and opportunities is not limited by gender. Specifically, the training focused on the installation and maintenance of solar PV systems.

In conclusion, the Project successfully addressed the major environmental and public health crisis facing the residents of KY who suffered for years from the absence of sewage services. It was well-designed and implemented using modern technologies according to national and international standards, and it utilized renewable sustainable photovoltaic solar energy. The UNDP team effectively managed the various challenges that arose during the design and implementation of the Project interventions, despite the complex implementation environment in the Gaza Strip.

The following are the recommended interventions based on the evaluation findings, conclusions, and lessons learned:

Recommendation 1: Mobilize funding and investment to expand the wastewater networks in KY city, in order to connect neighborhoods that are currently not connected to the sewage system.

Recommendation 2: Explore opportunities to utilize the treated water from the infiltration basins as a new water resource, in addition to developing the infrastructure of the recovery and reusing scheme in Al Fukhari area to enable farmers to have better access to treated water for irrigation and agriculture purposes.

Recommendation 3: Support the development of proper disposal and recycling routes for sewage sludge to eliminate risks to the environment and human health. Additionally, explore ways to utilize valuable compounds in the sludge such as organic compounds, inorganic non-toxic substances, phosphorous, and nitrogen-containing compounds.

Recommendation 4: Strengthen the women's empowerment and capacity development component in future projects by providing additional trainings that target women and girls, taking into consideration the specific needs of persons with disabilities (PwDs). The trainings should cover advanced energy systems, agribusiness, water resources, and environment.

Recommendation 5: Expand the awareness campaign and create knowledge through:

- Targeting female households in the marginalized communities with education and awareness campaigns on wastewater management and good hygiene practices; to enhance engagement and responsiveness of the local population in the wastewater management and water sector.
- Raising awareness towards sustainable wastewater reuse in urban and farming areas, in coordination with local actors and community-based organizations in the wastewater management sector.

Recommendation 6: Provide ongoing technical training for WWTP staff and technicians, with a focus on topics such as process control and quality management; to ensure they are able to adopt modern methods and techniques in the wastewater treatment sector. Additionally, provide training to technical staff from the municipalities to ensure they can maintain the constructed infrastructure, such as wastewater networks and pumps, during the operation process.

Recommendation 7: Foster active engagement of local municipalities in the design and implementation of various activities, as a means of building capacity and promoting local ownership.

Recommendation 8: Strengthen financial sustainability and effectiveness of sewage services by:

- Providing institutional capacity building and technical assistance to enhance the capabilities of the wastewater department and staff at the CMWU.
- Establishing a wastewater collection system for the eastern towns of KY governorate to support the payment of water bills, thereby creating a stable source of income for the CMWU.
- Promoting cooperation between the CMWU and relevant municipalities to establish and operate an effective billing system that covers the operational and maintenance costs of the WWTP.

Recommendation 9: Develop a policy and an effective dissemination mechanism to promote the reuse of treated wastewater by PWA and CMWU, in coordination with the Ministry of Agriculture (MoA).

Recommendation 10: Create opportunities to empower youth, both women and men, to participate as entrepreneurs and startups in farming, agricultural value chains, and processing in Al Fukhari area and neighboring communities near the WWTP. This can be achieved through investment, business funding, and the provision of support programs.

1. Introduction

1.1 Local context

Khan Younis governorate covers a vast geographic area of approximately 108 square kilometres and is situated in the southern part of the Gaza Strip. It is a densely populated region with an estimated population of around 413,000 residents, according to the Projected Mid-Year Population for Khan Younis Governorate by Locality 2017-2026 report by PCBS, as of 30 May 2021. Khan Younis city is the second largest city in the Gaza Strip, occupying a total administrative area of 59 square kilometres and is presently home to approximately 275,000 residents. The Khan Younis governorate has been facing a prolonged lack of a comprehensive sewerage collection system and a functional wastewater treatment plant, resulting in exacerbated sewage disposal issues and unsanitary living conditions in densely populated areas. In response to these challenges, the Khan Younis and Bani Sohaila municipalities have implemented a public sewage collection system to serve a portion of their residents. Presently, approximately 40% of the population in the Khan Younis Governorate are beneficiaries of this sewerage system. Unfortunately, since there was no wastewater treatment plant in place, the collected wastewater had to be pumped without any treatment to the main storm water box culvert. From there, it flowed out by gravity to a storm water infiltration pond located in the north-western side of Khan Younis city. However, in 2008, the wastewater collection system was diverted to six ad-hoc collection lagoons established temporarily in the western side of Khan Younis city. As of September 2019, more than 15,000 cubic metres per day of partially treated wastewater was discharged through the lagoons and into the Mediterranean Sea. This situation posed significant health risks to the residents of Khan Younis, as it did not only threaten their public health but also contaminated the ground water aquifer, sea water, and marine life. The concentration of nitrate in some of the Khan Younis water wells had reached alarming levels of around 458 mg/l, which is almost nine times higher than the recommended level of 50 mg/l set by the World Health Organization (WHO). The presence of nitrate in water has been associated with severe health impacts, particularly among children and infants.

1.2 Descriptions of the Project

For a long time, the Khan Younis Governorate had been facing the challenge of not having a comprehensive wastewater collection system or a functional wastewater treatment plant. As a result, the sewage generated in the area was either disposed of in the environment through cesspits or collected and discharged into the Mediterranean Sea without any treatment. This persistent issue had been posing significant risks to public health, as well as contaminating the groundwater aquifer and the sea, and threatening marine life in the area.

To address the severe consequences of this problem, the Palestinian Water Authority (PWA) identified the Khan Younis Wastewater Treatment Plant (KY WWTP) as a critical environmental project. The KY WWTP was deemed necessary to protect the health of Khan Younis residents, preserve water

resources, and safeguard the environment. Its operation would also contribute to the PWA's goal of achieving water security and balanced water management by providing a new non-conventional water source through the recharge of the aquifer with treated wastewater that can be recovered and used for agricultural purposes.

The construction of KY WWTP and Solar Energy system, referred to as the 'Project', aims to address the long-lasting problem of inadequate wastewater management in Khan Younis governorate. The project seeks to protect the public health, water resources, and the environment of the residents by developing public and social infrastructure in the Gaza Strip.

This Project was implemented under UNDAF Outcome 3: Palestine's infrastructure and natural and cultural resources are more sustainably used and managed, and Palestine Programme Framework (PPF): Outcome 4: Leaving no one behind: Social Development and Protection. The donors of the Project are:

- KY WWTP project: Kuwait Fund for Arab Economic Development through the Islamic Development Bank (US$ 42 million), Government of Japan (US$ 14. 829 million) and UNDP (US$ 1.175 million).
- Solar energy project: The Norwegian Ministry of Foreign Affairs (US$ 2. 179 million).
- UNDP contribution: US$ 1,175,000

"The long-term desired impact of the Project was to improve the health of Khan Younis residents and protect the environment in the Gaza Strip. The direct beneficiaries of the Project are approximately 217,000 residents of Khan Younis who can be served by the first phase of the KYWWTP project. Other beneficiaries include Khan Younis Municipality, the Coastal Municipalities Water Utility, and the Palestinian Government, as the project will contribute to enhancing the management of water and wastewater services."

The challenging economic situation in Gaza has resulted in a low collection rate of electricity fees, which GEDCO (Gaza Electricity Distribution Company) relies on for operation. These unforeseen conditions have posed constraints to the operation of KY WWTP, which were not initially anticipated during the design and construction of the plant.

Due to the dire economic and political situation, coupled with limited resources of CMWU, CMWU have indicated that they are not able to cover the full costs associated with the running of KY WWTP. As electricity costs form a significant portion of the operational expenses for the KY WWTP, implementing a more cost-efficient system is crucial to ensure the immediate and sustainable operation of the plant. Therefore, the proposed intervention of implementing a solar energy project for KY WWTP is expected to provide a constant supply of electricity and reduce the overall running costs by at least 50%. This would contribute towards attaining a sustainable operation of the plant.

UNDP was responsible and accountable for managing and implementing the Project, including the monitoring and evaluation of project interventions and achieving project outputs. UNDP team carried out the overall and day-to-day management and decision-making for the Project to ensure that the

project produces the specified results to the required standard of quality and within the specified constraints of time and cost in cooperation with the relevant municipalities and stakeholders.

Planned results according to the Project's documents are:

Impact	Improved access to adequate, inclusive and equitable sanitation and hygiene for residents of Khan Younis Governorate with special attention to the needs of women though the optimal operation of the Khan Younis Wastewater Treatment Plant (KY WWTP) utilizing renewable sustainable photovoltaic solar energy. This will contribute to protecting public health and the environment in the Gaza Strip.
Outcome	Palestine's infrastructure, and natural and cultural resources are more sustainably used and managed.
Construction of KY WWTP	Output 1: KY WWTP of a capacity of 26,600 cubic metres per day constructed and operated for one year after commissioning.
	Output 2: Effluent and emergency pressure pipeline of 18.6 kilometres length constructed.
	Output 3: Al Fukhari infiltration basins of 97 donums area to recharge treated wastewater into aquifer constructed.
	Output 4: Main electricity power supply line of around 3,000 meters length to operate the KY WWTP constructed
	Output 5: Design review, pre-contract services and construction supervision for the construction of KY WWTP performed
	Output 6: the implementation and operational capacity of the Coastal Municipalities Water Utility enhanced
Solar Energy System for KY WWTP	Output 1: 1.3 MWp renewable solar energy installed in KYWWTP to treat the wastewater in Khan Younis governorate.
	Output 2: Improved awareness of Khan Younis residents especially women regarding the importance of clean water and hygiene, and increased engagement of communities in plans for effective utilization of treated water

The focus of this evaluation was to assess the relevance, coherence, effectiveness, efficiency, likely impact, and likely sustainability of the Project. In addition, to measure to what extent the Project has achieved its planned results and its likely impact on the lives of beneficiaries and how the Project to contributed to significant change and added value for the communities of KY governorate. This will include design phase, implementation phase, handover process, and post completion assumptions of the Project, along with the changes occurring during the project implementation phases.

The report presents the methodology used for data collection, including the evaluation questions and the applied approach, and provides an analysis of the key findings. The report also includes conclusions, recommendations, and lessons learned based on evidence-based findings.

2. Evaluation scope and objectives

2.1 Purpose of the evaluation

The primary objective of this thematic evaluation is to facilitate continued learning, accountability, and transparency of development interventions. It aims to evaluate the actual results, uniqueness, added value, and significance of the Khan Younis Wastewater Treatment Plant (KY WWTP) for the community of Khan Younis Governorate and the Gaza Strip. Through evidence-based recommendations, best practices, and lessons learned from the KY WWTP and solar energy system interventions, this evaluation will inform ongoing and future interventions. The evaluation will also serve as a crucial information source for UNDP and national stakeholders in mapping and planning strategic scaling-up opportunities.

2.2 Scope of the Evaluation

The evaluation encompasses both the construction of the KY WWTP and the installation of the solar energy system. It will primarily focus on the conditions and challenges encountered during the design stage before the actual construction. It will also cover the solar energy system, which was completed in December 2022, despite the Israeli delays in issuing approvals to access construction materials and equipment into the Gaza Strip.

Geographically, the evaluation covered the relevant locations in Khan Younis where the interventions were implemented.

The evaluation was carried out during the final stage of the project implementation period, from November 2021 to April 2022. However, due to the additional time required for the completion and testing of the solar energy system, the evaluation period was extended until December 2022.

2.3 Specific objectives of the evaluation

The specific objectives of this evaluation will be to identify and assess the following:

SO1: The evaluation will assess the social and environmental impact of the project, with a particular focus on how the interventions are expected to contribute positively to the improvement of public health and the environment in the Khan Younis Governorate. It will also examine how these improvements can have a broader impact on the overall conditions in the Gaza Strip.

SO2: The relevance of the Project to the needs of the local community and the national strategic priorities.

SO3: The efficiency, effectiveness, likely sustainability and coherence of the Project's results, achievements, limitations as well as the applied approaches and used methodologies.

SO4: The contribution to the crosscutting issues, including gender equality and women's empowerment, people with disabilities, and the environment.

SO5: Provide concrete recommended actions, which can be used to inform the handover process as well as guide future similar interventions.

2.4 Evaluation criteria and key questions

The assessed evaluation criteria included relevance, coherence, effectiveness, efficiency, likely impact, and likely sustainability. The relevance criterion focused on the appropriateness of the project to the local context, the needs and interests of the local population and communities, and its alignment with UNDP/PAPP and donors' strategies. The effectiveness criterion assessed the level of achievement of the different expected outputs and their contribution to the relevant outcomes. This criterion also focused on assessing the major challenges faced during the project and the potential challenges that may arise after project completion. For efficiency, the evaluation team examined the extent to which resources and inputs led to the intended results and to what extent they were cost-effective .The likely impact criterion focused on the assessment of the positive and negative consequences of the project's activities. Finally, the likely sustainability criterion assessed which project results are expected to continue after project completion.
The evaluation matrix (Annex 6) includes the details of the indicators and measures used to evaluate the project relative to the evaluation questions. Based on this, specific guiding questions for the FGDs and interview protocols were elaborated for each respondent, taking into account their roles and profiles. The evaluation findings, lessons learned, and recommendations will provide UNDP, donors, and partners with the information needed to make decisions, take actions, and add to their knowledge for designing similar future interventions. Table 2 provides a summary of the evaluation criteria and main evaluation questions addressed by the evaluation.

Table 1: The evaluation criteria and key evaluation questions:

Evaluation criteria	Key evaluation questions
Relevance To what extent the Project output and outcomes are consistent with national policies and priorities and needs of beneficiaries	1. To what extent was the Project relevant to the needs of the local communities in Khan Younis governorate? 2. To what extent are the expected outcomes of the Project consistent with the national policies and priorities and likely to contribute to a realization of the SDGs? 3. To what extent was gender and women issues addressed in the design and implementation of the Project?
Coherence To what extent the Project is coherent with UNDP and other actors' intervention in public health, water resources and environment	4. To what extent were the Project objectives coherent with UNDP strategic plan and other actors' interventions within the same context (Gaza Strip and public health, water resources and environment)? 5. To what extent does the Project interventions contributing to achieving each other's objective as well as the work of other national/ international actors in the same field?

Effectiveness: The extent to which progress of the Project toward intended results has been achieved.	6. To what extent has the KY WWTP to date been effective in addressing the actual needs of beneficiaries in Khan Younis in terms of water sanitation and hygiene? 7. What are the Project's major achievements, what are the supporting factors and how to build on/expand these achievements? 8. In which areas do the Project have the fewest achievements, why and how to overcome this in the future? 9. To what extent were the Project implementation approach effective towards achieving key objectives in the sector of wastewater treatment (such as quality of water)? 10. To what extent are the Project's approach being effective to provide practical and environment friendly solutions for wastewater treatment in Khan Younis. 11. To what extent can the construction of a renewable solar energy sustain the wastewater treatment in Khan Younis governorate? 12. To what extent has the Project been able to promote the empowerment of women?
Efficiency: How economically resources or inputs are converted to results, and whether the most efficient processes have been adopted.	13. To what extent have the Project applied the M&E system and used the inputs and resources to deliver its expected results? 14. To what extent is the Project efficient in budget allocation and cost-efficiency of the activities?
Likely Impact: Assesses the positive and negative consequences of the Project activities, direct and indirect, as well as intended and unintended	15. What are the likely impacts of the Project on the public health conditions and lives of Khan Younis residents? 16. To what extents have the Project contributed to an improvement of the environmental conditions of Khan Younis Governorate and the wastewater management sector in KY and the Gaza Strip? 17. To what extent are the interventions likely to promote positive change towards gender equality and the empowerment of women? Are there any unintended effects? 18. To what extent has the Project considered the inclusion of the marginalized groups, especially PwDs, in the activities?
Likely Sustainability: Measures the extent to which benefits of the Project is able to continue after completion of the Project.	19. To what extent does the Coastal Municipalities Water Utility's (CMWU) capacity and resources ensure a likely sustainable operation of the WWTP? 20. To what extent are the national actors/local government willing to provide support to the KY WWTP after completion of the Project? 21. Are there any social or political risks that may jeopardize sustainability of the KY WWTP? If yes, what are the mitigation measures to address such risks?

3. Evaluation approach and methods

3.1 Evaluation approach

The evaluation applied a participatory and inclusive approach, with a focus on gender equality and human rights during the implementation phase. The evaluation used the opinions and views of

beneficiaries and stakeholders, complemented by the observations and findings of the evaluation team, to determine the extent to which the planned results have been achieved. The evaluation was conducted in accordance with the UNDP and UNEG guidance for this thematic evaluation, and assessment was based on the criteria of relevance, effectiveness, efficiency, likely impact, and likely sustainability.

3.2 Data-collection tools and procedures

The tools and questions for data collection were developed in a gender-sensitive manner, including the development of gender-specific indicators and sub-questions. Culturally appropriate means were employed to encourage active participation from different groups within the targeted communities in KY governorate, including women and persons with disabilities (PwDs). A mixed method approach was used to validate information collected from beneficiaries and stakeholders. The following data collection tools were utilized:

1. Document analysis: The evaluation team performed a comprehensive analysis of the documents collected during the inception phase and throughout the data collection process, with a focus on key evaluation questions. This analysis included program documents, results framework, financial documents, reports from donors and other UNDP partners, and agreements. The document analysis was used to identify information gaps and support the development of the evaluation tools, such as specific questions for the key informant interviews and focus group discussions.

   References to the documents reviewed are noted in this report to the extent possible, in most cases in footnotes. The full list of documents reviewed and consulted is provided in Annex 5.
2. Field visits: Field visits: The evaluation team conducted field visits to the Project locations in Al Fukhari, eastern Khan Younis. These visits included two visits to the wastewater treatment plant, three visits to the Solar Energy System, and one visit to the infiltration basin located near the plant.
3. In depth interviews with Key Informants (KII): The evaluation team conducted in-depth interviews with key informants, including UNDP team, donors, and key stakeholders such as municipalities, (PWA), (CMWU), (PENRA), and (MoA). A total of 16 interviews were conducted, of which 14 were conducted in person and 2 were conducted virtually.
4. Semi-structured interview questions were developed for the different types of stakeholders to respond to the key questions and specific evaluation questions (*Annex 3*).
5. Focus Group Discussions (FGDs): The evaluation team conducted 8 FGDs with the participation of 75 beneficiaries (35% of whom were female) from different communities in KY identified in the project. The following FGDs were conducted in KY governorate:
   - Direct beneficiaries from KY City including women.
   - Local farmers.
   - Fishermen.
   - Al Fukhari resident's east of KY governorate.
   - Workers and contractors who participated in the construction work of KY WWTP.

- Residents from Al Mawasi area near the old temporary lagoons.
- Residents from Al Amal area close to the old water infiltration basins
- Residents and Mayors of the eastern villages KY governorate.

Detailed list of the FGDs and guiding questions is provided in *Annex 4* of this report.

3.3 Performance standards and stakeholder participation

The evaluation process was conducted in accordance with the OECD-DAC criteria to ensure that quality standards were applied in all phases of the evaluation. The evaluation team has ensured that the final report was developed in line with the United Nations Evaluation Group (UNEG) Quality Checklist for Evaluation Reports.
During data collection, UNEG guidelines were followed to protect the rights of informants and ensure that they were comfortable providing information. The evaluation team ensured that the participants were made aware of the scope and limits of confidentiality during the data collection process.

The evaluation aimed to ensure active participation of beneficiaries and stakeholders while maintaining the highest level of confidentiality and integrity. All actors, partners, stakeholders, and beneficiaries were fully involved and consulted during the evaluation process, and had the opportunity to actively contribute to the process. The performance standards for this evaluation were based on the evaluation matrix, which includes indicators and success standards for each evaluation question, as well as the data sources, data collection tools, and methods of analysis for each data source (Annex 6).

3.4 Data analysis.

The Evaluation Team conducted a detailed analysis of the secondary data findings from the desk review during the inception phase to complement primary data from the FGDs and in-depth interviews. Well-founded data was received from stakeholders and beneficiaries, and on-site visits were conducted to evaluate the Project's contribution towards reaching the Project outputs. Transcripts were generated for the in-depth interviews and focus group discussions, and findings were consolidated and analyzed to feed into the final evaluation report. Collected data was tabulated using Excel software, and data analysis was conducted in accordance with the requirements of the ToR and UNEG/OECD norms and standards. All questions were appropriately developed with the aim of

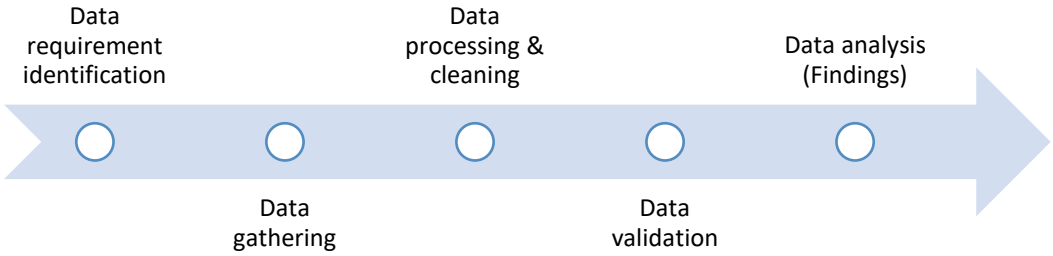

Figure 1: Steps followed in data analysis.

answering the evaluation questions according to the predefined measurable indicators in the evaluation matrix (Annex 3).

The Evaluation Team conducted data analysis to answer the evaluation questions, ensuring triangulation of findings by crosschecking information gathered from different sources using different data collection tools (Figure 1). The analysis of effectiveness focused on the Project's results, while the analysis of efficiency was based on the UNDP team's use of available resources. For the analysis of sustainability, the team relied on responses received from the UNDP team and consultations with key stakeholders.

Finally, the evaluation team aimed to the extent possible to provide clear, solid, and actionable recommendations based on the revised evaluation questions listed in the evaluation matrix.

3.5 Evaluation team

General Consulting and Training (GCT) was responsible for conducting this evaluation. The evaluation team consisted of a highly qualified Team Leader with expertise in conducting evaluations, studies, and surveys. Additionally, there was a national expert with proven experience in WASH interventions and wastewater management, a construction engineer, a solar energy system expert, a statistical analysis expert, and an administrative assistant to support the data collection phase across the Gaza Strip.

3.6 Limitations of the methodology

No major limitations were encountered by the evaluation team during the different phases. One potential risk to the evaluation was the instability in the Gaza Strip and the possibility of changes brought about by political situations. However, this risk did not materialize, and no changes in the political situation occurred during the evaluation period.

4. Findings

Khan Younis Governorate has long been grappling with the absence of a proper wastewater collection system and functional wastewater treatment facilities, resulting in the discharge of untreated wastewater into the environment, posing a serious threat to the health of residents and the quality of groundwater. The implementation of the Project faced several obstacles due to the difficult political and security situation in the Gaza Strip, including restrictions on the movement and transportation of equipment and tools. The challenges were further exacerbated by the outbreak of the COVID-19 pandemic in March 2020. Despite these challenges, the Project's notable achievements and results are highly commendable.

According to the evaluation findings from the FGDs and KIIs, the KY WWTP was identified as a vital and top priority for KY residents to address their longstanding wastewater problems. The integration of the solar energy system was also deemed essential to overcome the energy supply shortage in the Gaza Strip and ensure uninterrupted operation of the plant for 24 hours per day. However, the Project encountered some delays in starting the implementation phase due to the unavailability of additional funds required for the complete construction of the KY WWTP and its complementary components. The required funds were eventually secured from the Kuwait Fund for Arab Economic Development through the IsDB, and the Project implementation agreement was signed between UNDP and the IsDB in September 2013. In April 2014, there was a delay in starting the implementation process as the IsDB requested a design review instead of the initially planned constructability review. Following the signing of the agreement, UNDP proceeded to sign a contract with an international consultancy firm in July 2015 to provide design review and construction supervision services. Meanwhile, UNDP conducted a prequalification process to select international and local contractors for the construction works of the KY WWTP and its complementary components, including sewage network, equipment, and necessary infrastructure. The construction works of the KY WWTP, buildings, and main complementary components started on the ground in January 2017.

During the time of this evaluation:

- The construction of KY WWTP: The Project successfully delivered all planned activities and mostly met the 6 outputs defined in the results framework, including the construction and successful operations of KY WWTP, infiltration basins, and emergency pressure pipelines. However, there were some challenges related to output 6, which aimed to enhance the capacity of CMWU staff. Due to financial difficulties, CMWU was unable to recruit an operational team for the plant during the one-year operational period after the construction of the WWTP. Nevertheless, CMWU reported that the staff capacity was improved with significant support and commitment from the contractor during the remaining time of the commissioning period, and the staff had the opportunity to participate in the construction of the pressure lines and infiltration basins.
- Solar energy project: Under output 1, the design of the solar energy system was completed to be implemented in three phases, with a total capacity of 7 MWp. The first phase of the project, which was within the scope of this evaluation, covered approximately 1.3 MWp of the energy needs. Despite facing significant challenges due to restrictions from the Israeli side that prevented the entry of construction materials and equipment into Gaza, the UNDP team demonstrated flexibility and responsiveness, enabling the completion of this phase in December 2022 after more than a year of delay. The UNDP team's efforts were critical in facilitating the delivery of the necessary materials and completing this phase under the complex political conditions in the Gaza Strip.

The following section highlights the main findings from the evaluation, outlined according to the evaluation criteria provided in the TOR.

4.1 Relevance

To what extent the Project output and outcomes are consistent with national policies and priorities and needs of beneficiaries.

The consensus among all stakeholders and key actors in the wastewater treatment sector was that the KY WWTP was designed and constructed in line with international best practices and standards. Moreover, the installation of the solar energy system is recognized as a crucial component that addresses the current energy shortage in the Gaza Strip. The system provides sufficient energy supply, enabling continuous operation of the plant over 24 hours per day.

> H.E. Dr Mohammad Shtayyeh, Prime Minster of the State of Palestine said in a recorded speech: "The [KY WWTP] Project was critical to the lives of 400,000 Palestinians living in Khan Younis. The Project will protect the area from an inevitable environmental crisis, as one of the key interventions implemented in the State of Palestine in recent years".

Relevance was also confirmed by UNDP's ability to conceptualize the Project based on the local needs identified through a comprehensive needs' assessment with active participation of the relevant stakeholders in both the design and implementation phases of the Project.

Positive feedback was provided by all interviewed parties (stakeholders, municipalities, CMWU, PENRA, PWA, and donors) that the intervention addressed the urgent needs of the populations in KY city. It will also serve the needs of neighboring communities in the eastern towns of KY governorate after connecting with the sewage networks.

Given the immense gaps and urgent needs in the wastewater sector, the construction of KY WWTP was essential to address the chronic issue of wastewater in all communities in KY governorate. The evaluation found that the Project is highly relevant to the needs of KY residents, based on the information provided by beneficiaries and stakeholders, as well as the analysis of Project reports and documents. The evaluation found that the Project is highly relevant to the needs of KY residents. During FGDs conducted in KY city, the majority of respondents (over 95%) reported high satisfaction with the establishment of KY WWTP, which met their needs and priorities to improve the environment, enhance health conditions, and reduce the spread of diseases and infections.

Before the construction of KY WWTP, the Khan Younis temporary lagoons were discharging around 15,000 cubic meters per day of raw or partially treated sewage out of the total of about 100,000 – 120,000 cubic meters per day to the Mediterranean Sea in the Gaza Strip. The construction of KY WWTP has contributed to reducing the infiltration of wastewater into the aquifer, which has been affecting the quality of drinking water for all communities in KY.

The majority of beneficiaries reported that their health and hygiene conditions and practices have improved since the establishment of the KY WWTP. The residential area has become safer for them and their children as there is no longer wastewater in the streets. Additionally, the establishment of the KY WWTP has reduced conflicts between people in the neighbourhoods caused by flooded wastewater in the streets, especially in the old city of KY.

> "The project is the best thing that happened to us in our area, it helped solving the problems caused by chronic wastewater situation in our neighbourhood… now the streets are dry and clean and easy to move for all people including PwDs." A resident of KY city.

All interviewed parties provided similar feedback that the intervention was timely and addressed urgent needs of the populations in KY city, as well as neighboring communities in Al Fukhari, Bani Sohaila, Absan Al Kabira, Abasn Al Jadida, Khuza'a and Al Qarara. The Project was conceptualized by UNDP's based on local needs as identified by the national policy agenda with involvement and active participation of the relevant actors and stakeholders.

The lab test results of the effluent quality parameters for KY WWTP conducted by the Environmental Quality Authority (EQA) showed that all parameters conform the national standards for wastewater treatment (Annex 8). According to data and interviews with MoA, treated water from the WWTP has high quality compared to the other plants in the Gaza Strip, and therefore, can replace groundwater as a safe source for irrigation and agricultural purposes by the farmers in Al Fukhari area.

The treated water low cost (below 0.5 NIS per cubic meter) can support the farmers to expand farming activities and improve their economic conditions. Furthermore, this will lead to create more job opportunities for small farmers, women, and men in the area. For the water utility, additional revenue from selling treated water will help the CMWU to cover operational and maintenance costs.

Residents of non-sewer connected communities with the KY WWTP in the KY governorate have reported that they are still experiencing issues with wastewater in their residential areas, where there are thousands of cesspits with distances of up to 4 meters between each other. This situation poses serious safety and hygiene challenges for the residents, particularly for children. Additionally, there is a risk of potential collapsing of the cesspits, which could jeopardize people's lives. These communities are targeted to be served by KY WWTP but but to a lack of financial resources, the relevant authorities and municipalities have been unable to establish wastewater networks to serve these communities.

Residents of the Al Mawasi area, which is located near the sea, have confirmed the urgent need to connect the area to the wastewater network to protect the coastal area and seawater from pollution. In addition, residents of Bani Sohaila have reported that the most pressing issue they are currently facing is putting an end to the problem of wastewater.

> "I left my home because of the wastewater problems such as the bad smell, the spread of mosquitoes, and diseases. The network, if established, will end all the problems we suffer from in our daily life for many years." One citizen from Bani Sohaila area.

The Project is consistent with the National Policy Agenda (NPA) 2017–2022: National Priority 9: Quality Health for All and priority 10: Building Resilient Communities through providing access to the sewage network to improve the health and hygiene conditions for KY residents[2].

The Project is making a significant contribution towards achieving the Sustainable Development Goals (SDGs), specifically SDG 3 which aims to ensure healthy lives and promote wellbeing for all at all ages, SDG 6 (6.2 and 6.3) which aims to improve access to water and sanitation, reduce the proportion of untreated wastewater, and substantially increase recycling and safe reuse globally by 2030. Additionally, the Project aligns with SDG 7 which aims to enhance access to clean energy resources and promote the use of clean fuels and technology, through the installation of a solar energy system.

The implementation of the solar energy system is in line with UNDP's strategy for safeguarding the environment and protecting natural resources. Furthermore, it responds to the 10th national priority of the National Policy Agenda (NPA) on resilient communities, which focuses on ensuring a sustainable environment and adapting to climate change. The policy intervention for this priority is to increase energy efficiency and reliance on renewable energy, which the solar energy system contributes to.

The Project is contributing to achieve Strategic priority 4: Leaving No One Behind: social development and protection in the United Nations Development Assistance Framework (UNDAF) and UNDP's Palestine Programme Framework's related outcomes and outputs (2018 – 2022)[3].

The Project aims to serve the entire community in the targeted areas of KY governorate, including both women and men. Women constitute about 49.1% of the community, according to PCBS data. Furthermore, persons with disabilities (PwDs) are also among the beneficiaries of the Project in these targeted communities.

Gender equality has been a key component in the design and implementation of the Project. In the context of the Gaza Strip, women and girls have a leading role in households and are the main users of water. The Project serves the entire community in KY city through the construction of sewage systems and wastewater treatment facilities, which has a significant positive impact on protecting public health and the environment for all residents. Women, in particular, have reported improvements in household hygiene as they now have access to sanitation services and adequate quantities of safe water to cover daily family needs as a result of the sewage services, compared to the significant limitations when houses were connected to cesspits.

4.2 Coherence

The section provides analysis for coherence and assessing to what extent the Project is coherent with UNDP and other actors' intervention in public health, water resources and environment.

- The UNDP team has been successful in managing and building synergies, as well as leveraging other interventions in the Gaza Strip, to establish viable and effective partnership strategies to achieve the desired outcomes and outputs. This success has been confirmed by:

[2] State of Palestine's 2017- 22 National Policy Agenda: Putting Citizens First.
[3] United Nations Development Assistance Framework State of Palestine 2018-2022.

- The Project's documents and reports reveal a good level of coordination and information sharing between UNDP's different interventions with the aim of ensuring the high quality and sustainability of KY WWTP. This coordination was carried out during the design phase to build on lessons learned from other interventions implemented in the sector. Interviews with key informants confirmed these findings and revealed that the UNDP team conducted an in-depth review and analysis of other interventions and similar projects in the wastewater treatment sector in Palestine. The integration of lessons learned from previous similar UNDP interventions positively contributed to the development of a modern and sophisticated design compared to other wastewater treatment plants in the Gaza Strip.
- Interviews with actors in the wastewater management sector have confirmed a good level of coordination and joint planning with UNDP. The UNDP team has effectively coordinated the Project activities with relevant ministries and stakeholders to integrate the Project's outcomes into ongoing policies and practices at the national level. The UNDP team also successfully built a coordination mechanism among PWA, CMUW, KY municipality, and PENRA, which included clear identification of roles and responsibilities. This mechanism was crucial in ensuring the sustainability of the Project during the commissioning period and after the Project was handed over to CMUW.
- PENRA confirmed their participation in the development of the solar energy system study in coordination with the UNDP team and the consulting firm. The PWA also confirmed their engagement in the planning of the WWTP, particularly when the consultancy firm was contracted to provide the detailed design, carry out the design review, and during the implementation phases.

On strategic level, the Project is contributing to achieving the work of other actors in the wastewater sector, this was evident through:

- The construction of the WWTP in KY governorate complements other interventions in the wastewater treatment sector, including other wastewater treatment plants constructed in recent years in the Gaza Strip (Northern governorate, Gaza city and middle area, and Rafah). The operation of these wastewater treatment plants will have a significant positive impact on water quality and hygiene conditions for residents in KY and the Gaza Strip as a whole.
- The Project is expected to significantly improve the health conditions in the Gaza Strip, according to the Ministry of Health (MoH). It will also support MoH's strategy to reduce the spread of diseases and infections over the coming years. Moreover, the Project will contribute to the Ministry of Agriculture's (MoA) long-term strategy to use treated water from the infiltration basins for irrigation and food industries, thus promoting sustainable use of water resources and food security in the region.
- The construction of KY WWTP has led to a significant reduction (about 90%) of wastewater being disposed of in the sea, thus creating a safer environment and improving the water quality for other desalination interventions implemented by PWA.
- The Project is aligned with other interventions in the wastewater treatment and management sector, as it aims to improve access to clean water resources.
- The implementation of the desalination project funded by the World Bank in KY governorate is expected to significantly improve the treatment process at the WWTP, leading to a reduction of

the Total Dissolved Solids (TDS) in the effluent. This will create investment opportunities for the use of the treated water in irrigation and agribusinesses, and contribute to the sustainable development of the area.

4.3 Effectiveness

The assessment of the effectiveness calls for consideration of the degree to which progress of the Project toward intended results has been achieved

Despite the difficult conditions in the Gaza Strip after more than 17 years of blockade, escalation of hostilities, the Project was well placed within the local context towards a long-term and effective solution to the treatment of wastewater for the residents in KY governorate.

The findings from the FGDs indicate that the Project has effectively met the needs of the majority of respondents (over 90%) by providing access to clean water and improving hygiene levels to a high extent. However, non-sewer connected communities in KY reported that they continue to face serious wastewater problems and have high expectations for accelerating interventions to connect them to the KY WWTP sewage networks.

All stakeholders who were interviewed reported that the establishment of KY WWTP is one of the key national interventions that have been implemented in the Gaza Strip in recent years, especially in KY governorate. CMWU and PWA confirmed that the UNDP team effectively monitored the implementation process and ensured the quality of the deliverables. This indicates that the UNDP team consulted and involved them in both the design and implementation phases of the Project.

> "Treated water can be used to enhance farmers to use freshwater for irrigation in Al Fukhari area and contribute to solve water scarcity, maintain the environment, and open new opportunities for investment in the agriculture sector, thus improve the economic conditions for the residents." Al Fukhari Mayor said.

The staff of KY WWTP, who were interviewed, expressed their desire to receive continuous capacity development activities, such as advanced technical training, to improve their skills in process control and quality management for better operation and maintenance of the WWTP. They emphasized the importance of staying informed and updated with the latest developments in the wastewater treatment sector, as this would help them become competent and prepared to face potential challenges or problems, especially during emergency situations.

All outputs related to the construction of KY WWTP have been successfully completed, despite the challenges faced due to the long-standing blockade and restrictions imposed on the entry of certain materials and equipment deemed as "dual-use" by the Israeli authorities. The solar energy project, which aims to install a 1.3 MWp solar energy system to provide a constant supply of electricity to the plant, experienced some delays due to restrictions on the entry of construction materials and equipment into Gaza. However, this component was completed in December 2022.

Despite the physical nature of the Project and the construction works, it was designed to address the concerns and priorities of women in the Gaza Strip. Women play a leading role in households, and their children are the main beneficiaries of the Project's services, which provide access to adequate sewage services and improve health and hygiene conditions. The results achieved will benefit women and men equally through the sewage services. Moreover, the solar energy system included specific indicators for women's empowerment by providing advanced training to a group of 25 female engineers on solar system installation and maintenance.

All planned activities were successfully completed, and all outputs were mostly achieved as defined in the result framework. The KY WWTP has a current capacity to treat up to 5 million cubic meters of raw sewage per year, which is approximately 15,000 cubic meters per day. It is expected that the capacity will increase to 9.7 million cubic meters per day, once other communities in KY governorate are connected,

Regarding the solar energy system for KY WWTP, the installation of a 1.3 MWp solar energy system to provide a constant supply of electricity to the plant was completed in December 2022. However, this component experienced significant delays due to restrictions imposed by the Israeli side on the entry of construction materials and equipment, which were described as “dual-use” materials, into Gaza. (Table 2).

Table 2: Summary of achievements across the Project’s outputs.

Outcome/Output	**Indicator** and **Target**	**Summary achievement**	**Status**
Outcome: Palestine’s infrastructure, and natural and cultural resources are more sustainably used and managed	217,000 residents of KY have access to municipal safe wastewater treatment services	WWTP was established and functioning in Al Fukhari area and at least 217,000 residents in KY city have access to wastewater treatment services.	Achieved
Construction of KY WWTP			
1. KY WWTP of a capacity of 26,600 cubic meters per day constructed and operated for one year after commissioning.	Functional WWTP of a capacity of 26,600 cubic meters per day is constructed and operated	The WWTP is established and function according to the design standards and specifications with high quality effluent water compared with the national and international standards. The plant still operates below its maximum capacity with about 16,000 cubic meters per day due to incomplete connection of the neighbouring communities in KY governorate.	Achieved

2. Effluent and emergency pressure pipeline of 18.6 kilometers length constructed.	Effluent and emergency pressure pipelines of 18.6 kilometres length of 900-1100 mm diameter constructed	An efficient pressure pipeline (ductile iron) is constructed with dual use to pump the treated effluent from the effluent pump station from the WWTP site to AL Fukhari infiltration basins or to the sea in emergency situation, the total length of the pipeline is around 18.6 kilometres.	Achieved
3. Al Fukhari infiltration basins of 97 donums area to recharge treated wastewater into aquifer constructed.	Al Fukhari infiltration basins constructed on a land area of 97 dunums.	The established infiltration basins in the agriculture area of Al Fukhari located in the east of KY and are currently used have a capacity of 9.7 million cubic meters of treated water per year in the first phase.	Achieved
4. Main electricity power supply line of around 3,000 meters length to operate the KY WWTP constructed	Main electrical power-supply connection line is constructed to provide 4 Megavolt amperes (MVA) to operate the WWTP.	The power supply connection line is constructed and connects the WWTP with the main electrical line from the main grid and power station through the main electrical medium tension line, passing parallel to Salah Edeen Street. The line is providing continuous electricity for the operation of the WWTP over 24 hours per day. The design will also support the second phase 'if approved' to expand the WWTP for all residents in KY governorate.	Achieved
5. Design review, pre-contract services and construction supervision for the construction of KY WWTP performed	Conduct design review to vet the tender documents and make certain that work requirements are clear during the construction phase. Contractual services and construction services are in place to ensure smooth implementation of the construction work in compliance with the international standards in terms of quality and treatment process specifications.	The design review, pre-contract services and construction supervision were carried out by a professional consultancy firm. UNDP has selected a joint venture consultant of international and local experts to ensure proper design and construction of the different phases and proper operation of the entire project.	Achieved
6. Implementation and operational capacity of the	70% of the effluent and emergency pressure pipeline and infiltration basins	Under full coordination and supervision of UNDP, the CMWU staff implemented the emergency	Achieved

Coastal Municipalities Water Utility enhanced	implemented by CMWU staff, to empower the capacity of the national partners with the necessary experience to implement large-scale projects to operate the plant and ensure long term sustainability.	pressure pipeline in addition to the infiltration basins. UNDP agreed with CMWU to allocate staff for the WWTP during the one-year operation according to the agreement with the contractor. This component was not fully achieved due to the delay by CMWU to allocate the WWTP staff for about 9 months.	
Solar Energy System for KY WWTP			
1.1.3 MWp renewable solar energy installed in KYWWTP to treat the wastewater in Khan Younis governorate.	Establish solar energy system to provide alternative energy source to operate the WWTP	Designing the solar system and the infrastructure for the solar system was completed. Installation of equipment including solar panels and steel work was completed. The delay to complete this component was due to the restrictions imposed by the Israeli side on the entry of construction materials and equipment into Gaza.	Achieved (Dec. 2022)
2. Improved awareness of Khan Younis residents especially women regarding the importance of clean water and hygiene, and increased engagement of communities in plans for effective utilization of treated water	Conduct awareness campaign to improve KY residents especially women on clean water and hygiene and effective utilization of treated water	An awareness raising campaign launched on the importance of clean water, hygiene and effective use of treated water for KY residents, including housewives and farmers attended the sessions & visited KY WWTP the awareness campaign was completed by submitting the assignment final report by the consultant in May 2021. The awareness sessions for KY residents needs to be expanded to cover other communities in KY governorate in the next phases.	Achieved

During the interviews with the beneficiaries and stakeholders, certain areas of greatest achievements in the Project recorded as follows:

- The Project addressed urgent and high-priority needs of the residents in KY city, who had been suffering from wastewater problems and the negative impacts on hygiene and health conditions for years.
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- The Project demonstrated a high level of coordination between the UNDP team and relevant stakeholders, resulting in successful endorsement and implementation. Key agreements were reached with PENRA and PWA to provide energy for the WWTP, and with CMWU as the operator of the plant,
- According to data from CMWU, the KY WWTP has led to a reduction in the amount of wastewater being disposed of in the sea compared to before the implementation of the project. Prior to the project, about 15,000 cubic meters of wastewater were disposed of in the sea, but after the project, this amount has been reduced to about 2,000 cubic meters from the town of Bani Sohaila. This has resulted in a significant drop in seawater pollution to about 90%. However, it should be noted that Bani Sohaila town, as well as other eastern towns in the KY governorate, are still not connected to KY WWTP due to a lack of funds for the necessary infrastructure and networks. The construction of wastewater networks in these towns is not part of the project.
- The design of the solar energy system adopted a strategic vision to build an "on-grid system", taking into consideration the capacity and resources of the local electrical network in the Gaza Strip. This design approach will also serve future phases of the WWTP to expand the current capacity up to 44,900 cubic meters per day.
- The Project approach included several advantages, particularly to design and put into operation modern techniques in wastewater treatment, while considering the local context and available resources in the Gaza Strip. The approach also involved transformation towards low-cost operations and maintenance that have high potential for future sustainability.
- The technical experts at MoA confirmed that the technology adopted in the Project will contribute to upgrade the agriculture sector in KY to supply water at accepted purity for from the infiltration basins for irrigation purposes rather than dumping this water into the sea.
- After completion of the first phase of the KY WWTP, it has the capacity to treat all received amounts of raw sewage of about 5.5 million cubic meters per year (about 15,000 cubic meters per day). It is expected that this amount will reach 9.7 million cubic meters per year after connecting the other communities in KY governorate. (Bani Sohaila, Abasan Al-Kabira, Abasan Al-Jadida, Khuza’a, Al-Fukhari, Al Qarara and Ma’an area) when the WWTP is operating at full capacity.

- The KY WWTP underwent a sophisticated design conducted through a joint venture between international and local consultancy firms. The design utilized modern techniques, including a treatment method that uses air bacteria, without the need for high-cost materials or additives. This design has resulted in significant advantages for the successful operation of the plant, such as high performance, and a reduction in operational and maintenance costs.

- According to the lab test analysis, the national quality criteria and standards of effluent treatment were met, and even exceeded the international quality standards.

The areas of lowest achievements during both the design and implementation of the Project can be summarized in the following points:

- During the one-year commissioning period, there was a delay in recruiting the required staff by CMWU to operate the plant. The recruitment process was delayed for about 9 months due to internal financial challenges at CMWU. However, the UNDP team was responsive and able to reach an agreement with the contractor to expand the commissioning period, providing enough time for the recruited staff to complete necessary training and capacity building to operate the WWTP.
- Ongoing discussions and debates are taking place between CMWU and local municipalities in KY regarding the coverage of operational and maintenance costs of the plant. This issue will be further discussed under the sustainability section of this report.

Interviewed stakeholders highlighted the achieved results, as the Project was implemented under difficult conditions and times in the Gaza Strip. They further indicated that best practices of wastewater treatment were applied during both the design and wastewater treatment at KY WWTP. During the interviews with the senior technical staff at the PWA, CMWU, they expressed that:

- The design of the KY WWTP was a collaborative effort between international and local firms, which allowed for a tailored design that met the specific needs and context of the Gaza Strip.
- The KY WWTP is environment friendly, as the adopted treatment process is initiated and proceeding without need to add chemicals or expensive materials.
- The construction of the WWTP provided a unique opportunity to enhance the capacity of CMWU, local municipalities, and contractors to implement large-scale projects in the wastewater treatment sector.
- UNDP's effective coordination and partnership approach, utilization of resources and networks, and careful risk assessment were crucial in overcoming the challenges during the design and implementation phases of the Project.

Selection of the Project locations

The selection of a rural location on the eastern border of Khan Younis for the WWTP was another significant success factor in the Project. The urban area is about 2 km away from the plant, which helped to limit the negative impacts of the Project on Al Fukhari residents near the plant location.

In addition, safety and working conditions for the WWTP staff were also considered. This was accomplished through the provision of required infrastructure and adopting the safety guidelines and practices during the operation of the plant. The noise level inside the plant was recorded at about 70 dB which is within the international standards[4].

Solar Energy System for KY WWTP

Electricity shortage in the Gaza Strip has severely affected the availability of essential services, particularly health, water and sanitation services, which make the operation of KY WWTP under the electricity shortage a pressing challenge. Therefore, a stable and reliable energy supply (24 hours per

[4] The World Health Organization (WHO) defines noise above 65 decibels (dB) as noise pollution. The noise becomes harmful when it exceeds 75 decibels (dB) and is painful above 120 dB.

day) is essential to maintain the operation of the WWTP and avoid negative consequences on the operation of the plant in case of shortage or cutoff power supply.

According to GEDCO, the solar energy system at KY WWTP is estimated to produce 2.1 MWp, and after deducting GEDCO's percentage (25%), the net production will be 1.6 MWp. This net production will be used in net metering, and if activated for 12 months, GEDCO predicts that the electricity invoice for KY WWTP will be zero per year, meaning that the solar energy system will cover 100% of the energy needed for full operation of the plant.

The activities and results achieved are as follows:

- Local and international experts developed a comprehensive design for an extendable solar renewable energy system to serve KY WWTP, divided into three packages with capacities of 1.3 MWp, 3.7 MWp, and 2 MWp. The main part of the design was developed by these experts. The first package, consisting of 1.3 MWp of solar energy system installation, was successfully implemented with funding from NRO.
- The installation of the solar energy system was implemented through a local contractor supported by international experts who connected the newly constructed solar plant to KY WWTP's main electricity supply network.
- Medium voltage network installation was carried out to connect all energy sources in accordance with the design. This included the implementation of two transformers (1600 KVA rate power) with relevant switch gears through Medium Voltage Breaker.
- All power lines (GEDCO, PV, and generator) were connected to the Automatic Metal Clad, which played a crucial role in controlling the entry of various electricity sources for the first time in the Gaza Strip.
- A SCADA system was installed to manage and control the electricity network, as well as analyze the solar plant's performance.
- A three-day advanced training was conducted to improve the capacity of 15 engineers and technicians on real-time data analysis and control using the SCADA system.
- The solar energy system was handed over after a 2-week commissioning period under UNDP support and the supervision of international experts

The implementation of the project faced major challenges due to the COVID-19 pandemic. The consulting firm was unable to engage with the international expert who was expected to design the extendable solar plant and address technical aspects related to connecting with the mains and serving the surrounding neighborhoods even in case of electricity cuts. In response, the Representative Office of Norway to the Palestinian Authority (NRO) and decided on 19 August 2020 that there is a need to have an extension for the project implementation. Accordingly, addendum No.1 was signed on 15 November 2020 to extend the project until 31 August 2021, adding nine months to the timeline, but no additional funding was provided.

PWA and local municipalities reported that the solar energy system is a key component to ensure successful operation of the WWTP on the long-term. The first stage of the PV Plant will cover about 30 % of the energy treatment consumption. An agreement was signed with GEDCO to provide

electricity to ensure proper functioning of the on-grid system, so that the WWTP will supply the remaining amounts of the electricity to the public electricity network.

Awareness raising

In 2021, an awareness campaign was conducted in KY under the Solar Energy project (output 2) to raise community awareness, especially among women, about the significance of clean water and hygiene. The campaign aimed to improve community engagement and effective utilization of the recovered water. The main activities implemented during the awareness raising campaign included[5]:

- Questionnaire: targeting communities, residents, women, youth, students, farmers, etc. in the seven municipalities in Khan Younis Governorate.
- A social media plan was prepared and implemented using social media to cover the targeted communities in KY.
- Distribution of 20,000 brochures for education and awareness about best practices of hygiene and water-related issues in the KY municipalities, universities, schools, women societies.
- Distribution of 20,000 brochures regarding aims and impacts of KY WWTP to improve health status and protect the public health, water resources and environment for KY residents, and how important is the community contribution to pay the wastewater bills to ensure sustainable operation of the plant.
- Story creation, video production, photography, infographics, etc were prepared and developed.
- Workshops and awareness sessions conducted for 408 women in Khan Younis Governorate.
- Workshops and field outreaches conducted for 407 residents including farmers in Khan Younis Governorate.
- Enhance dialogue and interaction with the farmers' communities, offices of CMWU, PWA, and MoA on the effective utilization of the recovered water in the Gaza Strip and the recovered water of Khan Younis WWTP.

Based on the project documents and focus group discussions with beneficiaries, the evaluation found that the awareness campaign successfully reached stakeholders and beneficiaries at various levels. Despite the challenges posed by COVID-19 restrictions, the campaign was implemented and completed while adhering to safety and health measures and guidelines during the awareness activities with targeted communities. Instead of the originally planned three workshops, eight workshops for women were conducted with a smaller number of attendees due to COVID-19 restrictions. The total number of targeted women and girls who were able to participate in these workshops was 400 participants.

Promotion of women empowerment

Due to prevailing social norms, women often face additional obstacles in accessing sufficient health care for themselves and their children, especially women headed households. By addressing the shortage of water and wastewater services in KY the project has helped decrease the vulnerability of women and reduce their burden of work in households by eliminating the spread of diseases resulting from wastewater pollution in the city. According to focus group discussions, more than 80% of

[5] Assignment Final report: Improved awareness of KY residents regarding the importance of clean water and hygiene, and increased engagement of communities in plans for effective utilization of recovered water

women reported that the project has improved household conditions, including hygiene, child health, and providing safe seawater for children to swim during the summer, through the installation of sewage systems in their communities.

As a result of the Project, women were able to access clean water and further use adequate quantities for primary care of household and family affairs and potentially will face limited obstacles in accessing sufficient health care services for themselves and their children, especially for women headed households.

The project has contributed significantly to improving the living conditions of women who are at risk of contracting diseases due to exposure to wastewater pathogens. However, during the focus group discussions, women expressed the need to be involved in future consultations, training, and decision-making processes related to improving water and sanitation solutions.

The project also aimed to empower women through specific activities. One such example is the comprehensive capacity-building training program for a group of 25 female fresh graduate engineers on the design and installation of solar energy systems. This training program has helped enhance the participation of women in the local market.

Impact of COVID-19

Following the outbreak of COVID-19 in 2020, the Israeli approval for the entry of materials, especially for the last component of the KY WWTP project - "rehabilitation of pumping stations 8, 3, and 2 in Khan Younis for KY WWTP" - was delayed. The contractors were disappointed that the equipment could not be delivered to complete the planned work. However, the UNDP team and donors provided significant support to overcome these challenges and facilitate the entry of materials and equipment. Despite these challenges, the construction and commissioning work of KY WWTP continued and was completed by November 2019. The operation and performance of KY WWTP were successfully maintained without any interruption.

4.4 Efficiency

To measure how economically resources and inputs were converted to results, and whether the most efficient processes have been adopted.

The UNDP team regularly updated the Project's implementation strategy, taking into account the local context, and successfully executed the Project with efficiency and cost-effectiveness despite the complex political conditions in the Gaza Strip. Additionally, the Project's budget was utilized efficiently to ensure the best value for money and optimal allocation of resources for the planned activities.

The evaluation revealed that changes to the project timeline and budget allocation were requested after the approval of the KY WWTP project. The resources were used efficiently to achieve results in terms of flexibility in budget allocation within certain specific activities per output. Changes to the budget allocation within the project were communicated to and approved by the donors. This enabled the UNDP team to reallocate time and resources efficiently, taking into account the complex political situation in Palestine during both the design and implementation phases.

The Project has been efficient in using its allocated budget to enhance women's participation and promote health practices among women and girls, particularly in relation to hygiene and water resource management, through the implementation of a public awareness campaign in KY. Additionally, despite the project's small budget, a training program for a group of 25 female engineers was conducted under the solar energy component to further promote women's empowerment.

KY Wastewater Treatment Plant

According to the evaluation analysis of the planned budget and actual expenditures per output, it was noted that, overall, the project implemented the activities within the planned budget as provided in table 3. All planned milestones in the project were achieved. All outputs under the construction WWTP were achieved.

Table 3: Financial status of the construction of WWTP, April 2022.

#	Activities	Total original budget	Kuwait Fund/IsDB Contribution US$		GoJ Contribution US$		UNDP Contribution US$	
			Allocated Budget	Disbursement	Allocated Budget	Disbursement	Allocated Budget	Disbursement
1.	Constructing Main Steel pipeline	527,303	0	0	527,303	527,303	0	0
2.	Providing the Detailed Design for the Construction	946,804	0	0	946,804	946,804	0	0
3.	Constructing Phase-1 Effluent & Emergency Pipeline	30,487,903	19,213,158	14,626,997	11,274,745	11,140,922	0	0
4.	Constructing the Effluent and Emergency Pipeline	5,792,912	5,792,912	4,680,393	0	0	0	0
5.	Constructing the Infiltration Basins (CMWU Implementation)	7,144,591	7,144,591	5,410,579	0	0	0	0
6.	Consultancy for Construction, Design & Review	2,944,594	2,149,339	2,149,339.	795,255	795,255	0	0
7.	CMWU Direct Implement. Cost	517,500	517,500	403,638	0	0	0	0
8.	UNDP Direct Implement. Cost	1,203,629	0	0	150,629.19	150,629	1,053,000	754,253

9.	Miscellaneous (GoJ)	36,328	0	0	36,328	30,191	0	0
10.	Sub-Total 1	49,601,564	34,817,500	27,270,947	13,731,064	13,591,116	1,053,000	754,253
11.	UNDP GMS (8% GOJ & 7% KF/IsDB)	3,535,710	2,437,225	1,908,966	1,098,485	1,087,289	0	0
12.	Sub -Total 2	53,137,274	37,254,725	29,179,914	14,829,549	4,678,394	1,053,000	754,253
13.	Contingencies	4,867,275	4,745,275	0	0	0	122,000	-
Grand Total		**58,004,549**	**42,000,000**	**29,179,914**	**14,829,549**	**14,678,394**	**1,175,000**	754,253

According to the Project budget and financial reports, UNDP efficiently used the budget and allocated resources needed to achieve the planned outputs through the following measures:

- The UNDP demonstrated flexibility in modifying and updating the Project's plans. The plan was originally to construct temporary treatment lagoons to handle 10,000 cubic meters per day of wastewater during an emergency. However, the scope of work was modified to design and construct an extendable WWTP with the capacity to treat 26,100 cubic meters per day.

- UNDP was responsive to the increase in the initial cost estimation for the construction of KY WWTP. Following recommendations made during the design phase to ensure capacity and quality functioning of the plant, the cost was increased. UNDP successfully mobilized resources to secure the additional funding requirements by agreeing with the Kuwait Fund for Arab Economic Development and IsDB in 2011 to secure the required additional funds of US$42 million for the construction of phase 1 of KY WWTP. An additional funding agreement was also achieved in 2013 between UNDP and IsDB, with the engagement of CMWU and PWA.
- The GoJ approved UNDP's request to reallocate US$1,100,000 from the revised budget of 2007 to cover the costs of designing the WWTP through a joint venture between a local and an international consultancy firm. The remaining amount of the contract (US$153,196) was reallocated to cover other components distributed in the budget lines.
- A budget of US$1,000,000 was allocated to build the main inlet steel pressure pipeline. UNDP reallocated the remaining balance to cover the implementation of the treatment plant component, as distributed in the budget lines, in accordance with the agreement between UNDP and IsDB. However, the remaining section of the pressure pipeline, approximately one kilometer long and leading to the treatment plant site, was completed with funds provided by the Kuwait Fund/IsDB.
- The contract with the international consultancy firm included a one-year operation after commissioning, s well as reviewing the tender documents and design costs. This was a key factor in ensuring the successful operation of the WWTP after its handover to CMWU.

The original Project duration was from 2005 to 2007, with a planned period of 24 months. However, due to the unstable political and security situation in the Gaza Strip between 2006 and 2007, the planned activities were delayed. To cover the design phase and other construction work and equipment, additional funding was needed. UNDP contracted both international and local

consultancy firms to work on the project, and the detailed design and tender documents were provided in December 2010. UNDP then secured additional funding from the Kuwait Fund for Arab Economic Development (KF) through the Islamic Development Bank (IsDB) in September 2013, with a completion period of 54 months. UNDP reviewed and updated the entire Project, allocated budget lines and resources, and implemented the Project using the available funds.

After finalizing the procurement processes to contract the international and local consultancy firms to carry out the design review and provide the pre-contract and construction supervision services. The construction works started in January 2017. However, implementation of the Project was delayed due to the unstable political situation in the Middle East and the delay in coordinating the importation of some materials from Israel. Additionally, some contractual obligations needed to be fulfilled, and the following challenges impacted the timely implementation of certain activities:

- There was a delay of approximately nine months in obtaining approval from Israeli authorities to allow the entry of stainless-steel pipes, diesel generators, and pump stations into Gaza.
- Coordination between the Palestinian Authority and Israel came to a halt in 2020, resulting in delays in obtaining donation numbers necessary for importing materials and equipment without paying taxes/VAT.
- The COVID-19 pandemic and related restrictions caused delays in manufacturing, shipping, and importing construction materials and equipment into Gaza, which led to delays in the implementation of construction works on-site by the contractors.

In order to complete the remaining activities, which included the rehabilitation of the pumping stations, the UNDP team had to request a no-cost extension for the Project until September 2021. Due to the war on Gaza in May 2021, UNDP also requested another no-cost extension from the IsDB to extend the Project until June 2022 to complete the rehabilitation of the pumping stations.

The construction of KY WWTP included not only the treatment plant but also an administrative building for the staff. The building was designed with specific safety measures in mind, and necessary furniture, IT equipment, and network installations were provided to create a conducive working environment for the WWTP staff.

The Project demonstrated efficiency in allocating funding and resources to the activities, while ensuring adherence to national and international standards in both design and implementation phases. This was achieved by engaging and recruiting an experienced international firm in the wastewater treatment sector, which successfully applied the design during the construction phase and provided supervision services for the construction of KY WWTP through Artelia and Universal Group consultants.

UNDP has developed a clear letter of understanding with CMWU for handing over the management and operation of the KY WWTP in November 2020. UNDP team continued their efforts to complete the remaining Project activities and facilitate emerging issues between the contractor and the CMWU staff during the one-year commissioning period of the WWTP.

Selecting local contractors with expertise and good capacity to implement the construction work and installation of equipment enhanced the project efficiency. During the FGDs with the contractors and the senior engineers who were responsible for the construction of the WWTP, reported that this approach of joint cooperation between local and international firm was effective and provided the local contractors with unique opportunity to upgrade their capacity to implement large scale projects and achieve the desired efficiency and standards.

Solar Energy System

The solar energy system was completed in December 2022, despite the delay due to Israeli restrictions on the entry of construction materials and equipment into the Gaza Strip. As summary of the solar energy project financial status until the time of the evaluation is provided in table 4.

The Integration of the on-grid PV system into the WWTP was an effective measure in reducing the operational costs of the plant, as electricity costs make up approximately 60% of the total operational expenses. This will ultimately contribute to the sustainability of the WWTP's operation. The solar system's design incorporated a strategic vision of connecting it to the local utility system, also known as the on-grid system, while considering the capacity and resources of the electrical network in Gaza. This connection enables surplus power generated during the day from the solar energy plant to be stored in the main grid and returned to KY WWTP at night, ensuring continuous electricity supply (24/7) for the WWTP. Furthermore, the design and infrastructure development of the solar system will serve future phases of the WWTP, allowing for the expansion of the current capacity of 26,600 cubic meters per day to reach the intended capacity of 44,900 cubic meters per day.

Construction of the solar energy system will contribute to providing electricity on a continuous basis for functional operation of the WWTP; hence, ensuring sustainable operation of the WWTP. The commercial agreement with GEDCO through the two-way meters will also contribute to enhance self-sufficiency and efficiency.

Dividing the installation of the solar PV into three phases was efficient strategy, as it enabled the initiation of a sustainable energy source to the operate the WWTP. This approach has further enabled UNDP to attract other donors for the installation of the remaining phases for the sustainability of the plant.

Table 4: Financial statutes for the Solar Energy System for KY WWTP, December 2022.

Activities	Approved total budget US$	Total charged expenses US$	Variance US$	Percent Expenses
Project expenses – Grant recipient/UNDP Costs directly related to the implementation of the project	1,655,503	1,630,159	25,343.61	98%

Project expenses – cooperating partner(s) Costs directly related to the implementation of the project	0.00	0.00	0.00	0.00%
Overheads: Indirect administrative costs related to the implementation of the project	502,750	461,402	41,347.90	92 %
Total expenses	**2,158,253**	**2,091,562**	**66,691.51**	**97%**

In addition to cost-efficient management of resources, the Project's utilization of solar energy as a renewable and clean source of energy contributed to the preservation of the environment by reducing CO2 emissions and safeguarding the aquifer through an environmentally efficient wastewater management system in the Gaza Strip.

Risk Management, Monitoring and Evaluation

Overall The M&E systems implemented by UNDP allowed for continuous follow-up identification of challenges and potential risks, implementation of risk mitigation actions, and achievement of milestones within the planned timeframe.

During this evaluation, the assessment of risk management was primarily based on the Project's documents and reports, as well as interviews conducted with the UNDP team. The Project documents included a thorough analysis of potential risks and a comprehensive risk management plan. The necessary mitigation measures were put in place to ensure the smooth implementation of the Project interventions.

The risks during Project implementation were considered low to medium, and are mainly related to blockade and restrictions imposed by Israel on the Gaza strip. This complicated situation resulted in serious challenges and delay to purchase the required parts and equipment to complete the construction works of the WWTP which are mostly not available in the local market. The evaluation found that the implementation process was closely monitored by Project team, with extensive support from UNDP senior management throughout the duration of the Project. UNDP team was also responsive to follow up emerging risks during the escalations on Gaza Strip on May 2021 and the COVID-19 pandemic.

Efficiency of Project Management to achieve planned results

For such a complex and large-scale project with high quality parameter, the management team was efficient to manage all Project activities, and to provide needed follow up and supervision to ensure quality and timely implementation of planned activities. This was confirmed by the feedback from the donors, stakeholders, contractors and consultants. The main success factors included:

- Implementation has been working well overall, and all financial claims were timely issued without significant delay or disputes with the contactors and consultants.
- Well prepared research and technical analysis ahead of the Project to identify the available resources and expertise locally and internationally.

- Good networking and cooperation with the relevant actors and authorities in the wastewater treatment sector.
- Ability to engage all relevant stakeholders in the different stages of the implementation phase, particularly during the design, implementation, commissioning and handing over, which had a positive impact on achieving the planned results.

4.5 Likely Impact

Will assess the positive and negative consequences of the Project's activities, direct and indirect, as well as intended and unintended

The Project is a crucial, strategic intervention that has put an end to the long-standing suffering of KY residents who had been disposing of raw sewage in the environment without any treatment through thousands of cesspits in the streets and ad-hoc lagoons. This practice posed serious risks to the public health of the residents, as well as contaminating the ground water aquifer.

For many years, wastewater in KY was pumped into the sea off Gaza's coast, polluting the sea and underground reservoir. The water conditions in Gaza continue to drastically decline, particularly in the last two years before the construction of the KY WWTP due to increasing the amounts of pumping the raw sewage into the sea. This posed serious risks to the residents' public health as well as contaminating the ground water aquifer. About 75 percent of Gaza's 40-kilometer coastline was affected by pollution. Therefore, the EQA has warned residents against swimming outside of three specific areas. Residents in the Gaza Strip typically flock to the beaches to de-stress and escape the summer heat[6]. The amount of raw sewage disposed to the sea has been reduced to about 2000 cubic meters per day (comes from Bani Sohaila town in the eastern area of KY governorate which is beyond the scope of work of the Project). Consequently, this resulted in significant drop of the seawater pollution to about 90%.

> In his speech during the opening ceremony of KY WWTP, the Palestinian Prime Minister (Mohamed Ishtayya) said: This is a major national project implemented in recent years in Palestine that serves more than 400,000 of KY residents. The project contributed to protect the area the residents from an invetable humanitarian catastrophe".

All interviewed stakeholders reported common feedback and stressed that the Project has high impact to improve quality of life for KY and should be further expanded to cover all communities in KY governorate. Also, coordination between relevant parties and donors is needed to move forward to complete the second phase of the WWTP to reach the target capacity of 44,900 cubic meter per day, in addition to mobilize funding to connect the other communities in KY with sewage network.

More specifically, the direct impact of the Project is:

- Protecting public health and environment KY residents.
- Developing the public and social infrastructure in the Gaza Strip.
- Preserving the limited water resources in the Gaza Strip, especially the coastal aquifer.

[6] Environment Quality Authority (EQA) – Palestine, (April 2018).

- Providing a new water source through recharging the treated wastewater into the aquifer to ultimately be used for agricultural purposes.
- Enhancing the operational capacity of the CMWU as final operator of the treatment plant.

PWA confirmed that the Project was a vital strategic shift towards providing sanitation services in KY, which has a total population of approximately 400,000, who have been suffering for decades from the lack of adequate sanitation facilities. According PWA data, improvement of the water quality in KY governorate as a result of establishing the WWTP is expected to continue to improve over the coming years, this will also have significant impact on the hygiene conditions for the residents in KY However, it is still too early to identify the specific improvement rate of water quality due to the different factors affecting the water management sector in the Gaza Strip.

In the Gaza strip, groundwater from the aquifer is the only water resource available, CMWU data shows that abstraction from the aquifer is four times the aquifer recharge rate at 260 million cubic meter per year in 2020. In addition, more than 90% of the abstracted water is polluted and does not meet the national standards due to high salinity levels from sea water intrusion and high nitrate levels from uncontrolled use of agrochemicals and wastewater infiltration to the aquifer. Furthermore, the absence of sufficient wastewater treatment facilities results in approximately 35 million cubic meter per year of untreated wastewater discharged into the sea along the Gaza Strip coast of which about 5 million cubic metres in KY coast.

KY City was full of cesspits distributed in all streets that frequently flood and endanger the life of people and cause hygiene and health problems. After connecting the city with the sewage network, the number of cesspits in KY was reduced by at least 90%.

> One resident from Al Amal neighbourhood said: Before the installation of the wastewater network, wastewater used to flood into the streets of the neighbourhood. The situation was bad, he added, “Life before the construction of the wastewater plant was hard, now our children enjoy walking and playing safe in the streets”.

The KY mayor expressed great satisfaction with the results of the Project, describing it as a major accomplishment for the residents of KY. He highlighted the Project's success in halting the flooding of raw sewage in the streets of KY city and the camp, which has been a long-standing issue. The mayor also emphasized the immediate positive impacts of the WWTP's construction on minimizing waterborne diseases in KY, leading to visible and significant improvements in health and hygiene conditions. As a result, the mayor expects that the health and hygiene conditions of KY residents will continue to improve in the future. The mayor acknowledged that there are challenges related to covering the operational costs of KY WWTP due to the difficult economic conditions in the Gaza Strip, which negatively affect the collection rate of bills. However, he expressed optimism that joint efforts and contributions from other municipalities in KY would help overcome this situation. This can only be achieved when these municipalities become direct beneficiaries of the KY WWTP services and are connected to the wastewater network.

Feedback from the FGDs of people consulted in the interview indicated that the streets are clean now after years of suffering from the sewage water particularly in the old city of KY. For many years, they had to pay to discharge the cesspits on weekly basis using trucks outside the city. The situation now is significantly improved compared to the previous years.

Improving quality of groundwater

The Project has had a positive impact on the groundwater, as treated water has been used to recharge the aquifer. The groundwater level in the wells near the infiltration basin has increased from 4 to 6 meters, according to data from the PWA and MoA. In the first phase of the project, about 9.7 million cubic meters of water can be infiltrated annually into the aquifer. It is expected that the amount of water infiltrated will increase to 16.5 million cubic meters annually (MCM/year) after the implementation of the second phase of the project. The potential negative impact of the project is the saturation and overflow of the aquifer if the infiltrated water is not reused for agriculture. However, this issue can be mitigated and controlled through more investment in the Al Fukhari area to recover and reuse treated water for irrigation and other farming industries.

Construction of KY WWTP is expected to contribute to reducing drinking water pollution through reducing the amounts of wastewater disposed to the aquifer via cesspits and ad hoc lagoons. The quality parameters of the treated effluent exceeded the national standards, where loads of biochemical oxygen demand, nitrogen and phosphorus in treated waste water of KY WWTP fell below the national standards. This will clearly improve the quality of water on the long-term in KY governorate as provided in table 5.

The evaluation found remarkable improvement of the aquiculture well near the infiltration basins of KY WWTP. The aquifer quality of the existing agriculture wells (around 1000 m in the western direction of infiltration basin) was tested in 2018. It was noted that the Total Dissolved Solids (TDS) were high and the measurements exceeds 4000 mg/l. After the establishment of the treatment plant and infiltration basins, TDS gradually decreased as a result of charging the aquifer with treated wastewater until it reached about 2500-3000 mg/l, which indicates the positive effects on the groundwater aquifer, as it reduced the concentration of total dissolved solids (TDS).

The evaluation found good quality of effluent for all parameters and significantly exceeds the Palestinian standard for groundwater recharge compared with the other plant in the Gaza Strip. Table 5 shows the results of lab tests conducted by EQA and Islamic University labs for quality of the effluent from KY WWTP compared with Palestinian Standards (PS). As result of the design and construction of advanced and effective UV disinfection system for KY WWTP, the Fecal Coliform (FC) counts is less than 200 CFU/100 ml and as low as zero (0) CFU/100 ml.

Table 5: Concentration level of effluent from KYWWTP comparison with Palestinian standards.

Parameters	BOD	COD	TDS	TSS	NO_3-N	NH_4	FC	pH
Unit	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	CFU/100 ml	Value
PS Concentration level	40	100	1500	50	30	10	<1000	6-9
Effluent Concentration	<20	<40	2000 - 2500	<10	3-9	5	<200	7.8
KYWWTP Inflow	450 - 500	800 - 1100	2000 - 2500	350 - 500	-	80	10^8	8.2

Source: Environmental Quality Authority. March 2019.

BOD: Biochemical Oxygen Demand
COD: Chemical Oxygen Demand
FC: Fecal Coliform
TDS: Total Dissolved Solids
TSS: Total Suspended Solids
NO_3: Average Nitrate concentration
NH_4: Average Ammonia concentration

Table 6 shows the results of the lab tests conducted by the MoA for the WWTP plants operated in the Gaza Strip, it was found that the FC and other microbiological parameters in the effluent of KY WWTP are at very low levels and even reached negative or zero, compared with the other WWTP plants.

Table 6: Comparison of the Fecal Coliform results for the watewater treatmet plant in the Gaza Strip

Plant/Location	Fecal Coliform FC (Effluent/Outlet)	Fecal Coliform FC (Sludge)
Northeast Gaza/ NGEST	$8X10^2$	$4X10^3$
Middle area (Al-Buraij)	$2X10^5$	$5X10^3$
KY WWTP	*Negative (0)	Negative (0)

Results from: The Ministry of Health Microbiology Laboratory (March 2022).

** Negative: means that the testes samples are free of FC.*

The groundwater level is about 60 meters from the surface of the earth below the infiltration basins, this will further improve the quality of water from these wells. According to Al Fukhari mayor and PWA, a potential challenge is related to the prolonged shortage of electricity to operate the recovery wells, which resulted in diffusion of treated water into the aquifer of Al Fukhari area, thus, mitigating this issue require finding alternative electrical sources to ensure sustainable operation of the recovery wells.

The Project contributed to improving the infrastructure in Al Fukhari area around the WWTP, in terms of rehabilitation and maintenance of roads and constructing new sewage and electrical networks. According to MoA, PWA, and Al Fukhari municipality, these achievements need to be upgraded in future interventions to attract more investments for agricultural activities using the treated water produced from the WWTP.

The sludge produced from the WWTP is now stored at the plant site by the operator who may dispose it to the solid waste landfill instead of composting it and using for agricultural purposes, especially as the recent microbiological lab tests of the dried sludge (as seen in table 5) indicated that the fecal coliform and other pathogens counts as low as zero (0) CFU. This requires enhancing investment or donor response to avoid any related environmental challenges in the future.

4.6 Likely Sustainability

Will measures the extent to which adopted technology, approach, and benefits will continue after completion of the Project.

The Gaza Strip is grappling with a chronic humanitarian crisis, which severely impacts the livelihoods and access to essential services for its densely populated area of approximately two million residents. The longstanding Israeli blockade, internal divisions, and recurrent cycles of conflict and Israeli aggression have made it challenging to ensure the sustainability of interventions in the region, given the high levels of poverty and difficult economic conditions. The economic challenges have also hindered the development of local infrastructure and impeded efforts to improve municipal services for residents. Additionally, local municipalities face significant challenges in collecting bills, increasing revenue, and encouraging residents to pay the costs of municipal and sewage services. Consequently, it is unlikely for the municipalities and CMWU to achieve self-sufficiency without external aid.

To enhance sustainability of the Project's outputs, UNDP focused to ensure sustainable operation of KY WWTP after commissioning and handing over through the following:

Knowledge and experience transfer

- The UNDP and PWA have agreed that CMWU will be responsible for the operation of the WWTP to ensure its sustainability and continuous operation. Positive progress has been made in the commitment of the PWA, CMWU, and local municipalities.
- The one-year commissioning period of the plant was an essential component aimed at exchanging knowledge and proper codes of practice with WWTP staff. This activity was implemented with the close support and cooperation of CMWU to equip their staff with the necessary experience required to properly operate the treatment plant.

Financial sustainability

- The solar energy system was designed to optimize the operation of KY WWTP and reduce overall running costs, thus ensuring a sustainable operation of the plant.
- A constant supply of electricity for the plant is ensured through a net metering agreement with PENRA and GEDCO, which endorses the operation of the on-grid solar energy system covering all energy needed for the full operation of the WWTP.
- PWA has obtained Palestinian Authority endorsement to convert the electricity costs for the plant to monthly estimated costs, which are transferred through the PA financial system.

There are still challenges related to financial sustainability of CMWU and local municipalities to secure needed operational costs for the KY WWTP, particularly due to the hard-economic conditions in the Gaza Strip that have significant negative impact on the collection rates of the bills.

Furthermore, part of the municipality bills should be subsidized to CMWU for the wastewater management services, but this has not been implemented yet due to the limited collection rate. As a result, the KY municipality is currently subsidizing about 90% of the operation and running costs of the WWTP. Although PWA and CMWU confirmed that there was a clear agreement between the parties, the implementation of this agreement faces some challenges, and there is still ongoing debate between CMWU and KY municipalities to secure the operational costs of the plant.

The financial challenges, particularly the low salary scale of key staff and technicians, have resulted in a high staff turnover rate. According to the KY mayor, CMWU has been unable to fulfill its commitments to cover the operational costs due to the irregular payment of contributions by municipalities in the KY governorate. Therefore, KY municipality is now the main contributor covering the operational costs of the plant.

To address these issue and gauging sustainability, further work is expected to:

- Developing financial and strategic plans to enhance revenue and financial sustainability of the CMWU in coordination with the municipalities in KY governorate.
- Review options and develop functioning models between CMWU and the municipalities to increase bills collection rate so that municipalities can cover their contributions to the CMWU. Therefore, developing financing strategies is particularly essential, as the CMWU does not generate sufficient income to cover the operational costs.
- Enhancing investment opportunities in Al Fukhari area to generate income from distribution of treated water to the farmers,

The Project contributed to upgrade the capacity of the municipalities and the PWA to more effectively manage and regulate natural resources to in addition to treating the sludge coming out from WWTP to be used for agriculture purposes. ensure the equitable provision of sustainable infrastructure in wastewater treatment during both the design and implementation phases.

After constructing and commissioning the WWTP, one year of operation of KY WWTP was successfully carried out by the international contractor, who was responsible for the construction of the plant.

This period was essential component that aimed at exchanging knowledge and proper codes of practice with CMWU. This activity was implemented with close support and cooperation with UNDP team, in order to equip CMWU with the necessary experience required to properly operate the treatment plant to ensure the Project's long-term sustainability.

Essential sustainability factor was noticed in the evaluation that the PWA obtained Palestinian Authority endorsement to covert the electricity costs for the plant to be transferred through the PA financial system (Known as clearing).

Project's participatory approach and strategy to enhance capacity of PWA, CMWU, and local municipalities during the design and implementation phases positively contributed to establish national ownership and active engagement. Hence, ensuring their commitment to provide necessary support and facilities for sustainable operation of the WWTP despite the current economic challenges, which resulted in smooth handing over of KY WWTP to CMWU, as the recognized national body for municipal services and water resources management in the Gaza strip.

Inclusion of vulnerable groups including women and PwDs

The Al Amal lagoon was established in the northern part of KY governorate to collect wastewater from neighbouring communities, providing relief to residents who have suffered from pollution and flooding of wastewater in nearby houses for many years. The project took a human rights-based approach, responding to the needs of vulnerable communities and empowering women in the governorate by supporting their right to safe, clean water and hygienic sanitation, recognized by the United Nations General Assembly in 2010.

Under the solar energy project, the project also encouraged women's empowerment and gender equality through awareness campaigns, workshops for 408 women and girls, and training on the design and implementation of solar energy systems for a group of 25 female engineers. However, more work is needed to enhance the inclusion of women and persons with disabilities (PwDs) in the community and ensure their sense of ownership in advancing their participation in the wastewater and water resources management sector.

The project's scope of work was modified to ensure environmentally sound disposal of the treated wastewater through the construction and installation of an infiltration system. This addition maximizes the utilization of treated wastewater by recharging it into the aquifer for irrigation purposes and relieving pressure on the water aquifer.

5. Conclusions

The Project was implemented in accordance with national priorities and effectively addressed the significant environmental and public health challenges faced by KY governorate, which had for long suffered from the absence of adequate sewage services. The Project was implemented at a critical time and met the needs of KY residents by addressing the major environmental and public health challenges resulting from the absence of sewage services. Stakeholders and beneficiaries provided

positive feedback on the impact of the Project, which facilitated access to safe sewage networks and improved living and health conditions in the community.

The Project was effective, and the majority of the planned activities achieved their intended results. Despite the complex implementation environment in the Gaza Strip, the UNDP team successfully navigated various challenges during the design and implementation of the Project interventions. UNDP's efforts to facilitate and coordinate the entry of the remaining materials and equipment led to the completion of the final phase of the solar energy system, which had been delayed for more than a year due to restrictions imposed by Israel on the entry of construction materials and equipment into the Gaza Strip.

"The Project is well designed and commendable as UNDP launched this initiative with the aim of improving access to adequate and inclusive sanitation and high-quality sewage services for KY residents, utilizing modern technologies according to national and international standards, and leveraging renewable and sustainable photovoltaic solar energy. Despite the financial challenges faced by PWA, CMWU, and local municipalities in implementing strategic interventions in the wastewater sector, the Project has successfully laid the foundation for sustainable operation of the WWTP with clear commitment and endorsement from the relevant stakeholders.

The UNDP team's efficiency and responsiveness in addressing the challenges during the design and implementation phases of the KY WWTP project were highly appreciated by all stakeholders. The team's technical expertise and flexibility in the sector played a significant role in achieving this success. Despite the restrictions and blockade on the Gaza Strip, the team was able to mobilize all relevant national bodies, including PWA, PENRA, CMWU, and municipalities, to support the project's construction and operation. This level of collaboration and cooperation is crucial for successful project implementation, and the UNDP team's achievements in this regard are commendable.

The project successfully mitigated the associated risks during the design, implementation, and handover phases. Additionally, the project team was able to effectively address the emerging challenges related to the COVID-19 pandemic and the May 2021 hostilities on the Gaza Strip.

The sustainability of the KY WWTP project was confirmed through its modern design and efficient mode of operation, resulting in low operational costs and minimal use of consumable materials and chemicals during the wastewater treatment process. This sets it apart from other interventions in the Gaza Strip, showcasing its distinguished approach to sustainability.

The evaluation revealed that even though the KY WWTP project is a construction and infrastructure intervention, it is still relevant in supporting the needs and priorities of women. This is because women constitute about 49.1% of the community in the targeted areas of KY, according to the PCBS data. As women and girls play a leading role in households and are the primary users of water resources.

6. Lessons learned

- Given the ongoing unstable conditions and humanitarian crisis in the Gaza Strip, the ability to mobilize funds for emergency interventions has proven to be highly beneficial in addressing the needs and priorities of the most affected people.
- Targeted communities witnessed a significant improvement in their access to sewage services and improving living conditions. However, the non-sewer connected communities continue to face challenges in accessing sewage services, leading to issues such as wastewater flooding and landslides in the streets, along with other related consequences.
- The continuous support of the donors and the diligent follow-up by the UNDP team enabled the Project to successfully facilitate the entry of materials and equipment, including those classified as "dual use," during the construction phase. This allowed for the completion of the planned activities and ensured the success of the Project.
- Focusing on institutional building and staff capacity building, along with the construction and infrastructure activities, proved to be effective. Continuous organizational capacity building for CMWU and the WWTP team was an essential factor in guaranteeing the continuity of services and the sustainable operation of the plant.
- Engaging local community organizations in the awareness-raising activities would increase the impact of the activities and reach a wider audience, ensuring adequate representation of women. The messages should address the rights as well as the obligations of the target beneficiaries towards living in a safe environment. The awareness campaign should also target small farmers to educate them on the safe and effective utilization of treated water from the infiltration basins for irrigation purposes.
- Establishing common agreements between UNDP and relevant stakeholders such as PWA, CMWU, Khan Younis Municipality, and PENRA has been an essential component and successful practice in enhancing institutional capacities and promoting local ownership towards the sustainable and quality operation of KY WWTP.
- The joint venture between international consultancy firm and local contractors to design and construct the KY WWTP proved to be highly effective. It provided a valuable opportunity for knowledge and experience transfer to the local contractors and experts, which enhanced their skills and expertise in the field.
- The construction of infiltration basins to infiltrate the treated water was an important component of the WWTP. However, it is important to note that large amounts of treated water will accumulate in the aquifer over time, which will create several opportunities for potential investment in the treated wastewater.
- The presence of UNDP's competent management team and technical experts played a crucial role in achieving the planned results of the Project. Such technical expertise should be utilized to

expand and replicate the success of the current and future wastewater treatment plants in Palestine.

- Adequate attention should be given to sludge treatment in order to mitigate the pressure on the landfill near the plant location caused by the accumulation of sludge over time.

- The provision of technical and capacity building training for women graduates was a crucial intervention that enhanced community engagement, particularly among women, in the infrastructure and construction project. The success of this model can serve as a basis for designing future interventions to target other women groups, thereby promoting gender equality and women's empowerment in similar projects.
- The development of a new tariff and revenue collection system is crucial for improving the financial sustainability and viability of wastewater services. This should be done in coordination between CMWU and local municipalities to ensure effective implementation.

7. Recommendations:

The below are the recommended interventions based on the evaluation findings, conclusions, and lessons learned:

Recommendation 1: Mobilize funding and investment to expand the wastewater networks in KY city, in order to connect neighborhoods that are currently not connected to the sewage system.

Recommendation 2: Explore opportunities to utilize the treated water from the infiltration basins as a new water resource, in addition to developing the infrastructure of the recovery and reusing scheme in Al Fukhari area to enable farmers to have better access to treated water for irrigation and agriculture purposes.

Recommendation 3: Support the development of proper disposal and recycling routes for sewage sludge to eliminate risks to the environment and human health. Additionally, explore ways to utilize valuable compounds in the sludge such as organic compounds, inorganic non-toxic substances, phosphorous, and nitrogen-containing compounds.

Recommendation 4: Strengthen the women's empowerment and capacity development component in future projects by providing additional trainings that target women and girls, taking into consideration the specific needs of persons with disabilities (PwDs). The trainings should cover advanced energy systems, agribusiness, water resources, and environment.

Recommendation 5: Expand the awareness campaign and create knowledge through:

- Targeting female households in the marginalized communities with education and awareness campaigns on wastewater management and good hygiene practices; to enhance engagement and responsiveness of the local population in the wastewater management and water sector.

- Raising awareness towards sustainable wastewater reuse in urban and farming areas, in coordination with local actors and community-based organizations in the wastewater management sector.

Recommendation 6: Provide ongoing technical training for WWTP staff and technicians, with a focus on topics such as process control and quality management; to ensure they are able to adopt modern methods and techniques in the wastewater treatment sector. Additionally, provide training to technical staff from the municipalities to ensure they can maintain the constructed infrastructure, such as wastewater networks and pumps, during the operation process.

Recommendation 7: Foster active engagement of local municipalities in the design and implementation of various activities, as a means of building capacity and promoting local ownership.

Recommendation 8: Strengthen financial sustainability and effectiveness of sewage services by:

- Providing institutional capacity building and technical assistance to enhance the capabilities of the wastewater department and staff at the CMWU.
- Establishing a wastewater collection system for the eastern towns of KY governorate to support the payment of water bills, thereby creating a stable source of income for the CMWU.
- Promoting cooperation between the CMWU and relevant municipalities to establish and operate an effective billing system that covers the operational and maintenance costs of the WWTP.

Recommendation 9: Develop a policy and an effective dissemination mechanism to promote the reuse of treated wastewater by PWA and CMWU, in coordination with the Ministry of Agriculture (MoA).

Recommendation 10: Create opportunities to empower youth, both women and men, to participate as entrepreneurs and startups in farming, agricultural value chains, and processing in Al Fukhari area and neighboring communities near the WWTP. This can be achieved through investment, business funding, and the provision of support programs.

1. Annexes