

DEVELOPING A DYNAMIC DIGITAL GEO-PLATFORM FOR THE THIRD NATIONAL WATER MASTER PLAN



FINAL REPORT

Submitted By:



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LIST OF ABBREVIATIONS

GIS	Geographical Information System
GIZ	German Agency for International Cooperation
IT	Information Technology
JVA	Jordan Valley Authority
KAC	King Abdullah Canal
MCM	Million Cubic Meter
MWI	Ministry of Water and Irrigation
MWR	Management of Water Resources
NWMP	National Water Master Plan
WAJ	Water Authority of Jordan
WEAP	Water Evaluation And Planning Tool
WWTP	Wastewater Treatment Plant

EXECUTIVE SUMMARY

The final report represents the final requested deliverable from the consultant. The final report represents the main project achievement throughout the project cycle in addition to the consultant recommendations for future improvement.

The main project achievements were the development of the digital platform and uploading the available 3rd national water master plan documents.

Also, the consultant delivered 5 days training on the management of the digital platform for the key users from MWI, WAJ and JVA.

1. INTRODUCTION

1.1 BRIEF ABOUT THE PROJECT

This project is implemented under the umbrella of the GIZ Water Program project titled Management of Water Resources (MWR). This project is part of the GIZ Water Program project titled Management of Water Resources (MWR).

Through the dynamic and user-friendly Geo-platform, the result of the NWMP-3 will be presented. This platform should present the results of NWMP-3 in a systematic and automated way with user-friendly interfaces providing on spot analysis based on the updated values and parameters provided by all relevant data sources through direct link to their databases. The main objectives of the of the Digital Platform are:

- Present content of the Third National Water Master Plan (graphics and maps showing the current situation and what is planned)
- Ease digital updating of NWMP-3 (every 5 years)
- Show projects in the Capital Investment Plan and related information in the form of thematic maps (separate for water supply, wastewater, reuse, and energy)
- Show the status of the resources for allocation decisions:
 1. long-term average and the current amount of rainfall at representative stations
 2. storage capacity and actual stored amount in dams
 3. active wells with production in the last 3 years and current.

The platform will be ready with all tools needed to analyze GIS data to show the results in a map-based interface with the option to show all analysis charts and tables that supports the future planning and decision-making process.

The project Development Strategy will be conducted in two Phases. The success of the project in providing a long-term sustainable platform is dependent upon the completion of both project phases, furthermore, the Geo-Platform implementation will follow an incrementally approach so it covers all the finalized NWMP volumes contents and analysis results as they are ready.

The project has an addendum to the original contract (Contract No. 83393203). Under this addendum, the consultant in coordination with GIZ will assess the GIS activities in the water sector in Jordan and propose the best solution to create central GIS unit (s) to support the decision-making process in the sector, harmonize and regulate the GIS data, GIS technology and all water-related applications used in the sector.

1.2 PROJECT OBJECTIVES

The main goal of this project is to apply the concept of the sustainability and institutionalization of the activities of the Third National Water Master Plan to support the decision-making and planning processes. Therefore, specialized programming and web-based development services for the NWMP-3 results should be provided to ensure the authorization of the Ministry of Water and Irrigation to update these results based on the updated information.

The objective of this project is to design and implement a GIS-based platform based on the Third National Water Master Plan (NWMP-3). The platform will present the results of NWMP-3 in a systematic and automated way with user-friendly interfaces providing on-spot analysis based on the updated values and parameters provided by all relevant data sources through a direct link to their databases. The platform will be ready with all tools needed to analyze GIS data to show the results in a map-based interface with the option to show all analysis charts and tables that supports the future planning and decision-making process. The platform will show the management of the water sector institutions (MWI, WAJ, and JVA).

The main objective of the new task; “needs assessment for the proposed GIS unit to effectively and efficiently serve all water sector institutions” (addendum) is to modernize and harmonize GIS services in the water sector institutions and to define a common unified vision and establish a mutual framework for all counterparts within the water sector to efficiently and effectively utilize the GIS technology to support and enhance the decision-making process in MWI, WAJ, and JVA, the task resulted in proposing a unified GIS unit for the water sector with a roadmap for its responsibilities, services, and SOPs.

1.3 CONSULTANT TASKS

According to the project TOR, the consultant tasks are divided into two phases; inception phase and the implementation phase. The following methodology was adopted during the inception and implementation:

- Review all documents & presentations produced within each NWMP volume and identify the core content such as analysis results, maps, charts and tables.
- Review and analyze all data types, GIS layers with the data sources as needed to design the database model of the Geo-Platform.
- Consultation with stakeholders for initial input and analyze the quality of all data types needed to define the NWMP results.
- Study and understand the NWMP objectives by conducting meetings with GIZ and counterpart staff (MWI, WAJ, Water Utilities, and JVA)
- Assembly and mapping of base line information (land use, topography, drainage, vegetation, infrastructure, protected areas, cultural sites, etc.)
- Build the database design required to operate the Geo-platform and host the data from various sources
- Implement and deliver a digital platform for the water sector (NWMP) based on ArcGIS environment, which provides a customized web-based interface for presenting

the NWMP-3 results with an easy-to-use data entry application to enable all counterparts to update these results based on the updated information which shall be provided from the different data sources.

The following chart shows the main tasks of the consultant during the implementation phase.



Figure 1: The Consultant's tasks during the implementation phase

Under the “needs assessment for the proposed GIS unit to effectively and efficiently serve all water sector institutions” task, for the concept for GIS specialized training for the GIS unit staff to improve and built the capacity of managing, monitoring, and developing in the GIS environment within the whole water sector shall be developed. Furthermore, a separated final report was prepared and delivered specifically for this task.

The following NWMP-3 documents were reviewed and implemented in the project:

1. Rapid Assessment of the Consequences of Declining Resources Availability and Exploitability for the Existing Water Supply Infrastructure.

2. Third National Water Master Plan (NWMP-3) Volume B Water Resources with its Annexes.
3. Third National Water Master Plan (NWMP-3) Volume C: Water Demands, Uses and Allocation Gaps with its Annexes
4. Third National Water Master Plan (NWMP-3) Volume D: Planning and Decision-Support System Tools
5. Institutionalization Standard Operating Procedures for Preparation of the Annual Water Budget and the Water Master Plan through a Moderated Processes

2. PROJECT ACHIEVEMENTS

2.1 Identifying the Data Sources

- All data sources for the 3rd national water master plan volumes contents were identified and the data inside the platform database was recognized and implemented in a comprehensive way.
- The consultant reviewed and analyzed all data types as needed to build the Geo-Platform.

2.2 Enforcement of the Database Schema

- The Geo-database model for the 3rd NWMP platform was implemented in three successive phases (Conceptual design, Logical design, and physical design).
- The 3rd NWMP data has been uploaded to the geodatabase:
 - Tabular data imported from Excel or entered manually into the database tables
 - GIS data collected from GIZ and then loaded to the database

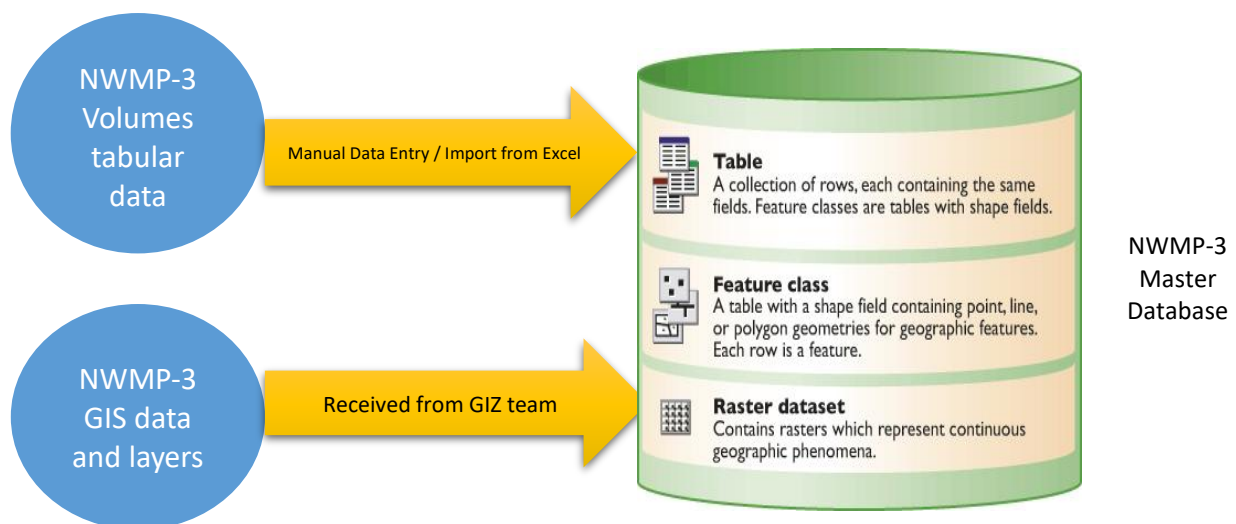


Figure 2: NWMP-3 Master Database

- Database was implemented with the following total features:

Total Feature Datasets	Total Feature Classes	Total Tables	Total Domains
27	101	87	183

Datasets:

- Administrative
- Agriculture
- Carto
- Climate
- Contours
- Demography
- Desalination
- Energy
- Geology
- GW
- GWL
- Industrial
- Infrastructure
- KAC
- Projects
- Reference
- Scada
- SW
- Telemetry
- Topography
- WaterDistricts
- WaterNeeds
- WaterRecharge
- WaterTrade
- WNet
- WWNet
- Zones

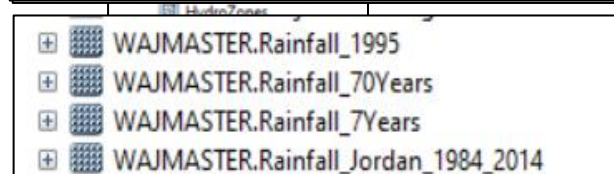
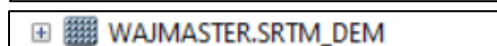
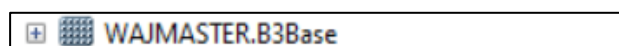
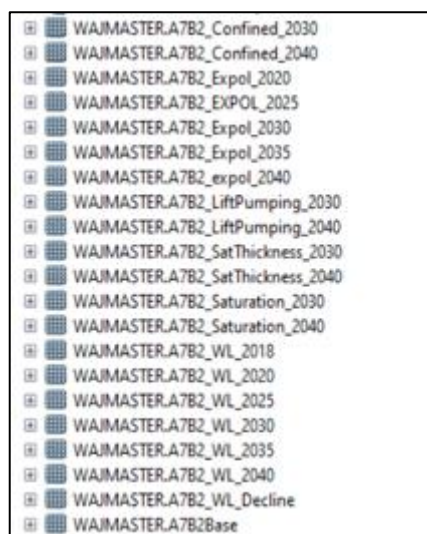
Tables

AnnualFlowKAC	IndustrialWaterUseByQty	RainfallLongTerm
AnnualProdWellsCons	IndustrialWaterUseByResource	RefugeesCampsWells
AnnualRainFallStatistics	IndustrialWaterUsePercentage	RICCARSummary
AnnualWWTPSummary	IndustrialWDEstimationsByCompany	SedimentAssessment
BasinsWellfieldsFacts	IndustrialWDEstimationsByQty	StorageDamsRainfall
CIPCriterialKP	IrrDistributionWaterUses	SupplyRequirementForecast
CIPEvaluationDetails	IrrigationFutureTrends	SWBasinsRainfallTrend
CIPInvestmentsCategory	IrrigationGWARemoteSensing	SWRainfallVolumes
CollectedWaterDams	IrrigationSummaryByComponent	TelemetricStationsPRUStatistics
DamsAnnualStorageStatistics	IrrigationSummaryBySource	TiberiasStatistics
DamsInflowOutflow	IrrigationWaterRequirements	TourismWaterUse
DamsProjectsFeasibility	KACLosses	WaterAllocationByResource
DamsWaterLevel	LossesBySection	WaterDeficit
DomesticWaterShare	MainSectorsProjections	WaterDemandASEZA
DSAWRUse	NRWProjections	WaterDemandCommercial
EcoAffordProjections	NRWRReductionRates	WaterDemandMunicipal
ForecastWRDevelopment	NRWWaterSupply	WaterDemandOverall
GWEnergyConsumption	ObservationNetworkStatus	WaterExchange
GWExploitabilityDetails	PopEstimationByGov	WaterExportsStatistics
GWIndustrialConsumption	PopGrowthRates	WaterImportsStatistics
GWZWaterSupplied	PopGrowthScenarios	WaterUsageBySector
GWRBasinsAssumed	PopProjectionsOverall	WaterUsesGov
GWUsesAnnual	PopSyriansGov	WDMunicipalCapita
GWWaterBalance	PopSyriansGrowthRates	WDSupplyBalance
GWWellfieldsAbstraction	PopWaterSystem	WellFieldsProdFC
HistoricIndustrialWaterUse	PotentialRunoff	WLStatistics
HotelsWaterUseRatesKP	PriorityInvestments	WSPopulation
IndustrialMajorConsumers	ProjectsEvaluation	WWTPAgniDemand
	ProjectsRankingMatrix	WWTPDetails
		YMKRiverStatistics

GIS Layers

<ul style="list-style-type: none"> Administrative <ul style="list-style-type: none"> Governorates Kingdom Liwaa Localities Municipalities Qadaa Regions Villages Agriculture <ul style="list-style-type: none"> Farms IrrigatedAreas Carto <ul style="list-style-type: none"> PalestineMask Climate <ul style="list-style-type: none"> EmitterStations Contours <ul style="list-style-type: none"> EvaporationContours Isohyets_1995 Isohyets_70 IsoHyte_BGR PrecipitationContours RainfallIsohytes 	<ul style="list-style-type: none"> Demography <ul style="list-style-type: none"> CensusDistricts LocalitiesPopulation Desalination <ul style="list-style-type: none"> WaterDESPlant WellsDESUnits Energy <ul style="list-style-type: none"> ElectricityPoles ElectricPS EnergySources Geology <ul style="list-style-type: none"> Faults Geology GW <ul style="list-style-type: none"> Aquifers BrackishExtent ProductionWells WellFieldsAreas WellFieldsPoints GWL <ul style="list-style-type: none"> A7B2WL2018 A7B2WL2040 DeclineRates Industrial <ul style="list-style-type: none"> IndustrialWS MiningSites MiningZones 	<ul style="list-style-type: none"> WaterNeeds <ul style="list-style-type: none"> NeedsAllocation WaterRecharge <ul style="list-style-type: none"> GWRDistribution MARFacilities WaterTrade <ul style="list-style-type: none"> Exports Imports WNet <ul style="list-style-type: none"> DeadSeaCollector ReusePipes TanksSites wConveyanceLine wDiversionPipes WNAqabaSecondary WNAqabaTertiary WNLines wPumpStations Topography <ul style="list-style-type: none"> Wadis WaterDistricts <ul style="list-style-type: none"> DemandCenters WaterSystems wServiceAreas WWServicesAreas 	<ul style="list-style-type: none"> Infrastructure <ul style="list-style-type: none"> Facilities KAC <ul style="list-style-type: none"> Canal Checkgates DevelopmentAreas HydStructure Turnouts WCarriersStructure Projects <ul style="list-style-type: none"> CIP WaterProjects Reference <ul style="list-style-type: none"> LandCover Landmarks MainCities MainVillages Streets Towns WaterBodies Scada <ul style="list-style-type: none"> ScadaSites WaterControls SW <ul style="list-style-type: none"> DesertDams Reservoirs Rivers Springs StorageDams StorageDamsAreas SWMajorBasins SWSubBasins Telemetry <ul style="list-style-type: none"> MonitoringWells RainfallTelemetry VariousTelemetry
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Raster Datasets



2.3 Implementing NWMP Digital Geo-Platform:

The developed digital platform consists of the following components:

- A- **NWMP-3 Volumes Portal:** The consultant used the ArcGIS technology to implement the content of the volumes including: providing dynamic map viewers that allow to navigate and switch between the map layers and providing dynamic tables and charts. The listed below ArcGIS products were used during the implementation of the platform:
 - a. ArcGIS Portal: it allows organizations to organize, discover, use, and share spatial information across an entire enterprise
 - b. ArcGIS Story Maps: is a story authoring web-based application that allows to share maps in the context of narrative text and other multimedia content
 - c. ArcGIS Dashboard: is a view of geographic information and data that allows creating of charts and maps to see trends which allows displaying multiple visualizations that work together on a single screen.
 - d. ArcGIS Sites: it allows to create a tailored web page experience for users to support sharing portal's authoritative GIS data to other departments.
 - e. ArcGIS Application Builder: the ArcGIS Platform comes with a set of frameworks for application development that allows developers and non-developers alike to create and share applications very quickly. These builders allow non-developers to configure through wizard's web and mobile applications based on content from an organization's ArcGIS Portal implementation.

Each available volume of the 3rd NWMP was addressed by analyzing its content including: figures, maps and tables wherein the following steps were followed for each volume during the platform implementation:

- Each table listed in the documents was considered within the geo-database design
- Each map Layer listed in the documents was collected from the GIZ team and included in the geo-database model
- Data was collected and inserted into the tables and layers according to the volume's documents
- All tables were considered in the data entry application to allow future edit/update operations
- Each table was provided in a dynamic style (connected to the database table) within the digital platform
- Each map was prepared in a dynamic map viewer to allow map navigation with dynamic table of content
- Each chart was represented in a dynamic format (connected to the database table)
- All volume content including text, charts, maps, photos, and tables were organized in a story telling style and published to the digital platform.

The following snapshots show the final product of the Digital Platform / Volumes' presentation components:

Digital Platform Home Page:



NWMP-3 Volumes Main Page:



Rapid Assessment

Executive Summary
Introduction

SOP's & Processes

Volume B
(Water Resources)

Executive Summary
Introduction
Groundwater Resources and Related Infrastructure
Rainfall and Related Observation Network
Surface water Resources and related infrastructure
Treated Wastewater
Hydrological Model developed for the entire country
Climate Change impacts, using different approaches

GIZ

Volume C
(Water demands)

Summary of results-status November 2021
Water Uses
Water Demand (Municipal,Industrial,Agriculture)
Water Allocation and Gaps
Major Findings and Recommendations

GIZ

Volume D
(Planning and decision-support)

Introduction
The Countrywide WEAP Model Of Jordan
Special Modelling Concepts For the Assessment of Climate
Outputs From The Model
Conclusions and Recommendations

GIZ

Volume E
(Water supply infrastructure)

Water system description
Existing supply and distribution networks
Served/unserved areas of water supply
Plans to expand/replace network

Volume F
(Wastewater and related infrastructure)

Centralized/Decentralized municipal waste water systems
Industrial wastewater systems
Other wastewater systems
Served/unserved areas of waste water network
Plans to expand/replace network

Volume G
(Synthesis, findings and recommendations)

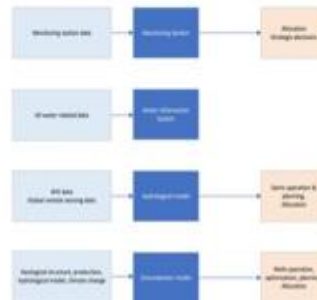
Overall recommendations
Related consequences
Capital Investment Projects (CIP)

SOPs (Home Page)

SOP's & Processes

External Processes Groundwater Balances JSA Process Overview of Processes Production Forecast Wastewater Infrastructure Wastewater Planning Wastewater Reuse Planning Water Demand Water Production Water Supply

External Processes



Rapid Assessment Report (Home Page)

Rapid Assessment

Rapid Assessment of the Consequences of Declining Resources Availability and Exploitability for the Existing Water Supply Infrastructure

[Get started](#)

- Executive Summary
- Introduction
- Water Resources
- Water Resources
- Water Demands, Uses and Allocation Gaps
- Water Supply Infrastructure
- Key Findings
- Investment Planning
- Recommendations
- Rapid Assessment Annex Links

Volume B (Home Page)

COLLECTION
Volume B
Water Resources (Conventional/non-conventional)

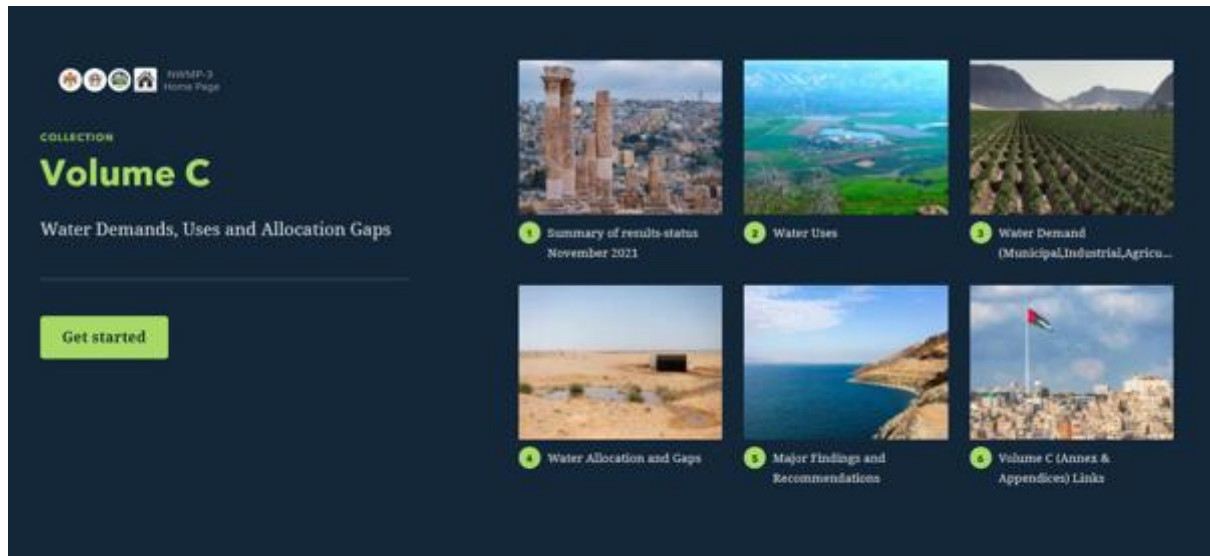
Get started

- Executive Summary
- Introduction
- Groundwater Resources and Related Infrastructure
- Rainfall and Related Observation Network
- Surface Water Resources and Related Infrastructure
- Treated Wastewater
- Hydrological Model Developed for the Entire...
- Climate Change Impacts, Using Different Approaches
- Volume B (Annex & Appendices) Links

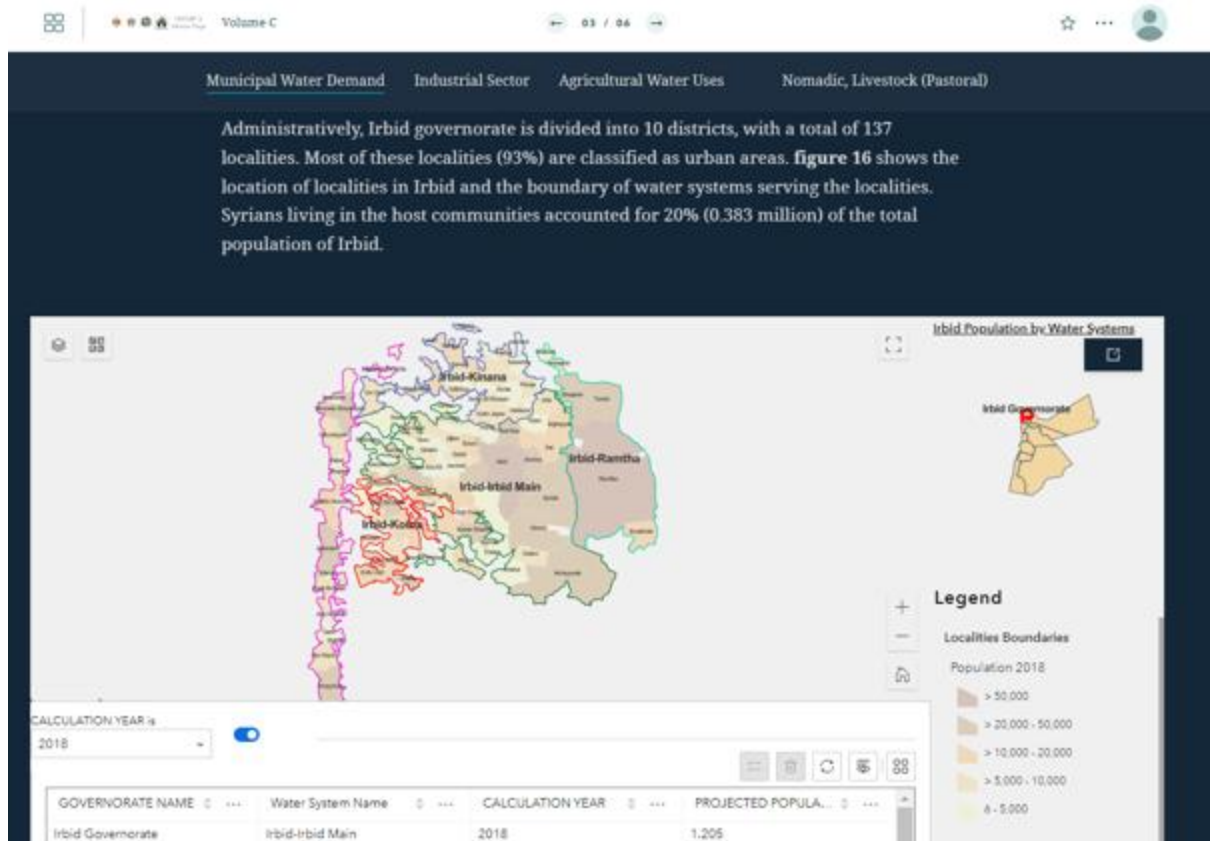
Volume B (insider page)



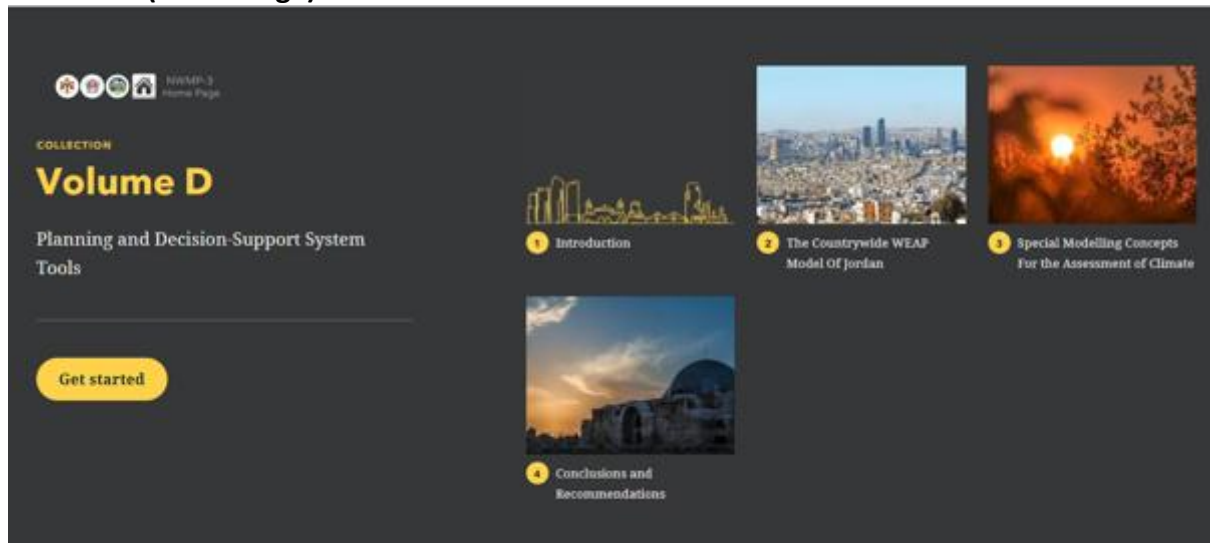
Volume C (Home Page)



Volume C (insider page)



Volume D (Home Page)



Volume D (insider page)

Figure 4: The interplay of different models used for the assessment of climate change impacts

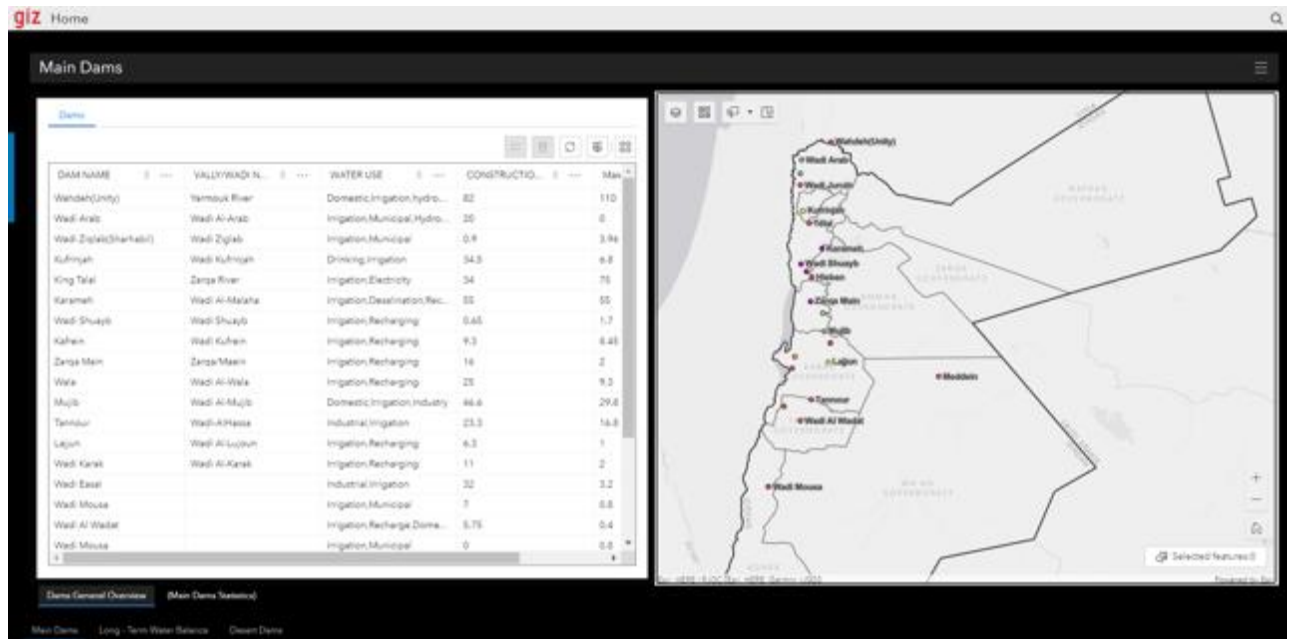
1) The LISFLOOD hydrological model

In order to quantify the changes in the hydrological system in Jordan induced by climate change, the quasi-physically based hydrological model LISFLOOD was developed, that incorporates the best and most current data available. In order to allow for a smooth integration of the data into the existing MODFLOW and WEAP models for further analyses, the domain and grid size of the model were exactly matching with the MODFLOW model. Information integrated in the model are:

- B- NWMP-3 Dashboards: Dynamic dashboards were implemented within the platform to support the decision-making process and offer different level of data representation; the following operational dashboard views were provided:
 - a. Dams Dashboard
 - b. Volume (C) Dashboards
 - c. CIP Dashboard

The following snapshots show the final product of the Digital Platform / Operation Dashboards Component:

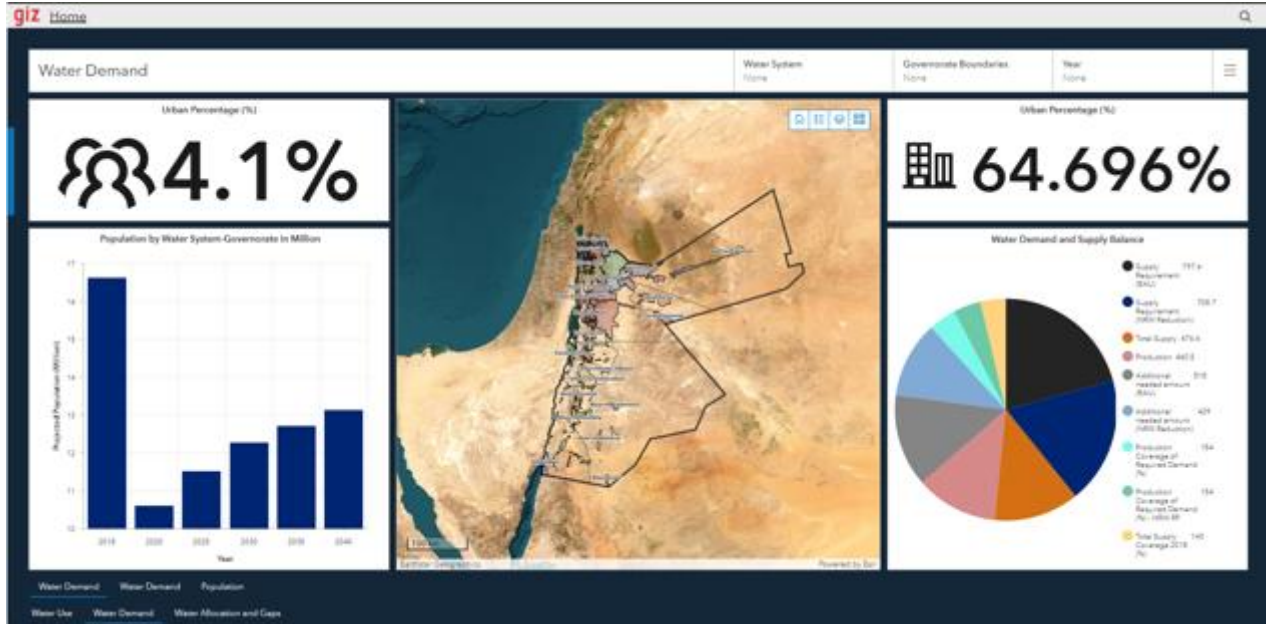
Dams Dashboard



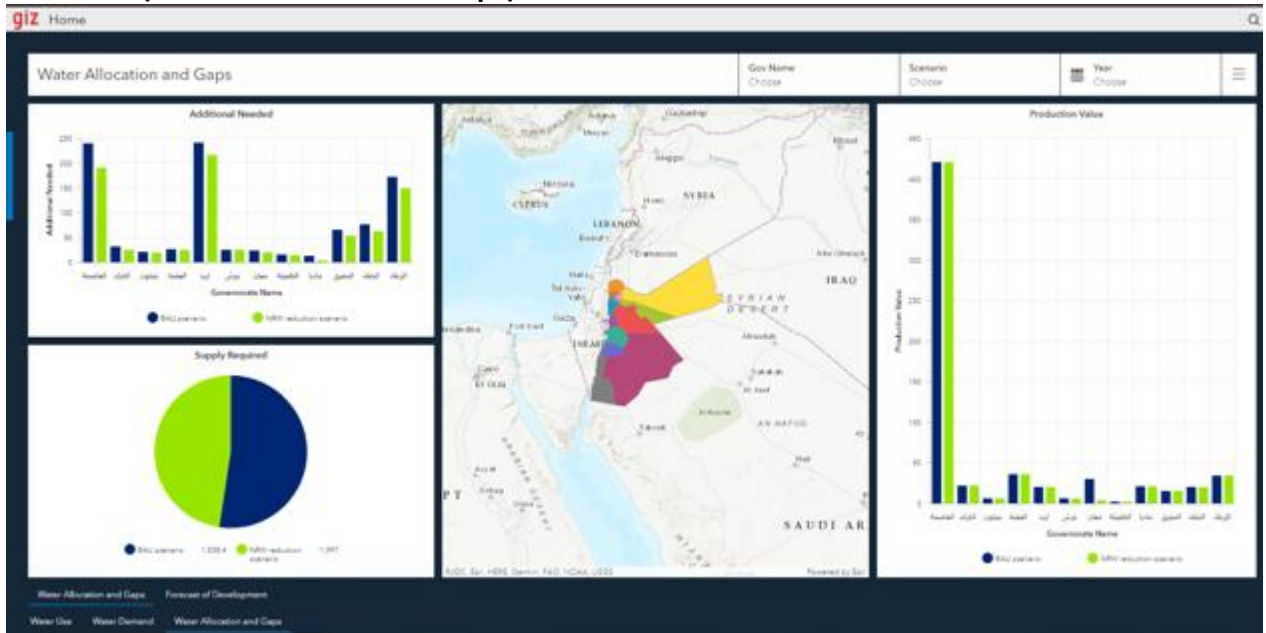
Volume C (Water Use) Dashboard



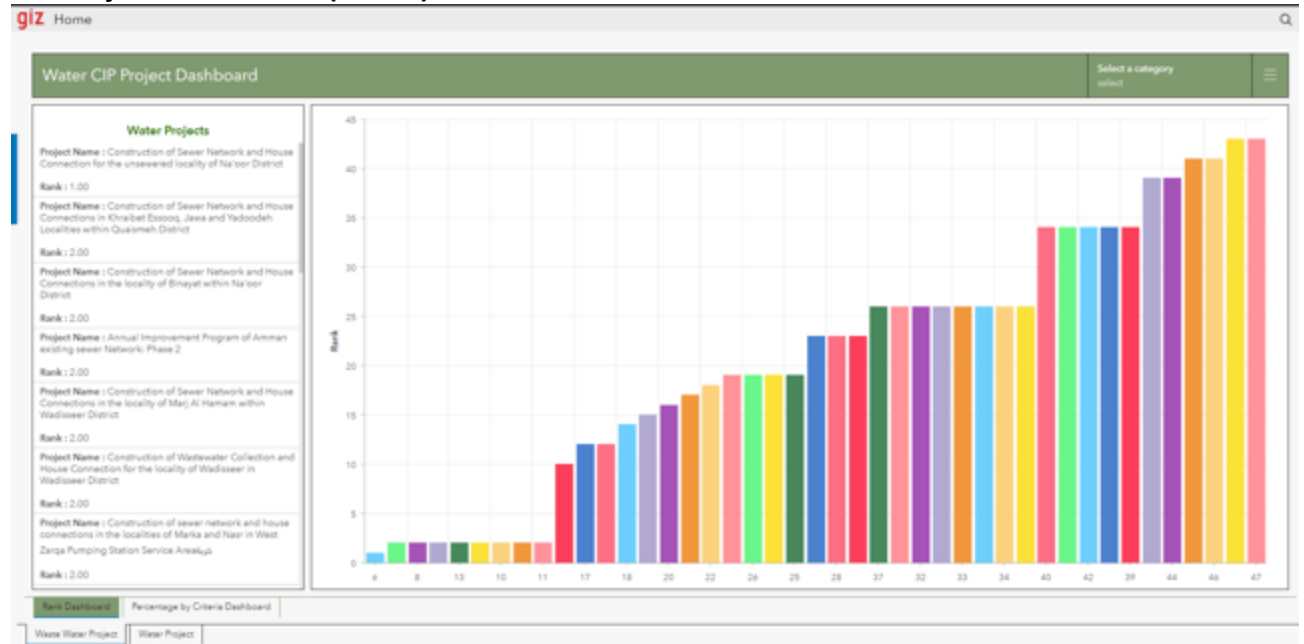
Volume C (Water Demand) Dashboard



Volume C (Water Allocation and Gaps) Dashboard



CIP Projects Dashboard (Water)



CIP Projects Dashboard (Waste Water)



- C- Data Entry/Update Application: The data entry tools allow to enter all data as received from the stakeholders through an easy-to-use web interface running under the NWMP platform portal, the entered data will be saved to the NWMP database.

Data Entry Application

The screenshot displays the 'Data Entry Application' interface. At the top, there is a navigation bar with the 'giz' logo and links for 'Home', 'NWMP-3', 'Dashboard', and 'Data Entry App'. Below the navigation bar is a header section with the application title 'Data Entry Application' and a small icon. The main content area shows a breadcrumb trail 'Data Entry' and a 'Data Entry' section. A table with the title 'KAC Losses' is visible, with the year '2010' entered in the first row. Below the table, there is a form with several input fields: 'CANAL ID', 'CANAL CODE', 'TOTAL RELEASED FROM CANAL (MCM)' (value: 95.29), '% LOSSES PERCENT' (value: 13.1), 'DISTRIBUTION NETWORK TYPE', 'CANAL PART' (value: KAC North), 'CANAL NAME' (value: KAC), 'TOTAL DELIVERED TO CANAL (MCM)' (value: 109.65), 'LOSSES IN CANAL (MCM)' (value: 14.36), 'LOSSES TYPE', and 'CALCULATED BY' (value: MWI). A 'SUBMIT' button is located at the bottom left of the form.

2.4 Platform Management Module

The digital platform administrator can fulfill the following administration tasks through the ArcGIS for Portal and ArcGIS Desktop software:

- Create and manage groups to control access to the platform components.
- Manage the geodatabase features through ArcGIS for desktop
- Add, modify, and publish the GIS layers to the platform though Portal interface
- Add/delete/modify the content of the volumes
- Modify the map layers, symbology and dashboards and publish the results to the platform

2.5 Training and knowledge transfer

The consultant conducted 5 days training on the management of the digital platform for 23 employees from the key stakeholders (MWI, WAJ and JVA). The training covered topics related to the management of the digital platform and data updating. The training course outline and manual can be found in annex 1 and annex 2 respectively.



The consultant provided the participants with the following documents:

- User manual with training exercises documentation
- Demo account for one month to practice the training exercises
- Certificate of completion



3. CHALLENGES AND REMARKS

- Ensure the data acquisition sources and confirm preparing the data in a well and proper format on a timely basis, since most of the data were collected from the volumes documents and inserted manually to the platform during the development of the digital platform.
- Ensure the trained team in MWI, WAJ and JVA are available for data updates and have all the required tools and capabilities to perform the updates on regular basis and/or when needed.

4. AREAS FOR FUTURE IMPROVEMENTS

- Engagement of the stakeholders should be improved by activating and enhancing the SOPs to cover the NWMP platform data update and to engage the platform in the decision support and planning processes in the water sector
- To implement the remaining volumes in the Platform (Volume E, Volume F and Volume G)
- Developing mobile applications to feed the platform with data updates from the field upon site visits
- To integrate the Digital Platform with the existing systems of data sources such as NWIS, eGWMS and WMIS systems

5. CONSULTANT RECOMMENDATIONS

- Improve the GIS environments in MWI, WAJ and JVA in terms of hardware and software licenses
- To ensure continues support from the higher management from MWI, WAJ, JVA to activate and use the platform and continue updating the data
- To provide advanced training courses for the platform operator to ensure they have the capacity to perform administration and analysis tasks whenever needed.
- Continuous review of the platform data update shall be done on regular basis from the management

ANNEXES

ANNEX 1: User Manual

ANNEX 2: Training Course Agenda