Iraq Water Resources Evaluation: 
An Overview of the Existing Conditions

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Abstract

On July 2003, the Italian Ministry of Environment financed a project called “New Eden” to the Iraq Foundation, an NGO active in the reconstruction effort in Iraq. The objective of the project focuses on the identification and prioritization of key water management problems, and on development of a comprehensive policy using a participatory process for water resources management in Iraq. Through resource planning, the project has identified actions to bring major improvements to the welfare of the Iraqi population and condition of their environment, both of which have significantly deteriorated over the last decade. The project would guide donor assistance for development and contribute beneficially to water management, including investments from other economic sectors.

The first phase of the project was dedicated to data gathering to create an organized and comprehensive overview of the biophysical and socio-economical data. On the basis of collected data, the development of an integrated water management model is important to understand Iraq’s water needs and to prepare an action plan for the management of water resources in Iraq. A major objective of the project includes concrete proposals for immediate actions that do not require substantial financing, but which can bring significant and rapid results to the Iraqi people and their environment.

These analyses define the Priority Action Plan in agreement with local authorities and stakeholders to outline the capital investment program of emergency water works in selected critical areas. Successful completion of this project entailed the collaboration and cooperation of the existing engineering and scientific community in Iraq through missions of Italian and U.S.A. technicians coupled with the efforts of local Iraqi Foundation experts. Our approach included collaboration with local experts to identify and assist in solving key water- and environment-related problems.

Introduction

After 25 years of wars, constraining embargo, and a repressive policy a new challenge faces the Iraqi people: The reconstruction process and management of water resources. Since its conception, the New Eden Project, directed by the Iraq
foundation and supported by the Italian Ministry of Environment, aims at reaching the following goals: a) Preservation and management of national water resources, b) Provision of safe and clean water to the population, and c) Restoration of the Iraqi environment. The working group focused its interests on two main areas: a) Mesopotamian Marshlands rehabilitation process, and b) Rehabilitation of the water supply system in the Basrah and Thi Qar governorates.

The first phase of work for the project is dedicated to data gathering. The goal of this action is to create an organized and comprehensive overview of the physical data, of the data on main work, water control structures, the water supply and sanitation situation, and on environmental data. During this phase, water demand for potable water, irrigation and industrial uses would be analyzed, and on the basis of data collected, an integrated water management model would be developed to better understand water needs, and to prepare an action plan for water resource management in Iraq.

Preliminary evaluations on-site have identified two immediate actions. A pilot project consisting of monitoring the rehabilitation of a representative marsh—the Abu Zareg marsh—would document the response of those wetlands to the re-flooding process. Simultaneously, a feasibility study would optimize the use of available energy sources to improve the supply of potable water in southern Iraq. Various restoration scenarios of the three main marshes composing the complex of the Mesopotamian wetlands have been developed. The restoration process analyzes existing structures and activities in the area and aims to optimize water resources in an integrated way. The New Eden Project constitutes a useful tool for the management of water-related issues in southern Iraq.

**Data Gathering and Numerical Modeling**

The New Eden project-working group assessed the existing conditions of water resources and water infrastructure in Iraq to target crucial situations that need urgent actions, with provision for recommendations to obtain additional data to assist Iraq in optimizing its management of water resources in the medium- to long-term goal. The data gathering campaign covered the sectors and included an overview of the physical data (topographic and geomorphologic information) using a compilation of existing maps (mainly NIMA and Russian maps). This task was completed by the acquisition of processed satellite images for substantial information such as: topography, land use, and evolution of the morphology.

The main operation regarding water structures was documented from an analysis of control structures along the Tigris and Euphrates rivers conducted by the United States Army Corps of Engineers (USACE). Meanwhile, a survey was conducted close to the Iraqi ministers to obtain an overview of the water supply system and sanitation conditions. This survey also defined the demand for drinking water and water for agricultural and industrial purposes. The survey revealed a general vision for the following sectors: water resources, general data on water quantity and quality, general
data on population and water consumption, and general data on the system (network pipes and other structures).

Finally, in order to complete the campaign, the environmental field was surveyed. The working team collected information regarding military and industrial contamination (UNEP), soil quality, habitat and sediments. The data collected was then organized via GIS. Although the database is currently updated, this work in progress must be completed in order to accurately document the condition of the various areas surveyed.

The development of an integrated water management model is an important element in preparing an effective action plan for the management of water resources in Southern Iraq. The goals will improve public health, allow for the recovery of agricultural and industrial production, and manage the reconstruction of the Mesopotamian marshes. As water is a scarce resource in Iraq, it is important to optimize its use. The initial phase of the modeling approach adopted by the working team focuses on the restoration of the marsh.

First, the entire hydrology of the Tigris and Euphrates rivers was analyzed, with discharges identified at each critical point of their bed coupled with various uses of water identified (industrial, agricultural, domestic). This informed us about available water quantity for marsh restoration purposes. A bi-dimensional numerical model constructed on the basis of topographic information gathered using available water quantity. The local conditions concerning soil infiltration and the evapotranspiration are included in the modeling process.

The model offers a comprehensive overview of the dynamic of the restoration process. The model is updated with innovative topographic and hydrologic data, including comprehension for optimum restoration scenarios for the marshes, including, for example: the systemization of the marshes with artificial channels to optimize circulation in the marshes, upgrading the quality of water. At this stage, initial modeling activities concentrated on the Central marsh region and various scenarios that included modeling of natural, artificial, and mixed re-flooding.

**Immediate Action Plan**

During its investigations, the New Eden Again project identified a list of projects that should be immediately taken into account in the southern Mesopotamian region. The following projects were targeted and studied and are hereby presented with guidelines: a) Central or Qurnah Marshes and the Glory River, b) Awr Al Hawizeh Marshes, Hammar Marshes and the Nassiriyah channel network, and c) Water sanitation issues within the geographical triangle including the cities of Nassiriyah, Qurnah and Basrah.
Restoration of the Qurnah marsh

The Al Qurnah or Central Marshes originally stretched over an area of approximately 3,121 km², and are considered the key marshes among the wetlands of southern Mesopotamian. Situated within a quasi-triangle delimited by the cities of Nassiriyah, Amarah and Qurnah, these marshes are bordered by the Euphrates River on the south and by the Tigris River on the east and receive waters from three main rivers that originate from the Tigris. The central marsh was reduced to a dry plain in less than ten (10) years.

![Figure 1. The evolution of Central marsh between 1973 (left) and 2000 (right).](image)

From the central position of the Qurnah marsh, all marshes can connect with the hydrologic complex of the Tigris and Euphrates rivers. However, due to its vast dimension and lateral extent, and the lack of adequate water resources, results limit the establishment of a complete re-flooding scenario. In view of the limited availability of water, alternatives must be found to best budget water availability.

The re-flooding project would focus on bringing water to former shallow lakes that could link via artificially created channels that would create a “green network.” Progressively, reed beds and natural flora would expand providing a natural habitat for marsh dwellers, fish, wildlife, and migratory birds. The development of the “green belt” would emphasize the conservation of water resources. For maximum efficiency, initial steps for this restoration process focuses on the areas closest to water sources as outlined in this basic description of the physical process:
a) Regulation of the East-West channel - Water used for the re-flooding process would stem from the East-West channel. To control water levels and discharges in the Prosperity River, a control structure would be designed and constructed at the junction of the two branches.

b) Building inlet structures - Breaching the south dyke of the East-West channel in several places to create escape structures, and inlet control structures planned control in-flow.

c) Creating inlet channels - Inlet structures connected to inlet channels to drive water to depression areas to re-create former shallow lakes would be planned according to the existing drainage channels and irrigation network.

d) Isolation of existing rice paddy fields and oil fields - There is a large band of reclaimed land parallel to the Prosperity River that also coincides with future oil field exploration. This band of agricultural activity must be preserved from the re-flooding project. Planning a dyke to surround the area would isolate existing rice paddy fields; also, the irrigation system would be studied.

e) Connecting shallow lakes - to create an interconnected network of wetlands via recreated channels according to natural depressions would constitute the next step. If needed, channels would be dug out to create a flow. It is imperative to create a circulation of water between the deeper parts of the marshes. Those channels will be more or less flooded per seasonal timing, realized step-by-step in a north-south direction.

f) Building outlet structures - plans are in place to design two outlet structures to reconnect the Euphrates River and the Qurnah marsh to return the overflow of the Qurnah marsh to the Euphrates River. Implementation of this proposed plan requires the careful evaluation of possible alternative scenarios to follow an adaptive management approach to the problem. Nevertheless, there are a number of activities for immediate action that need implementation a priori: a) topography, mapping, and remote sensing activities, b) developing and updating an hydrological monitoring network, c) environmental studies, d) natural wetland studies, e) constructed overflow wetland studies, f) building a numerical hydrological model, g) construct regulators, and h) conversion of the Glory River.

Figure 2. Possible restoration scheme.

Restoration of the Awr Al Hawizeh Marsh

The Awr Al Hawizeh marshes are trans-boundary wetlands straddling the Iran-Iraq border. Covering an average area of 3,500 km² during the flood season, during dry season this marsh is reduced to 650 km². The Awr Al Hawizeh marsh spreads along
the East side of the Tigris River within the Amarah area, receiving water from different branches and sub-branches of the Tigris River along the Iraq/Iran border.

Figure 3. The Al Hawizeh marsh desiccation process. The situation in 1973 (left) and in 1982 (right).

Despite efforts to desiccate the Awr Al Hawizeh marsh, it is still a major wetland area containing a significant amount of remnant habitat with the biodiversity characteristic of the Mesopotamian marshes. Since the Awr Al Hawizeh marshes are still considered pristine, when compared to the Al Qurnah and Al Hammar marshes, the goal of any restoration project is to expand these marshes, and the restoration scenario is based on the following actions: a) Clearance of Mine fields - Survey the area and clear the wetlands from any military wastes, the cleared zone then providing security for the return of the marsh dwellers and for follow-up activities; b) Connection of the marshes with water sources - In order to have better control over the water sources feeding the area, it is necessary to construct or redesign the control structures along the main branches of the Tigris that drive the waters to the Awr Al Hawizeh marsh. The gates closing the flows that enter the marsh will be reopened with new control structures planned for an optimal hydro period, and c) Regulation of the water level at the Al Hawizeh marsh outlet - Construction of some control structures on the Outlet Rivers that drain to the south will provide better control of water levels inside the marsh. For that purpose, the Kassarah and the Suwaib rivers would be remodeled and equipped with control structures.

The following studies are required for monitoring the restoration process: a) Topography, mapping, and remote sensing, b) Developing and updating a hydrological monitoring network, c) Environmental studies, d) Building a numerical hydrological model, e) Construct regulators, and f) New alignment.
Restoration of the Hammar Marsh

Situated between Nassiriyah on the west and Basrah on the south-east, the wetlands south of the Euphrates River and north of a sand dune belt create the southern border. Originally, the Hammar marsh received water from several branches of the Euphrates River with seasonal excess flows from the Al Qurnah marshes, but the marsh outlet has gradually been channeling towards the Shatt al Arab. Hammar Lake, a deep body of water located in the center of the marshlands has become a dust bowl during the past 30 years. In the 80s, the water regime overseeing the Euphrates was also reduced due to the creation of numerous hydroelectric and irrigation designs. In the vast Hammar marshes region, the construction of outsized roadway dykes linking oil fields was part of the initial desiccation process. To desiccate the area in its entirety, the “Mother of Battles” (MOB) River that diverts the flow of the Euphrates from the marsh was created with two regulating sluice dams built along the river. The following actions will restore the Hammar marsh: a) Topography, mapping, and remote sensing activities, b) Developing and updating a hydrological monitoring network, c) Environmental studies, d) Constructed Overflow Wetland, e) Building a numerical hydrological model, f) Control Structure and new channel alignment, and g) Intersection between the Euphrates River and the Third River.

Downstream from Nassiriyah, a hydraulic node regulates water flows deriving from the Euphrates River and Main Outfall Drain (MOD). This regulator diverts water through the MOB, and further diverts water to the Loyalty to the Leader channel (LTL). The following studies and engineering works have been identified to restore the hydraulic system for the rehabilitation of the marshes: a) Survey - A detailed survey of the region for premise documentation of the functioning conditions of the node; b) Closure of Channels - The MOB River is currently closed and appears temporarily blocked for the purpose of building a regulator. However, a definitive work must be undertaken to close the MOB River; c) Water treatment - The MOD water source should be used for the purpose of the marsh restoration process, but its quality remains unknown. However, the water from the MOD could be partially cleaned through a phyto-treatment process; and d) New Channel Alignment - Once the Nassiriyah dam is removed and the MOB River closed, some channel alignments need completion to drive existing waters towards their original flows.

Water And Sanitation Evaluation

During the past two decades, the water and sanitation sector in Iraq experienced a steady, devastating decline. Aging infrastructure, poorly maintained equipment, corroded, damaged and badly leaking water distribution networks and sewer systems, acute understaffing, and low technical capacity and morale are some key causes to problems in the sector, and include: a) More than 50% of water losses in water distribution networks due to wear and corrosion of pipes, illegal tapping of water, and collateral damage from the recent war and looting. These leaks allow contaminants such as raw sewage to seep into the water supply posing serious health risks; b) More than 70% of all sewage untreated, resulting in more than 1 million cubic metres of raw sewage discharged into rivers daily. Wear and corrosion of sewer pipes,
numerous leaks, broken-down pumping stations and malfunctioning of various treatment mechanisms have resulted in clogging of sewers and back-flows of sewage into streets, homes, hospitals and schools; and c) Power failures and shortages affecting more than 50% of all water and sewage treatment plants.

The following points address the above problems: a) Undertake a comprehensive assessment for the sector as a whole to include water for: basic needs, cities, food security, industry and energy, and maintenance of ecosystems; b) Restore water and sewage services immediately to a minimum acceptable standard; and c) Repair of water distribution networks to reduce water losses greater than 50%, and to ensure that safe water (free of pathogens) reaches family levels. (There is a need to prioritise this work over that of increasing water production.) This may also require a full inspection and mapping of the network checking for illegal connections. In addition, assurance that families obtain information on how to store and use water safely to avoid its contamination after collection, and d) Rebuild the entire water system of the area of interest.

We are focusing our attention in the southern portion of Iraq, which is characterised by marshes within a number of scattered communities. The area of intervention is a triangular vertex which including: Basrah in the south, Al Qurnah in the northeast, and Nassiriyah in the northwest. In an effort to organise overall activities, the following tasks have been identified with assigned costs based on unit and size, and with administrative partitions: The Governorate of Thi Qar and Nassiriyah as Governorate Capital, and The Governorate of Basrah and Basrah as Governorate Capital.

Each governorate is divided into districts. For each main city of each district we obtained key facts about population, size of the urban area, and number of scattered communities in the district, as well as pertinent technical information. We have determined that the following activities need to be undertaken: a) Survey, b) Network analysis, c) Leakage detection, d) Rehabilitation/Reconstruction, e) Implementation of new works, f) Implementation of Supervisory Control, and g) Data Acquisition.

**Immediate Effective Actions - Abu Zareg Marsh Monitoring Plan**

**Objectives**

The overall objective of the project is to restore the original ecosystem in the Abu Zareg marsh by artificially recreating original flood conditions. Monitoring of the restoration program would supply key indications of the marshlands with respect to the re-flooding process as shown in the following objectives:

- **Ecological Restoration:** The on-going process of natural recovery provides an opportunity to monitor and gain knowledge from the environment how to best encourage the ecological restoration of the more superior marshes. The study of the resettlement of different species would constitute a key factor to measure the Impact of the program.
• **Environmental monitoring:** As the marsh recovers, the impact of the restoration on environmental conditions in and around the marsh would be monitored to discover opportunities where natural processes associated with the marsh can be replicated elsewhere in the former marsh area and other areas in Iraq.

• **Hydrological Modeling:** It is necessary to create hydrological models that can be used to study how to best replicate the natural flooding and flushing cycles (hydro periods), and how to best manage available water resources to maintain the ecological and environmental viability of this marsh, and how to utilize lessons learned elsewhere. Moreover, hydrological models would be useful tools for the water budget of the overall area.

• **Improve Water Quality:** As water passes through a restored marsh and as natural biological processes occur, water quality is improved. The study of the quality of the water as it enters and exits this marsh will provide vital data needed to understand this natural process. The improvement of water quality would upgrade the living conditions of the marsh Arabs.

• **Capacity Building:** Training activities for Iraqi technical staff would take place in Italy. This pool of engineers will then have the ability to manage the rehabilitation of other Iraqi marshes.

**Scope of Work**

Train Iraqi engineers for local monitoring of the project, Survey actual conditions, Monitor water, soil, and ecology, Develop a hydrological model for the marsh area, Study the construction of control structures, Build a management network of the marshes, Replant reeds and various native plants, and restock fish.

**Feasibility Study for Potable Water in the Qurnah-Basrah-Nassiriyah Triangle**

The feasibility study focuses on optimizing the use of readily available energy sources and brackish water to improve the potable water supply to the scattered communities in the southern Iraq. In addition, this project is expected to increase the availability of fresh water in the overall area, thus contributing to the restoration of the marshes.

**Objectives**

The project aims at setting up desalinization plants for the production of potable water to supply the local population (some 3.5 million people), and to manufacture bottled water with considerable export potential to Kuwait and other countries throughout the Gulf region. The project builds on the use of available water from large natural resources, which, unfortunately, contain a high salt content. In addition, the project aims at utilizing the natural gas that is at present wastefully burned to produce energy required in the desalination process. Currently, a specific industrial facility that can harness this source of natural energy does not exist. For small villages not connected to the water supply system or electricity distribution grid, the possible use of solar energy for desalination will be explored. (This pilot study will work for capacity building.)


**Scope of Work**

The objective to set-up a rational strategy for extrapolating natural gas from the oil fields as the energy source to produce potable water and includes: a) Identification and analyses of characteristics of available natural gas; b) Collection of data required to establish the needs for potable water in the study area; c) Determination of characteristics of existing infrastructure for water supply, and for treatment and distribution of potable water in the study area; d) Definition of dimensions, costs and energy needs for different solutions regarding desalination works; e) Identification of characteristics, dimensions and costs of energy production plants; and f) Examination of options and costs of constructing electric mains or of using alternative energy sources.

**Conclusion**

This article is an overview of the working strategy and actual achievements of the *New Eden Project working group*. Restoration of the Southern Iraqi environment and the upgrade of water quantity and quality deliverable to the inhabitants of the targeted area are the leading activities of the New Eden Project working group. Initial results of the data gathering campaign, modelling exercises, and assessments conducted on-site allows the working group to prioritize the following: - Restoration of the former Mesopotamian marshlands, and - Rehabilitation of the water supply system in Basrah and Thi Qar governorates.

The following steps for the working group consist of the development of an integrated numerical model to manage the marsh rehabilitation process and for water resources in Iraq. As a pilot project, the first considerations for the restoration of the marshlands would come from monitoring activities in connection with the rehabilitation of the Abu Zareg marsh. Simultaneously, a study will be conducted to utilize natural resources available to implement desalinization units for upgrading water quality and quantity delivered to the inhabitants of the targeted area. These preliminary studies, in addition to the continuing data gathering process and modeling activities, would produce a viable tool to lay the foundations for an integrated management program for water resources in southern Iraq.

**References**


