Iraq Salinity Project **Technical Report 11**

Report B4. Guidelines to a salinity management framework in Iraq

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The Iraq Salinity Project is an initiative of Government of Iraq, Ministries of Agriculture, Water Resources, Higher Education, Environment, and Science and Technology, and an international research team led by ICARDA – the International Center for Agricultural Research in the Dry Areas, in partnership with the University of Western Australia, the Commonwealth Scientific and Industrial Research organization (CSIRO) of Australia, the International Water Management Institute (IWMI), Sri Lanka, and the International Center for Biosaline Agriculture (ICBA), Dubai, United Arab Emirates.

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This technical report series captures and documents the work in progress of the Iraq Salinity Project, in its seven research themes, working at the regional, farm and irrigation system scales. Technical reports feed into the *Iraq Salinity Assessment*, a synthesis and solutions to solving the problem: Situation Analysis (Report 1); Approaches and Solutions (Report 2) and Investment Options (Report 2).

Key words: southern Iraq, central Iraq, spatial distribution, remote sensing, irrigation, salinity mapping.

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This document is based upon descriptions of the water and salt system, land use and soil conditions in the Mesopotamian plain reported previously. References to detailed descriptions in these other reports are provided where applicable.

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0. Highlights

Several interventions are needed to allow a better management of water and soil salinity in the Mesopotamian plain. These are:

a) Institutional strengthening of the water managing agencies and organizations to allow simultaneous management of water quantity and water salinity;

b) Improvements to "on the ground" irrigation and drainage strategies to reduce excess water consumption and allow better management of saline drainage water;

c) Optimal land use selection to classify non-saline land use, salinity-limited land use and salt-tolerant land use to allow a focused land and water management approach;

d) Improving infrastructure efficiency and infrastructure operating guidelines for simultaneous water and salt load management (at multiple scales throughout the Mesopotamian plain);

e) Interventions to reduce salt inflow into the Tigris and Euphrates river systems, e.g. salt interception schemes to prevent saline groundwater inflow in the lower reaches of the rivers;

f) Special focus on operational rules for the drainage network in the Mesopotamian plain, including dedicated operation of the Main Drain for water and soil salinity management.

1. Introduction

Salinity management in Iraq needs to incorporate actions at various scales:

- Basin scale (within Iraq): Salinity management frameworks, institutional arrangements, investment decisions.
- Irrigation project scale: Irrigation project management.
- Farm scale: Farm-scale intervention and adaptation.

Funds to invest in salinity mitigation activities at the national or catchment scale are usually limited, which calls for careful decisions about how they are best spent. Short-term field-scale solutions generally have a tendency to incur costs elsewhere that can sometimes outweigh the initial investment. Where integrated salinity management has been implemented successfully (and there are few instances where this has occurred), decision making has taken account of economic, social, and environmental concerns at a scale that reflects all the major costs and benefits likely to accrue.

The approaches to investing in salinity management generally need to cover three interrelated component strategies: recovery, containment, and adaptation. These need to be implemented within an overall salinity-management framework in order to ensure that upstream and downstream effects are considered and the best financial investments are chosen. A key step in the process of salinity management in the irrigated areas of central and southern Iraq will be to develop the management framework so that it incorporates all the issues that are important to the Government of Iraq and the various key stakeholders involved.

This document identifies the steps needed to develop a salinity management framework for the Mesopotamian plain in Iraq, without considering external influences on water quantity and quantity from outside the plain.

2. Improving salinity management

Several interventions are needed to allow better management of water and soil salinity in the Mesopotamian plain. All of the interventions focus on the management of salt throughout the plain, similar to the way in which water is managed. Interventions to improve salt management are needed at different levels; national, project and field level.

2.1 Institutional strengthening for salinity management

Institutional strengthening of water managing agencies and organizations is needed to obtain simultaneous management of water quantity and water salinity. The main reason for the success of salinity management in the MDB in Australia is that all organizations involved adopted the goals and objectives developed by the Australian salinity management framework. To develop an effective Iraqi salinity management framework, the same shared goals and objectives are needed.

From an agricultural point of view, the ultimate goal of irrigation is to deliver water of sufficient quality and quantity that the areas, selected for agricultural (irrigated) production, will maintain favourable soil water salinity levels in the root zone, and supply sufficient water for the removal of excess salts below the root zone during the cropping season. From a regional water management perspective, the goal of salinity management is to decrease the salinity of the supply water, and maximize the use of the existing drainage network to minimize drainage water volume and maximize drainage water salinity. From an urban drinking water perspective, the water quality at the supply point would need the lowest possible salinity levels, even where drinking water is treated using reverse osmosis methods.

Ministries should collaborate (at least the Ministry of Water Resources, Ministry of Agriculture, Ministry of Environment, Ministry of Municipalities and Public Works) to develop clear and common objectives, define required outcomes, roles and responsibilities and be given a clear mandate for a salinity management framework.

This level of institutional strengthening would best be implemented through the office of the prime minister, and would likely fit with objectives from donors like WorldBank and UNDP.

2.2 On the ground improvements

Improvements to "on the ground" irrigation and drainage strategies are needed to reduce excess water consumption and allow better management of saline drainage

water. These improvements should aim to optimize irrigation and productivity efficiencies. Improved irrigation efficiency would result in improved drainage water management to reduce drainage water and maximize salinity concentrations. At the same time, in field drainage systems (e.g. tile drains) can be installed, reconstructed, maintained and actively managed to reduce excess drainage water production immediately following irrigation applications.

These interventions focus on the water demand side and are strongly related to activities employed by the Ministry of Agriculture.

2.3 Land use planning

Optimal land use selection to classify non-saline, salinity-limited and salt tolerant land use is needed to allow a focused land and water management approach. Land use planning is strongly related to the required outcomes of a salinity management plan. It is water and soil driven, but must also address national objectives of poverty alleviation and food security and thus requires a well-defined outcome setting.

A selection of land where irrigated agriculture is feasible, and the intended land use for areas that are not irrigated influences the choices for technical interventions for water and salt management. When using the approach of "salinity targets" in the Tigris and Euphrates rivers, similar to the MDB approach (e.g. salinity target at Morgan), the levels of acceptable salinity are dependent on water use downstream of the locations where the targets are set. If no irrigated agriculture exists below a specific location, it will not contribute to the setting of the salinity target levels. At the same time, the selection of salinity targets will partially determine the suitability of land downstream of the location where the target applies. However, existing soil salinity will likely be the main determinant for land use planning at a regional level.

Land suitability for irrigation is based on the current soil salinity, but on a regional level also on the "gap" between supply and demand of irrigation water. While the supply of water is based on the rainfall in the upper catchment and the available storage in the dams, the demand side depends on the crop area and crop types grown in the area. The water demand also includes the volume necessary for salt management in the crop root zone (also known as a leaching fraction). When the soil salinity of the root zone is higher at the start of the growing season, the required leaching fraction will be higher than when the soil salinity is low at the beginning of the season. Thus, selection of areas suitable for irrigated agriculture has an impact on the water demand as well.

Identifying saline areas at the farm scale and developing guidelines for land use (not to be used for irrigation, partial use, suitable, etc) has made a significant difference in Australian case study areas - Tragowel, Shepparton and Coleambally in particular (Australian experience, 2012). This approach works best when it becomes an integral part of a whole farm planning process.

2.4 Improving infrastructure and operational efficiency

Improving infrastructure efficiency and infrastructure operating guidelines for simultaneous water and salt load management (at multiple scales throughout the Mesopotamian plain) is an intervention focusing on the water supply side. Since the objective of this intervention is to maximize the volume of good quality water, and minimize the volume of saline water, the main aim is to separate good quality water from saline water, and to reduce evaporative losses in the system (evaporation control). Evaporative losses are a loss of available water and result in an increase of salinity concentration in the water.

One area where it may be possible to improve water management for better salinity control is the use of Lake Tharthar for water storage (Hydrology of Mesopotamian Plain, 2012). The purpose of Lake Tharthar is to eliminate flooding risks from the Tigris River by diverting excess water flows to the reservoir, and to store excess water and to re-release it to the Tigris and Euphrates rivers for irrigation purposes (WCC, 2006). Currently, low salinity flood water mixes with saline water in Lake Tharthar, and covers a large surface area. This results in an increase of salinity of the flood water due to mixing and evapo-concentration. One possible intervention could be to partition Lake Tharthar so that smaller sections are used to store low salinity flood water for release to irrigation. The interventions focus both on the physical layout, as well as the operational efficiency in the region.

In the set of Murray-Darling Basin salinity management interventions, the reduction of evaporative areas, thus reducing the loss of water in the system, resulted in a large return for low investments over a short time frame.

2.5 Direct salt reduction interventions

Direct salt reduction interventions focus on the removal of salt influxes into the water supply system. This could be achieved by developing "terminal" salt storages, such as evaporation basins, or by installing a groundwater pumping network to intercept return flow to the Tigris and Euphrates. In the Murray Darling Basin, evaporation basins have been successfully used in the Murrumbidgee Irrigation Area (Griffith, NSW), and salt interception pumping systems have been successfully implemented in the Kerang area (Swan Hill, Vic) (Australian experience, 2012).

In the Mesopotamian plain, the lower reaches of the Tigris and Euphrates appear suitable for salt interception pumping systems. However, the investment and benefits of these interventions must be carefully evaluated. The benefits of salt interception schemes are highly dependent on the land use planning described in paragraph 2.3. If no irrigation or other beneficial water use occurs below the location of the salt interception scheme, the benefits of the scheme will be less than when a large part of the population (or environmental systems) depends on the river water.

2.6 Optimized drainage network operation

One of the largest advantages that the Mesopotamian plain has over the Murray-Darling Basin is that it has a main outlet drain - a third water system specifically designated to saline drainage water. While the aim should be to reduce the volume of water and maximize the salinity of the water in the main outlet drain, it appears that some farmers have begun to rely on main drain water for agriculture. Optimizing the entire drainage network present in Iraq should result in a large increase in water quality throughout the system. Optimizing drainage network is related to improving on-field drainage, since this activity can only be undertaken if the drainage water can be separately handled from the irrigation water supply.

3 Investment choices

The salinity management framework is a high-level, holistic approach to improving water quality for users: urban, agriculture and environment. Within each of the interventions, choices have to be made on where to invest. The benefits of the

interventions are dependent on the required outcomes for urban, agricultural and environmental water use.

Figure 1 shows the schematic interaction between the suggested interventions. The relations show the interactions and dependencies of activities, thus guiding a holistic approach towards Government of Iraq and donor investments.

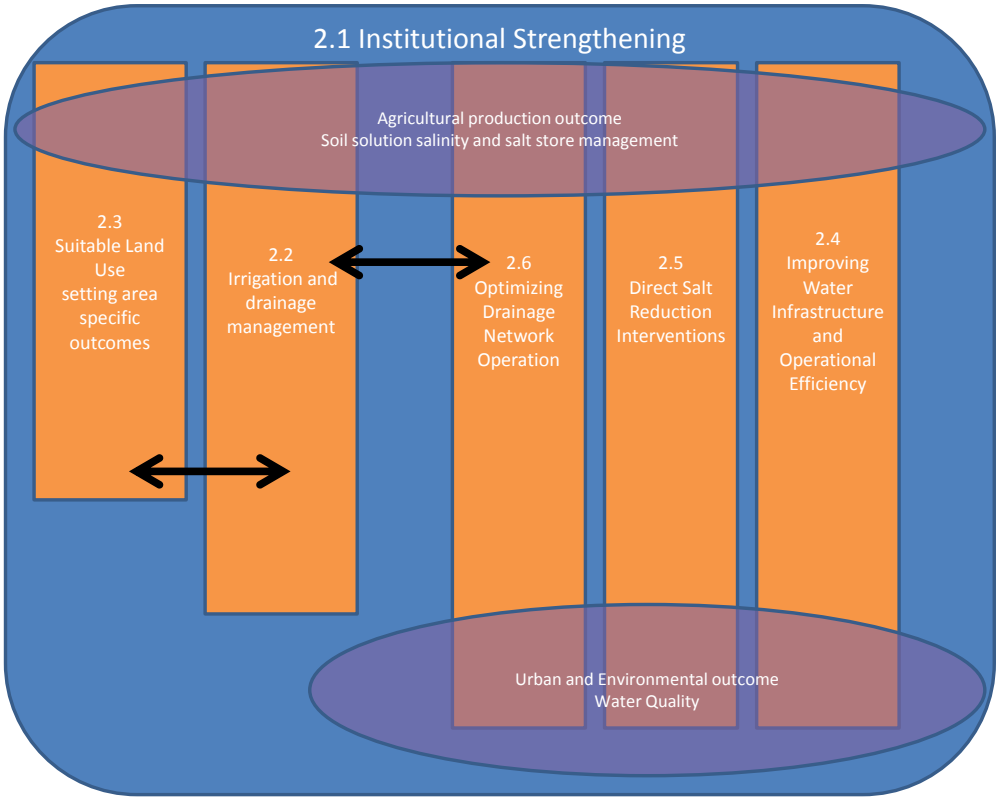

Figure 1: Salinity management interventions within the salinity management framework.

This representation of the framework shows that investment in the institutional aspect of the salinity management framework is needed before any other interventions can be made. It also shows which interventions contribute more to the agricultural production objectives, and which interventions contribute to a low salinity water outcome (urban and environmental objectives).

Interventions 2.4 and 2.5 are the more traditional interventions, allowing short term construction processes for long term benefits. Interventions 2.2, 2.3 and 2.6 are less tangible investment options in that it is more difficult to measure success. However, they are no less important.

References

Australian Experience in salinity management in the Murray-Darling Basin, 2012 [reference to be completed]

Hydrology of Mesopotamian Plain, 2012. [reference to be completed]

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