APPENDICES

With the Second advisory review of the monitoring programme for the Lining of the Ismailia Canal Pilot Project, Egypt

(appendices 1 to 6)

APPENDIX 1

Letter from DGIS dated 21 June 2000 in which the Commission has been asked to submit an advisory review.

Rutgers, Marien

To: Akolhoff@eia.nl
Subject: RE: bezoek Commissie m.e.r. Ismailia lining project in Egypte

Commissie voor de m.e.r.
CS
INGEKOMEN 2 1 JUNI 2000
dossier: 020 - 127

FAX

Aan Commissie MER, Utrecht,
fax 030-230.43.82
attentie Ciska van Gelderen

Den Haag, 21 juni 2000

Hierbij verzoek ik de Commissie voor de m.e.r. om de kwaliteit van de monitoring van het pilot project Lining of the Ismailia canal in Egypte te beoordelen en hiervoor een advies uit te brengen. Tenminste de volgende kernvragen moeten in de beoordeling in beschouwing worden genomen:

- Is het grondwatermeetnet correct geïnstalleerd?
- Hoe is de kwaliteit van de verzameling, analyse en presentatie van de data.
- Is het op korte termijn uitvoeren van een m.e.r. nuttig en noodzakelijk?

Met vriendelijke groet,

Marien Rutgers (DOB)

APPENDIX 2

Project information

Proposed activity: A request for an ORET grant ('Ontwikkelingsrelevante Export Transacties', Export Transactions relevant for Development) has been made by Bitumarin for delivery of materials and equipment for the lining of one kilometre of the Ismailia Canal in Egypt. The transaction is to be considered as a pilot activity, which if successful, may find a large-scale application in lining the Ismailia canal in particular and of other irrigation canals in the Nile Delta in general. The advice presents Terms of Reference for a technical and financial feasibility study with respect to the pilot project. Furthermore the advice presents Terms of Reference for an EIS for the Ismailia Canal as a whole, assuming that lining will be applicated on a large scale.

Categories: Flood prevention/control DAC CRS-code 92021; River development DAC CRS-code 97300

Project numbers: DGIS: WW92850; JRC 381-93; MER/020/95; Commission for EIA: 020

Procedural information:
Letter requesting advice for Terms of Reference: 29 March 1996
Advice for Terms of Reference submitted: 20 June 1996
Letter with request to submit an advisory review: 20 August 1999
Advisory review submitted: 16 March 2000
Site visit: 28 June – 1 July 2000
Second advisory review submitted: 24 July 2000

Composition of the working group of the Commission for EIA:
Mr P. Eversdijk
Mr J.W. Kroon (chairman)
Mr T. van der Zee
Mr J. Zuurveld (resource person)

Technical secretary: Mr A.J. Kolhoff

APPENDIX 3

Working programme site visit

28 June	10.00 – 12.00	Briefing on the project by Mr H. Ruyssenaers and Mr N. Leguit of Bitumarin
	12.00 – 15.00	Site visit – technical works
	15.00 – 16.30	Meeting at the site with Mr D. El-Quosy and Egyptian Dredging
29 June	10.00 – 15.00	Site visit – monitoring network
	18.00 – 19.00	Working group meeting
30 June	15.00 – 18.00	Drafting of the report
1 July	10.00 – 13.00	Visit of the Ground water research institute. Presentations: - Dr A. Khater: activities & achievements of RIGW - Dr N. El Arabi: general outline; objective /working plan - Dr O. Gamae: drilling supervision / field monitoring program - Eng. M. Dawoud: data analysis / data base / seepage calculation
	15.30 - 17.00	Debriefing for Mr T. Morad representative of the Netherlands Embassy

APPENDIX 4

Terms of Reference for a monitoring programme of the pilot project

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1. OBJECTIVES

The monitoring programme is aimed at the collection of the following data:

- general information of the pilot project;
- measurements of physical parameters for appraisal of structure performance (reduce leakage, increase of discharge capacity, reduction of flow resistance et cetera);
- monitoring of aspects of critical structural elements during installation for technical quality assessment (i.e. trimming of slopes and bottom, sealing of mattresses, attachment upperside of mattresses by ground anchors);
- systematic registration of installation process for extrapolation of investment costs to large-scale application of the composite lining system (required man-hours, material quantities and operational hours of equipment).

2. DESCRIPTION OF MONITORING PROGRAMME

In this chapter a detailed description of the key elements of the monitoring programme will be given.

2.1 General information

The gathering of general information of the pilot project consists of the following issues:

- key plan of area where the trial project is located;
- cross-sections Ismailia Canal before lining;
- local bottom depth;
- height of banks, levees and dikes;
- design cross-shore profiles after lining;
- construction details of Bitumarin lining system:
  - attachment of Hypofors membrane to Betomat mattings of concrete blocks;
  - manufacturing of concrete blocks;
  - earthworks;
  - equipment used for installation of mattresses.

2.2 Physical parameters

The measurements of the physical parameters for appraisal of structure performance (reduce leakage, increase of discharge capacity, reduction of flow resistance etcetera) will focus on the following:

Bathymetrical/topographical data
Bathymetrical and topographical measurements should be performed at regular distances in series of (transversal) profiles along the trial section. The profile measurements simultaneously encompass the entire exposed and underwater parts of the canal.

The measurements are carried out along profile lines which should be a straight line at right angles to the canal banks and should be controlled from a bench mark with known reference level.

It is proposed to apply a distance of 50 m between successive profiles lines. This means that a total of 21 profile measurements should be performed along the trial section.

The exposed part of the profile should be measured with topographic instruments consisting of an engineer's level with tripod in combination with a levelling staff. The underwater part should preferably be measured with a portable echo-sounder fixed on a small rubber type boat, with the transducer mounted under or on the side of the boat. When echo-sounding instruments are not available, bathymetric profiles should be surveyed point by point from a boat, by measuring the depth of the canal bottom with a simple sounding line, consisting of a graduated rope and a ballast.

The measurements should be carried out for the existing situation, after trimming of the slopes and bottom of the canal and after the installation of the composite lining system.

Hydrodynamic data (current velocities and water levels)
Current velocity measurements should be carried out with a propeller type current meter (e.g. Ott propeller) operated from a small boat. The measurements should be carried out in several cross-sections. The cross-sections should be located near the upstream end of the trial section, midway and near the downstream end. For reference purpose an extra cross-section should be located at a sufficient distance upstream of the trial section (say 500 m).

In each cross-section the measurements should be carried out in 3 stations (in the centre of each profile and at either side of the centre at a distance of 15 m). In each station the current velocity should be measured at 5 points in the vertical (0.5 metre below the water surface, 0.5 metre above the bottom and 3 points evenly distributed over the remaining vertical).

For ease of interpretation the measurements should preferably be carried out in each cross-section simultaneously. However, from a practical point of view this is not considered as a realistic option (because of required manpower, number of instruments et cetera). In stead, it is proposed that during the whole measuring programme at one location (e.g. at mid-depth in the centre of the cross-section which is located 500 m upstream of the trial section) the current velocity is measured on a semi-continuous basis, say every hour. This measurement can also be carried out with a propeller type current meter or an automatic autonomous self-recording current meter.

The current measurements, on a monthly basis, should already start before the installation of the lining system (say a total number of three times). The objective of these measurements is twofold, viz. to gain experience in the measuring procedure and to obtain a representative measuring series for the existing situation (baseline situation). After completion of the lining system the current measurements should continue over a sufficient long period (say six-month) in order to some obtain insight in the variability of the process.

In general, a properly maintained propeller meter is a reliable instrument for use in uniform and quasi-stationary flows. Inaccuracies, generally, being in

the range of a few percent. However, depending on the specific type, the functioning of the impellers may be sensitive to silt or sand. Therefore, calibration of the instruments should be done regularly in a known current.

Water levels can be determined easily by visual observations using a fixed tide board with centimetre-scale and known reference level. The measurements should be carried out simultaneously with the flow measurements in the same cross-sections. As it is expected that the daily variation of the water level is only small, a measuring interval of one hour will be sufficient.

Geophysical data (groundwater levels, bottom samples)
Groundwater levels should be measured on a semi-continuous, day-to-day basis, before, during and after completion of the lining works. The measurements should start already 3 months before the actual installation of the lining system (base line situation) and should continue over a period of 6 months after completion of the works.

To perform these measurements, extra groundwater gauge-tubes (?) should be placed along the channel in the area where the trial project is executed. It is proposed to place the gauge-tubes in the same cross-sections as where the current measurements are performed, viz.: at a distance 500 m upstream of the trial section, near the upstream end of the trial section, midway and near the downstream end.

In each cross-section the gauge-tubes should be placed at either side of the canal at a distance of 5, 10, 50, 100, 250 and 500 m from the canal banks.

The filters in the gauge-tubes should be situated at a sufficient depth below the saturation zone in order to prevent drying up.

Bottom samples should be collected by means of an ordinary Van Veen type grab, and should be analysed on grain-size distribution. For the determination of the wet bulk density, samples should be collected by means of a medium size core-sampler, fitted with one-way valves to retain soft material. The collected samples may be regarded as practically undisturbed. Bed material should be transferred into 100 ml containers (marked and labelled, with known weight and volume) and sealed in plastic. In the field laboratory the total weight should be determined to an accuracy of 10 mg and should be stored in an electric oven to dry. Both wet and dry bulk density should be calculated, yielding the porosity of the material.

It is proposed to collect the bottom samples in the same profiles as where the bathymetrical measurements are performed. The samples should be taken after trimming of the bottom and the slopes of the canal (but before placing of the lining system).

Daily weather conditions
The weather parameters (air temperature, surface water temperature, humidity, degree of cloudiness) and the water temperature at the project site should be measured on a semi-continuous, day-to-day basis, before, during and after completion of the lining works. The objective of these measurements is to estimate the total loss of water mass of the trial section induced by evaporation.

The measurements should start already 3 months before the actual installation of the lining system (base line situation) and should continue over a period of 6 months after completion of the works.

2.3 Aspects of critical structural elements

From a technical point of view it is concluded that the proposed construction is sound, simple and well workable (see NEI report, September 1995).

It is also understood that the delivered supplies will comply with the quality for Netherlands water related structures.

It is assumed that the Contractor will adopt a proper quality control system for the proper realization of the construction process, i.e. that specifications will be fulfilled and that construction will proceed according to the programme.

Processes that can be subjected to quality control system are listed in the Table enclosed (derived from Manual on the Use of Rock in Hydraulic Engineering, CUR 169).

During construction stage monitoring of aspects of critical structural elements should be carried out for technical quality assessment. For the composite lining system the contractors quality plan should at least address the following critical aspects (and the corresponding placing tolerances):

- cleaning, excavation and smoothing of bank and canal bottom (unevenness);
- positioning of mattresses (interstices);
- adhesion of mattresses with bituminous sealing strips (leakage);
- attachment of mattresses to the slope with stakes or ground anchors (instability);
- results of find inspection by divers (with video equipment).

It should be stated that the final monitoring programme of this stage can only be made with the construction contract and contractors quality plan on the desk.

2.4 Systematic registration of project

Systematic registration of all stages of the project should be carried out to enable an extrapolation of the investment and maintenance costs to large scale application of the lining system.

The registration should comprise the following issues:

- required man-hours (local and foreign staff) for work preparation, training, manufacturing and assembling of mattresses, transportation, earthworks, installation and maintenance of the composite lining system;
- material quantities;
- type of equipment and operational hours;
- re-calculation;
  by post (part of the work) keep up to date: man-hours, equipment-hours, supplies, stocktaking of all equipment with description of normative parameters.

3. PROCESSING OF MONITORING DATA

The bathymetrical and topographical data as measured during the period of the survey should be reduced to Chart Data or to Ordnance Data depending on the request of the Ministry of Public Works and Water Resources. The applied Data must be clearly defined and reference marks mentioned in detail. The results should be presented graphically in plots and on diskette in ASCII-format.

The water levels should also be reduced to Chart Data or to Ordnance Data. The results should be presented in tables and on diskette in ASCII-format.

For the current measurements in the cross-sections the full period of the records must be elaborated and presented in 4 ways, including relevant information on location (cross-section, station), depth of instrument, local depth below CD, type of instrument and serial number, type of impeller and serial number, and calibration data:

- graphically in plots per station, showing the current velocity distribution over the vertical, positive in the downstream direction;
- on diskette in ASCII-format;
- per station showing the depth-averaged velocity and unit-width discharge;
- per cross-section the total discharge.

Separately, a table should be provided showing the comparison between the reference current recorder (e.g. at mid-depth in the centre of the cross-section which is located 500 m upstream of the trial section) and the current velocities in the remaining cross-section.

For the groundwater level recordings the results should be presented in 2 ways, including relevant information on cross-section, date etcetera:

- graphically in plots of one week each, showing the daily distribution of the groundwater level along the cross-sections;
- on diskette in ASCII-format, one column for the time (interval of 1 day), and one for the groundwater levels at the various locations per cross-section.

Bottom samples should be analysed on grain-size distribution, the results graphically presented in a curve showing the weight-percentage on or through the sieve (larger or smaller) versus particle diameter. Sand, silt and mud fractions must be taken into account.

Of the undisturbed samples, the wet and dry bulk density must be stated, yielding the porosity, in a tabulated form showing columns for sample number, location, wet volume, wet weight, wet bulk density, dry volume, dry weight, dry bulk density and porosity.

All measured weather parameters (air temperature, surface water temperature, humidity, degree of cloudiness) and the water temperature at the project site should be tabulated against time, the head of the table

indicating location, date and relevant particulars like types of instruments, serial numbers and calibration data.

APPENDIX 5

Monitoring programme and technical works

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1. INTRODUCTION

In 1996 a general monitoring programme was proposed in the advice prepared by the Commission for EIA to evaluate:

- General progress and effects of the physical lining works.
- Effects on seepage, discharge flows, and irrigated areas.
- Registration of required inputs and results for large-scale application.

This monitoring programme is included in this report as appendix 4.

Regarding anticipated seepage reduction a programme was made for measurement of canal discharges and cross-sections, in combination with measurement of groundwater levels near the lined section of the canal.

The Ministry of Water Management and Irrigation (MWRI) would be in charge of the overall programme, while various activities in monitoring would be entrusted to different (research) agencies of MWRI. A consultant would be appointed by MWRI to liase between the Dutch supplier Bitumarin, the contractors, and the Ministry's agencies.

In groundwater monitoring a series of 5 cross-sections was proposed; upstream of the pilot area, near the upstream end, midway and near the downstream end of lining. In order to determine the effect of the seepage, and to establish the flow pattern of the groundwater, a total of 6 wells in these cross-sections were recommended on either side of the canal, at a distance of 5,10, 50, 100, 250, and 500 meters from the canal banks.

Furthermore, a schedule was laid down for analyses and processing of monitored data, and reporting to involved partners, including the Commission for EIA.

2. THE MONITORING PROGRAMME

2.1 Observations and progress

1. Apart from the already existing monitoring of discharges and groundwater levels in the area of the lining pilot, a number of shallow wells, with some 10 meters depth were constructed. Additionally, several new deep wells of some 40 meters depth were included in the monitoring programme for groundwater recording.

2. Recording of groundwater levels in the total grid started in May 1999, while because of clogging of 4 wells, the monitoring programme was considered not complete. In July 1999 Water Management and Irrigation Systems Research Institute (WMISR) made a first progress report available on their monitoring. Data were presented on canal cross sections, on canal discharge measurements and on groundwater levels, together with recommendations for further data collection and additional observation wells to be constructed. A period of nearly two months (May-June) was covered on monitoring of groundwater levels. No analysis was made yet

regarding the seepage flows from the canal section, due to the shortage of the recorded period.

3. Because of some faulty dredging of the canal during September 1999, a serious increase in seepage occurred, which caused damage to agricultural crops of adjacent fields, and even to some housing in the neighbourhood of the canal. As a consequence of farmers' protest, WMRI ordered an additional 40 observation wells to be constructed for groundwater level monitoring. Some 20 shallow wells were identified in the neighbourhood of an irrigation distributary and irrigated agricultural fields that are located at the upstream end of the studied canal section. This was found necessary, because distributary canal and fields are at a higher elevation than the Ismailia canal and immediate surroundings. Therefore, the possible effects of seepage and drainage of this area on the groundwater levels of the monitoring programme can be incorporated into the seepage analysis, required for the lining programme.

4. As from February 2000 the Ground Water Research Institute (RIGW) was charged with the implementation of the groundwater monitoring programme. RIGW started the data recording as from 1st of March for 6 lines of observation wells. Part of the old grid of observation wells (a total of 8) will be used for the analysis. The majority of the recording points (36) will come from the newly installed grid. The originally proposed recording of twice a week was stepped up to a monitoring of 4 times a week. Some deep wells, immediately adjacent to the canal, have automatic recorders installed; the remainder of the observation wells is manually recorded by gauging

5. Flow discharge measurements of the canal are taken simultaneous with the groundwater level recording, and are taken by the General Directorate for Water Distribution in the Delta–Tanta. The Zagazig department of MWRI is in charge of the gauging of canal bottom and embankments, together with the General Directorate for Water Distribution in the Delta-Tanta. The programme has a total duration of 18 months.

2.2 Conclusions

1. The Commission observed a possible constraint in the determination of seepage flows after lining, which is confirmed by RIGW. Due to the rather coarse sandy and sometimes gravely material found in the boreholes along the canal, it appears that the soil underlying the canal may have a high water transmission potential. Therefore, lateral flows, originating from unlined canal sections might disturb the monitored groundwater levels near the canal, which will influence calculated seepage flows.

2. Another disturbing factor may be formed by the irrigated areas lying in the neighbourhood, and upstream of the pilot and located at higher elevation than the canal. Possible sub-surface drainage from these areas could disturb recorded groundwater levels. In order to determine the possible effects of this area RIGW installed additional piezo meters in the surroundings of the irrigated area.

3. It cannot be estimated in how far the three approaches (empirical, analytical, and modelling) of analyses of data, proposed by RIGW will be able to neutralise these effects. It is also not yet clear in how far the two pumping tests, to be initiated by RIGW, will provide an answer to this question.

2.3 Recommendations

Based on the site visits and the discussions held at the various institutions, it is recommended:

1. To reconsider, or stop the monitoring programmes in canal discharges and groundwater levels, and its resulting analyses of seepage flows, in case no full lining of the canal section, including the bottom, will be achieved. Results of monitoring will most likely not lead to any conclusion at all on anticipated reduction in seepage flows.

2. In case a full lining of the canal, according to the initial proposals, is carried out by MWRI, this same Ministry should entrust one organisation only, preferably RIGW, with the full responsibility of the monitoring and analyses of recorded data. This would mean, that RIGW will be provided with recorded data on canal discharges, canal cross-sections and bottom levels, and progress of the lining activities.

3. THE TECHNICAL WORKS

3.1 Observations and conclusions

1. The Hypofors Bitumen mattresses were delivered by Bitumarin since August 1999.

2. Mid-November 1999 the block production started; at present around 120.000 blocks (of the 500.000 in total) are completed. The quality of the concrete blocks rather differs and also can not be determined due to the lack of quality control.

3. According to the Egyptian Dredging Company (EDC) the dredging works of the bottom are completed and the bottom of the canal complies with the required depth. Bitumarin asked for soundings every 5 m. The MWRI felt that soundings every 50 m should be sufficient. However, there are no soundings available, so that not can be determined if the bottom is smooth and the depth sufficient. It has to be stressed that it is very important to install the mattresses on a smooth bottom. Considering the (potential future) navigation function a sufficient depth is required.

4. At the end of February 2000 EDC was started with testing the method of installation of the mattresses. At the end of March EDC started with the actual work. Presently, (last week of June 2000) mattresses are installed only at the slopes, over a length of about 150 m, 2 mattresses of 6.5 m each, which means a total width of 13 meter. According to the manual,

prepared by Bitumarin, the lining should be installed both on the slopes and the bottom. EDC claims that it is impossible to install mattresses on the bottom due to occurring stream velocity (0,5 to 1 meter/second). A trial with a 100 ton pontoon failed. According to the manual a 400 ton pontoon with a 100 ton crane should be required. It can be concluded that, as a result of the implementation of inadequate equipment, it is not proved that it is impossible to install lining on the bottom of the canal under the present circumstances, as the EDC claims. In order to enable judgement of the technical feasibility and the effectiveness of the construction, which is the main goal of the pilot project it is imperative that the technical works are executed in accordance with the manual, which means a complete lining. Moreover, if only a lining on the slopes is installed, some potential risks have to be taken into account and further investigation is needed on:

- Possible scouring at the edge of the slope mattresses; due to that, instability of the slope can occur;

- The effect of the changing of the ground-water flow from the canal at the bottom end of the slope (piping influencing the stability of the embankment, effect on water logging).

5. In order to realise a waterproof lining system the connection of the Betomat mattresses is the most critical element of the lining system. As a consequence special attention must be paid to a precisely trimming of the surface of the slope and bottom of the canal and to the connections of the mattresses. It is observed that the mattresses not always are installed in a straight line. As for the quality control of the under water part of the lining system, only observations of a diver are feasible, it has to be stressed that it is very important to install the mattresses in straight lines. Moreover no soundings of the underwater slope were available, so that it can not be observed if the under water part of the slope was smooth before installing the mattresses.

6. It seems that the average width of the bottom of the canal is more than was foreseen. This could mean that less than the planned 1000 meter, will be lined.

7. Due to the present execution problems a proper evaluation of the project will be difficult. As a result a judgement of the effect of the Betomat lining system can not be made on: execution technique, waterproofness of the construction and, execution time and costs.

3.2 Recommendations

Based on the site visits and discussions it is recommended:

1. To implement a quality control system for the manufacturing of the concrete blocks.

2. To gauge the cross section of the canal at a distance of approximately 5 m.

3. To pay special attention to the sealing of the Betomat mattresses, especially on the underwater slope and the bottom. Therefore, it is very important to install the mattresses in straight lines.

4. To execute the lining of the bottom at the same time with lining of the embankments of the canal. This implies that the bottom of the 150 m canal section should be completed before continue installation of mattresses on the embankments.

5. To think about a method for maintenance dredging works after completing the lining system.

APPENDIX 6

Terms of Reference for a study on the environmental and socio-economic impacts of the Ismailia pilot project

Introduction

During the visit of the Commission for EIA, the RIGW stated that they felt the need to gather information on the changing agricultural situation due to lining. Therefore, they will study two farms in depth in the area adjacent to the site where the pilot project is under construction. The Commission is of the opinion that studying these two farms will not provide sufficient information to enable an assessment of the expected changes. In order to achieve the following objectives a land use map should be made and a farmers survey should be carried out. In this appendix guidelines are provided for the execution of a study on environmental and socio-economic impacts of the pilot project lining of the Ismailia canal.

Objectives of the study:

- To get insight in the socio-economic situation and changing agricultural production circumstances due to expected change in seepage as a result of lining of the Ismailia canal.
- To get insight in the view / perception of the farmers concerning the expected changes due to lining of the pilot project.
- To get a brief impression of the overall socio-economic impacts in case of large-scale application of lining of the Ismailia canal.

Land use map

A land use map should be made in order to get an idea of the impact of seepage in the area adjacent to the canal. It is known that dependent on the extent of seepage the following problems occur: flooding, water logging and salinization of the soil. There is a strong relation between the occurrence of these problems and the land use. All types of agricultural land use and other forms of land use should be mapped. The area for which this map must be made is an area of three kilometres length starting adjacent to the canal at 75.0 km up to point 78.0 km. The first kilometre (section 75.0 – 76.0) is the pilot site the following two kilometres are required as control area. The width of the area can not be demarcated precisely. The area to be considered and mapped is the area affected by seepage and this might differ along these three. On basis of field visits it is expected that an area up to two kilometres from the canal can be affected by seepage. For the preparation of the map aerial photos could be used and field visits should be made.

Rapid rural appraisal

A farmers survey should be executed in the area on the southeast side (adjacent to the right bank) of the canal. This study provides information on the agricultural production situation of the farmers. This information together with the information from the land use map offers the opportunity: (i) to get an impression of the environmental and socio-economic impacts of lining and, (ii) to make an assessment of those impacts in case of large-scale application on basis of extrapolation of gathered socio-economic data.

Method
To gain information from the farmers use can be made of a rapid rural appraisal (RRA). For the selection of farmers use should be made of a transact walk. This means that crosswise to the canal a line is drawn. It is recommended to draw two lines, one line in the area where decrease of seepage is expected to be maximum (it is suggested to start this line about four to five hundred meters from where lining starts, at point 75.5 km) the second line is a control line (it is suggested to start this line at point 78 km). The length of the lines should be determined by the area which is still affected by seepage an area up to two kilometres from the canal. Therefore, it is expected that this line has a length of about two kilometres. All the farmers who own or rent one or more fields along these lines should be included in the survey. The maximum number of farmers surveyed on each line should not exceed twenty. In total about 40 farmers should be surveyed. These farmers should be surveyed two times. The first survey should be carried out as soon as possible and focus on the situation without lining and the perception of the situation after lining. The second survey should be executed among the same farmers one year after completion of the lining.

Base line information
Information on the following subjects must be gathered in the survey:
- soil type and soil conditions
- ha flooded
- ha water logged
- ha salt affected
- ha reeds / natural vegetation
- type of crops grown (information on yields and costs and benefits are not relevant for the purpose of this research)
- employment situation
- occurrence of water borne diseases

This information should be gathered by making use of a RRA under the selected farmers. During the first visit the farmers should be asked what type of changes they expect in the agricultural production situation at their fields and for the area as a whole due to the pilot project. During the second visit it can be asked if expected changes occur already and one should be aware and investigate changes mentioned in the area. For the purpose of the study it is not required to execute an extensive farmers in-depth survey. The RRA can be executed by one person in 24 days (including two visits of 40 farmers, data analysis and reporting).

Presentation of information
It is recommended to make a cross section of the area affected by seepage. Within this cross section different land use zones should be distinguished. For each land use zone the base line information asked for should be provided.

Integrated analysis and reporting

In the final report the results of the monitoring of ground water should be combined with the results of the farmers survey and the land use map.