IMPROVING CHANNEL MAINTENANCE METHODS FOR EGYPT'S IRRIGATION SYSTEMS

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ABSTRACT

AFTER THE CONSTRUCTION OF THE HIGH ASWAN DAM IN EGYPT (1950s), THE CHANNEL MAINTENANCE METHODS ADOPTED BY EGYPT'S DEPARTMENT OF IRRIGATION INCLUDED THE EMPLOYMENT OF HEAVY, INEFFICIENT CONSTRUCTION EQUIPMENT THAT WAS UTILIZED WITHOUT AN EFFECTIVE MAINTENANCE PROGRAM. BY THE 1980s, THESE PRACTICES HAD SERIOUSLY DAMAGED EGYPT'S IRRIGATION AND DRAINAGE CHANNEL PRISMS AND EMBANKMENTS, AND WERE FAILING TO EFFECTIVELY CONTROL THE GROWING POPULATION OF AQUATIC WEEDS.

IN AN EFFORT TO IMPROVE THIS CONDITION, THE CHANNEL MAINTENANCE PROJECT WAS FORMULATED (1986) BY THE EGYPTIAN MINISTRY OF PUBLIC WORKS AND WATER RESOURCES, WITH SUPPORT FROM THE INTERNATIONAL BANK FOR RECONSTRUCTION AND DEVELOPMENT AND THE UNITED STATES AGENCY FOR INTERNATIONAL DEVELOPMENT. THE PROJECT'S PRIMARY OBJECTIVE WAS TO IMPROVE AD HOC CHANNEL MAINTENANCE PRACTICES BY REPLACING THE ESTABLISHED SYSTEM OF CHANNEL EMBANKMENT EXCAVATION WITH AN EFFICIENT PREVENTIVE MAINTENANCE PROGRAM THAT INCLUDED A BALANCED CYCLE OF WEED CONTROL MOWING, HERBICIDE TREATMENT AND DESILTING. A VARIETY OF MODERN CHANNEL MAINTENANCE EQUIPMENT WERE USED, INCLUDING HYDRAULIC EXCAVATOR-MOUNTED SHALLOW-DRAFT BUCKETS AND WEED MOWERS, AND MOTORIZED HERBICIDE SPRAYERS. PROJECT EFFORTS BEGAN IN JUNE 1989 AND ARE PLANNED THROUGHOUT THE 1990s.

INTRODUCTION

Until the late 1950s, when the High Aswan Dam was constructed, maintenance requirements for Egypt's irrigation and channels were minimal. This was mainly due to the presence of silt deposits that were left by periodic flooding of the Nile river.

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The few aquatic weed populations that did appear were easily controlled with manual labor, and earthwork repairs as conditions required. In general, the farming population was able to rely on the fertile silt to revitalize their soil; and farmers unhampered by maintenance problems were able to produce adequate crops.

This condition changed drastically, however, when the high dam was constructed. The presence of the dam greatly reduced sediment deposited downstream and allowed a dramatic increase in aquatic weed growth due to the presence of clearer water which allowed more sunlight penetration onto the channel beds. The addition of agricultural fertilizers in the drainage water and perennial use of the channels has also encouraged weed growth, which continues to spread to all of Egypt's waterways.

THE CHANNEL MAINTENANCE PROJECT

In an attempt to reduce the damage being done to channels from over-excavation with heavy equipment, and to effectively control the aquatic weeds, during 1986-89, Egypt's Ministry of Public Works and Water Resources (MPWWR) requested the International Bank for Reconstruction and Development (IBRD), and the United States Agency for International Development (USAID) to assist in resolving their serious channel maintenance problems. Both the IBRD and USAID responded with funding and technical assistance and the multimillion dollar support effort for a Channel Maintenance Project (CMP).

Objective:

The objective of the CMP was to improve channel maintenance activities in the Irrigation Sector while reducing operational costs. The project was workcharged with introducing modern channel maintenance practices, replacing the traditional system of excavation with a balanced cycle of weed mowing, herbicide treatment and desilting.

The 8-year project, planned in 1986, began implementation in June, 1989. During the project, the equipment fleet of the channel maintenance contractors, including, for the first time, private sector companies, was upgraded. The new effort was to focus on cycle-based maintenance schedules, which

would be introduced over the entire 48,000 kilometers (28,800 miles) network of public channels. Technical assistance (TA) was therefore provided to the irrigation sector, the Weed Research Institute (WRI), and to the Public Sector Excavation Companies (PECs) to improve management, planning and monitoring, together with specialist support on specific technical issues. Special attention was given to improving the control in the use of chemicals. The results expected were improved maintenance performance at lower costs.

Replacing Old Methods with New Technologies

The CMP efforts began by supplementing or replacing old, inefficient channel maintenance practices with new, modernized ones. While manual labor employment was, and still is, used in areas inaccessible to modern equipment, the PECs's application of large dragline excavators as the primary means for channel bed desilting and weed removal was the initial area of concern. The practice of removing large amounts of soil, using deep draft toothed buckets, was noticeably over-excavating channel prisms and working at a high rate of cost to remove aquatic weeds.

A strategy was therefore developed to reduce dragline use and implement the project' objectives. The initial plan was to maintain the channels and control weeds through an integration of modern maintenance methods (**Table 1**). Use of these methods in a cyclical pattern would effectively control all submersed, emersed, ditchbank, and floating aquatic weeds growing at an increasing rate in all parts of Egypt' irrigated lands. As the CMP effort was to be focused on the use of mechanical equipment, a large amount was ordered, delivered to the field sites, and commissioned.

To ensure that the modern equipment employed would be effectively utilized, three computerized management systems, including the Maintenance Operations Management System (MOMS), the Equipment Management System (EMS), and the Materials Management System (MMS) were developed as part of the initial project effort. The use of the data from these systems provided irrigation system maintenance operation managers with accurate, current information from which periodic plans have been made.

Table 1: Modern Methods of Channel Maintenance

SUBMERGED WEEDS	- Excavation with shallow-draft, toothless buckets - Herbicide injection into channels - Harvesting with weed harvesters - Mowing with weed-mowing buckets - Mowing with weed boats - Cabling and drag chaining
EMERSED/ DITCHBANK WEEDS	- Mowing/mulching with mowers - Excavation with shallow-draft, toothless buckets - Spraying with herbicides - Scraping with sloper blades
FLOATING MARINE WEEDS	- Spraying with herbicides - Excavation with shallow-draft, toothless buckets - Harvesting with weed harvesters

Herbicide Ban

After the PM program had been developed and the implementation effort had begun, for a number of reasons beyond the scope of this paper, in January 1991 the GOE banned the use of herbicides in Egypt's channels and drains. The project subsequently discontinued its plan to use herbicides and in their place added a wider range of mechanical equipment and a biological control method (weed-eating grass carp). While the MPWWR realized that more equipment meant increased maintenance costs and the introduction of fish a change of focus, the changes had to be effected in order to combat the ever-increasing aquatic weed growth. From 1991 until the present time (December 1992), a revised program has been used, utilizing grass carp and the following additional equipment.

- Sloper blades mounted on motorgraders
- Weed mowing boats
- Amphibious weed harvesters

In order to provide adequate technical reference material to the MPWWR personnel working with the new technologies, the technical assistance team also developed a Weed Control Manual for the Channels and

Drains of Egypt and an Irrigation and Drainage Systems Maintenance Manual. These manuals are serving as guidelines for effective channel maintenance, both in planning maintenance activities and completing maintenance tasks.

Current Channel Maintenance Practices

The practices developed by the CMP (which is still continuing in 1992), has resulted in the following methods of channel and drain maintenance.

MANUAL CONTROL

The age-old method using manual labor is still a significant part of the weed control effort. But while at least 55 % of all weeds are normally controlled by this method due to increasing labor costs and decreasing labor supply when needed, this control is on the decline. The risk of becoming infected with bilharzia disease from wading in water infested with parasites is a great detriment to the use of this effort. Also, the MPWWR does not recognize this method of control as an effective way to do channel maintenance.

MECHANICAL CONTROL

Completing channel maintenance, especially weed control, with mechanical equipment is the most popular method used in Egypt. The modern equipment used is as follows:

Shallow-draft. Toothless and Perforated Excavation Buckets

The most effective mechanical equipment used to date are the shallow-draft buckets that are used to control submersed aquatic weeds. Excavation is kept to a minimum, usually once during the weed-growth season (March-May), since this is the most effective time to remove the accumulated biomass. Like ditchbank weeds, emersed weeds should also be excavated before they set seed.

Floating weeds (waterhyacinth) are also removed with shallow-draft buckets, clearing the channels and drains for desilting and/or eradication of submersed weeds.

These buckets may be used for excavation of emersed and ditchbank aquatic weeds before seed set to avoid their spread. Only one shallow excavation should be made per year for weed and/or silt removal.

Flail Mowers - for Ditchbank Weeds. Flail mowers are used each weed growing season to cut down and shred ditchbank weeds. Mowing is normally performed early enough in the weed growing season (March-May) before target weeds set seed to avoid spreading undesirable weed seeds. Flail mowing of regrowth eliminates the need for mechanical excavation of ditchbanks to control ditchbank weeds.

Mowing Buckets
The mowing bucket is an open skimming shaped bucket with a sickle-type cutter on the cutting edge. This bucket mows the weeds and at the same time is able to gather the cut weeds. The mowing bucket is effective in mowing underwater grasses but inefficient in mowing heavy, course weeds.

Drag Cables or Chains
A cable or chain suspended across a channel and dragged upstream by two tractors is an effective method to control high density weeds. This operation can be inefficient when it drags or up-roots submersed weeds which are allowed to flow free and/or entangle on the drag cable or chain and plugs control structures.

Embankment Reshaping Using a Sloper Blade
Reshaping or restoring a channel bank to design specifications, using a sloper blade mounted on a motorgrader can facilitate a weed mowing program. Also, a channel bank can be maintained and be weed free by employing a sloper blade to scrape the side slopes clean of weed growth.

Mechanical Weed Harvesters
Controlling aquatic weeds with mechanical weed harvesters is usually ineffective and expensive, although occasionally successful in carefully selected channels. Some units are being effectively employed for skimming floating weeds; others have been successfully

used for harvesting deep-growing submersed weeds located on a flat-bottomed channel bed.

Weed-Mowing Boats
Weed-mowing boats with vertically and horizontally-mounted cycle bars are effective in selected areas. The high maintenance and cost to operate the units makes them uneconomical to use.

BIOLOGICAL CONTROL METHODS

The White Amur fish (grass carp) bred at the WRI's delta barrage fishery, has become effective in the control of some aquatic weeds, although most fish are fished out of the channels soon after being planted in them. Grass Carp have been successfully stocked in some larger channels, such as in the Suez area, and with effective control, have successfully controlled aquatic weeds.

CURRENT STATUS

As of December 1992, the status of the CMP is as follows:

1. The MPWWR's plan of integrated maintenance practices and techniques have been revised. New equipment has been procured to replace old units.

2. Additional modern channel maintenance equipment has been added to project areas.

3. A modern PM program, contained in two manuals that include CM maintenance cycles, has been developed and is being implemented in Egypt's irrigation directorates.

4. CM personnel have been trained on modern maintenance methodologies.

5. CM equipment repair shops have been established and equipped with modern tools to maintain CM equipment.

SUMMARY AND CONCLUSIONS

In summary, the CMP effort has begun to be successful in improving the traditional maintenance practices that have formerly resulted in channel deterioration. The employment of appropriate mechanical and effective biological maintenance methods in place of dragline excavators have begun to control the vast and heretofore uncontrolled weed populations growing throughout the country. The abrupt moratorium on herbicide use has and will continue to detract from the success of the project, but to what extent remains to be seen.

Realizing the need for additional funding and resources, the European Economic Community (EEC) has recently (May 1993) shown an interest in adding their support to the CM effort. This aid is planned to begin in May 1993 when the current USAID technical assistance contract is due to expire. A definitional mission was completed in May 1992 by EEC consultants and discussions are currently being held to determine the future involvement of the IBRD, USAID and EEC.

In conclusion, if MPWWR personnel managing the CM effort effectively and efficiently utilize the modern equipment, biological maintenance method, and other updated knowledge and skills provided by the project, emergency situations will be prevented and the channel maintenance effort successful.

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