AGENCY FOR INTERNATIONAL DEVELOPMENT
WASHINGTON, D. C. 20523
BIBLIOGRAPHIC INPUT SHEET

FOR AID USE ONLY
Batch 70

1. SUBJECT CLASSIFICATION
A. PRIMARY: Food production and nutrition — AP12-0000-G240
B. SECONDARY: Drainage and irrigation--Tunisia

2. TITLE AND SUBTITLE
Some aspects of an open drainage canal maintenance program

3. AUTHOR(S)
Davis,W.J.

4. DOCUMENT DATE: 1961
5. NUMBER OF PAGES: 16p.
6. ARC NUMBER: ARC TN631.62.D265

7. REFERENCE ORGANIZATION NAME AND ADDRESS
AID/NE/USAID/Tunisia

8. SUPPLEMENTARY NOTES (*Sponsoring Organization, Publishers, Availability*)
(In English and French. French,18p.: PN-AAE-879)

9. ABSTRACT

10. CONTROL NUMBER
PN-AAE-878

11. PRICE OF DOCUMENT

12. DESCRIPTORS
Canals
Drainage
Maintenance
Tunisia

13. PROJECT NUMBER

14. CONTRACT NUMBER
AID/NE/USAID/Tunisia

15. TYPE OF DOCUMENT

AID 590-1 (4-74)

TN
631.62
D265

PN-AAE-876
AID/NE/USAID/TUNIS

Special Mission for Economic
and Technical Cooperation

SOME ASPECTS OF AN OPEN DRAINAGE CANAL MAINTENANCE PROGRAM

WILLIAM J. DAVIS
Soils Advisors
USAID/TUNIS

A.I.D.
Reference Center
Room 1656 NS.

156

CPI./2.64/200

TABLE OF CONTENT

Introduction	P. 1
Necessity for a Maintenance Program	2
Principal Causes for the Failure of Open Drainage Canals	3
Recent Research on the Mechanics of Open Drainage Canal Maintenance	3
The Ahmed Davis Shovel	5
Possible Application to a Drainage Canal Maintenance Program	6
Photos of Hand Shovel Method of Cleaning Canals	10
Photos of Ahmed Davis Shovel in Action	11
Photos of Backhoe Attachment for Light Rubber-Tired Tractors	12
Photos of the Gradall-Type Machine	13
Drawings of Ahmed Davis Shovel	14

INTRODUCTION

The development of the lower valley of the Medjerda River Basin of Tunisia includes plans for the irrigation of 62 thousand hectares of land. An additional 240 thousand hectares are to be developed for dry land agriculture, under a system of modern soil and water conservation practices. In any such complex agricultural development, adequate drainage of the land involved is necessary.

This report was written especially for the Medjerda Valley Development program. We believe that it contains many aspects of a drainage program that may be of value elsewhere, both in Tunisia and in other countries.

SOME ASPECTS OF AN OPEN DRAINAGE CANAL MAINTENANCE PROGRAM

I. Necessity for a Maintenance Program

Open drainage canals rapidly lose their effectiveness unless they are properly maintained. A good maintenance program is just as necessary as the original proper design and construction of the drainage canals. Because maintenance is so important for successful drainage, every effort should be made to develop a practical maintenance program. The program should give an annual maintenance schedule for the operations and practices to be followed. In addition, the program should give complete details for accomplishing the maintenance operations. It should provide for periodic inspection of operations by the personnel responsible for the program. The determination of the prorated share of the cost of the maintenance program, and arrangements for securing the necessary funds, must be agreed to in advance of operations. In the case of the Medjerda Valley Development Program, an arrangement may be arrived at whereby the land owners, cooperatives and the Medjerda Valley Authority will bear in appropriate shares the cost of the maintenance program.

In respect to the prorated maintenance payments, it may be advisable for the Medjerda Valley Authority to pay the maintenance costs of the larger drainage canals, while cooperatives and landowners pay for maintenance charges attributed to smaller drainage canals and farm canals within each cooperative unit.

II. Principal causes for the Failure of Open Drainage Canals

The principal causes for the failure of open drainage canals are sedimentation in the channel, excessive growth of vegetation, and channel and bank erosion. Sedimentation can be reduced by conservation practices on the watershed and by proper land use. Vegetation in the channel can be controlled by spraying, grubbing and clearing, grazing and burning. In recent years chemical sprays have tended to replace the hand method of cleaning vegetation from drainage channels. Channel and bank erosion are usually not as serious as sedimentation or excessive vegetative growth. Bank erosion can be controlled by either making the side slopes of the canal flatter and seeding them to a suitable grass, or by giving continuous and permanent mechanical protection with stone or other similar materials. Channel erosion may be controlled either by providing mechanical drops in the channel or by reshaping the channel to reduce the velocity of flow.

III. Recent Research on the Mechanics of Open Drainage Canal Maintenance

During the past ten to fifteen years American agricultural engineers, together with manufacturers of farm implements, have devoted considerable effort toward the design and construction of light earth moving implements that can be attached to light farm-size, rubber tired tractors. These combined efforts have been fruitful. Today, it is possible to obtain any type of light tractor attachment needed to do a specific job of earth moving. Not only have many different models of attachments been designed for land leveling, canal digging and cleaning and trenching for tile, but also these various attachment

models are now manufactured in different sizes so as to be specifically adapted to the work to be done and the size of the tractor available.

Some of the salient advantages of utilizing farm-size tractors and their attachments for earth moving operations can be briefly stated as follows:

a. Tremendous savings can be achieved.

b. The technique of operating light tractors and their attachments is less difficult to master than is the case with the larger equipment.

c. Greater versatility in the use of the farm-size tractor. This increases the usefulness of the tractor, and hence makes its ownership more economical.

The low cost of earth moving for drainage purposes is borne out by a study made by Mr. B. A. Boving, of the University of California, and titled "Drainage Cost Survey" and published in the April 1957 issue of "California Agriculture". The report states: "From this study it appears that earth moving - for agriculture drainage- costs between $0.15 and $0.20 per cubic yard in Northern California". Translated into Tunisian costs, these figures would be between 80 and 110 millimes per cubic meter. It is well to point out that Mr. Boving's cost figures quoted above include all types of earth moving, and that normally the cleaning of drainage ditches is somewhat higher than per cubic meter excavation costs incurred when a new canal is dug. Perhaps a fair cost figure for the cleaning of old drainage canals of sediments by this method might be 150 millimes per cubic meter. Today the cost of cleaning the drainage canals of

the Medjerda Valley is in the neighborhood of 300 millimes per cubic meter. There seems to be little doubt that the low figures quoted by Mr. Boving are, in part, the result of the utilization of light tractor attachments. Therefore, it seems logical that this same economic method can be applied by the Medjerda Valley Authority in its drainage canal maintenance program.

Prior to 1961, drainage canals in the Medjerda Valley, were cleaned by using ordinary hand shovels. With such a method, approximately one half of the laborers worked in the middle of drainage ditches while the others worked on the side of the ditch bank. Those in the center of the ditches transferred the mud to the shovels of the laborers on the ditch bank who, in turn, lifted the mud to the top of the bank. This unpleasant type of work, coupled with the ineffective implements used, resulted in expensive drainage canal maintenance costs.

IV. The" Ahmed Davis Shovel"

In 1961 and 1962 efforts were made at the Medjerda Valley Development Program to devise a better method of hand cleaning the drainage canals. As a result of this work, Mr. Ahmed Chebly, a Tunisian soils technician and William J. Davis, a soils advisor of U.S.A.I.D. Tunis, invented, built and tested a new type of hand operated shovel. This shovel, "the Ahmed Davis Shovel", works with a system of pulling ropes and pushing poles and allows all the laborers to work on the dry bank. (Pictures and drawings of this implement on pages 11 and 14).

Official tests proved the "Ahmed Davis Pelle" to be three-hundred percent more efficient than the former hand shovel method. Although the new shovel is designed primarily for sediment removal, it will also clean any vegetation providing the roots are not anchored in the hard, residual soil at the bottom of the canal. An additional advantage to the new shovel is that it allows the laborers to work under much cleaner conditions, and is, therefore, much preferred by them over the old hand shovel method.

V. Possible Application to a Drainage Canal Maintenance Program.

In a discussion of a drainage maintenance program the subject can logically be divided into three parts: (a) preventive measures which can reduce the amount of sediments entering the canal; (b) the mechanics involved in cleaning the canals of sediments and vegetative growth; (c) safeguards in planning operations designed to avoid excessive maintenance costs.

(a). Preventive measures:

Any preventive measure which reduces the amount of sediments entering the drainage canal automatically reduces the cost of the maintenance program. Preventive measures of this kind can best be achieved by the application of a complete soil and water conservation program to the entire watershed area. The advantages of a good soil and water conservation program are well understood at the Medjerda Valley Development Program. The practice of terracing steep slopes is already quite advanced. Perhaps now is the time to give more attention to the practice of providing grass waterways.

Grass waterways have proven to be one of the essential conservation practices for inhibiting sediment transportation during the rainy season. In those places where terraces and grass waterways do not effectively retard sediment transportation, it may be advisable to consider the practice of providing sedimentation basins at the base of the slopes.

(b). Mechanics of cleaning drainage canals:

Many chemical sprays have been produced in recent years for the control of canal vegetation. Experiments carried out in 1962 proved the use of these sprays to be non-economical at the Medjerda Valley Program. Perhaps this was due partly to the high cost of imported chemicals, partly perhaps to some undetected fault during the course of the experiments. In the future it would seem advisable to continue to test chemical sprays for the control of canal vegetation. However, for the present it would seem advantageous to control the canal vegetation by one of the methods outlined in the chart below (choice of method for vegetative and sediment cleaning).

The cleaning of sediments from the canals should be accomplished with (1) a rubber tired tractor with a backhoe attachment or (2) "The Ahmed Davis Shovel". The old hand shovel method of cleaning sediments should be completely eliminated. In general, wherever tractors and backhoe attachments are available, they should be used to clean all the larger canals and all places where it is physically possible for this type of equipment to operate.

The "Ahmed Davis Shovel" should be used at all locations where it is impossible to operate the backhoe attachments.

The following table gives a summary of the possible methods to employ in the cleaning operations:

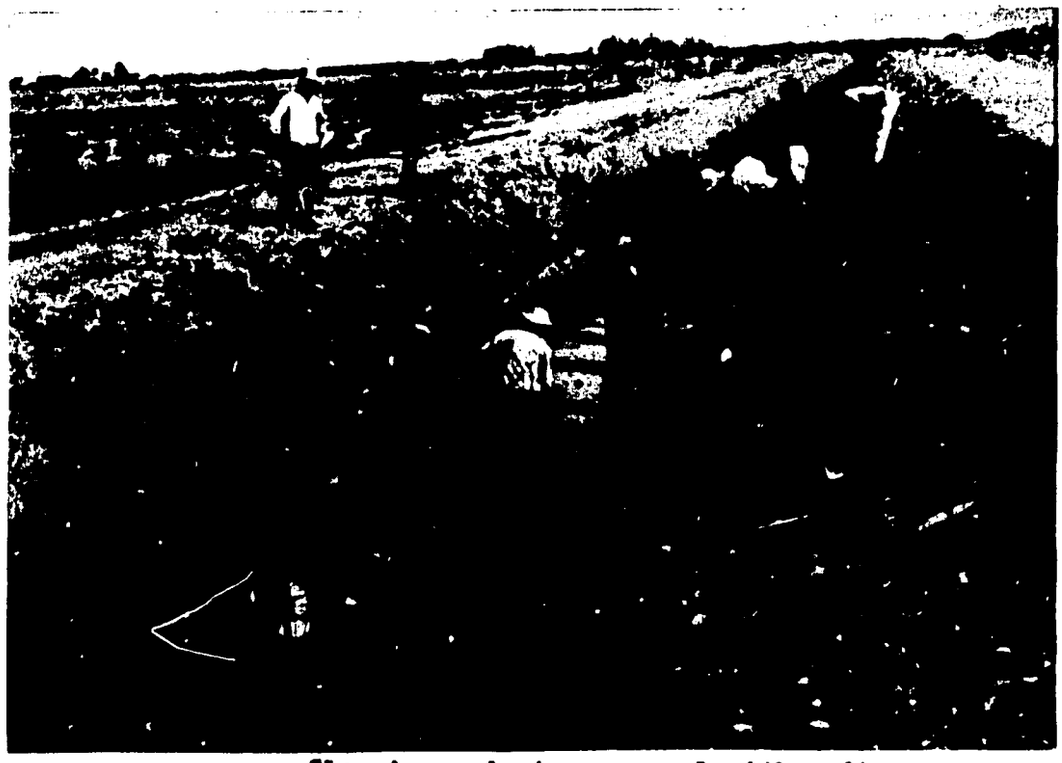
CHOICE OF METHOD FOR VEGETATIVE AND/OR SEDIMENT CLEANING

Method to be used	Description of Sediments and Vegetation of Canal	
	Thick sediments with or without vegetation	Slight or no sediments with floating vegetation
Light rubber-tired tractor, with backhoe attachment	All phases where physically possible to work	No
"Ahmed Davis Shovel"	Those places not accessible to the tractor and backhoe	Yes

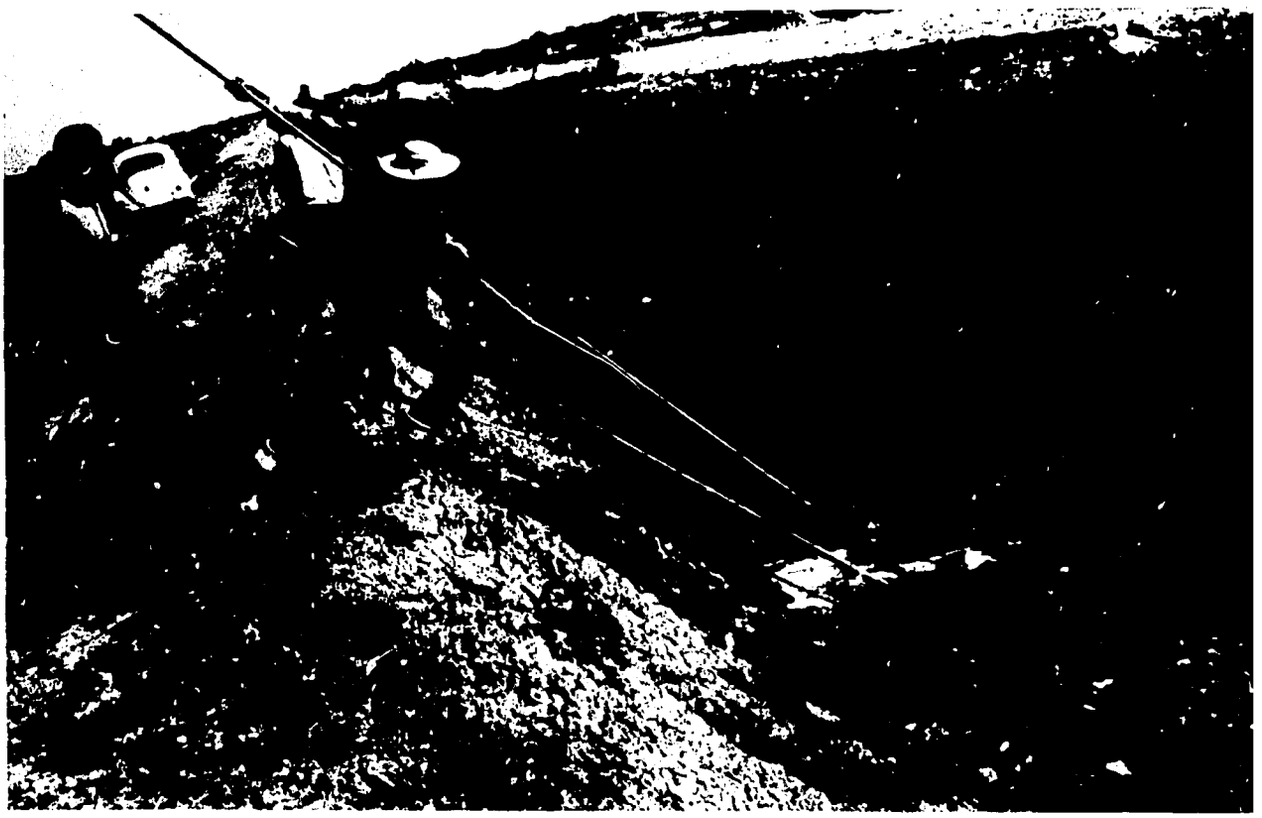
Other exceptions to the use of the "Ahmed Davis Shovel" are: (1) cases where canals have been so neglected that vegetation has been allowed to grow to 5 feet or more; (2) where sedimentation is slight but vegetation is well anchored into hard soil. In the latter case, neither the shovel nor tractors fitted with backhoe attachments are suitable to remove the vegetation.

(c). Safeguard against excessive maintenance costs:

Particular reference is made here to the "Ahmed Davis Shovel". Today its operation is accomplished with relief labor. In this respect it is important to point out that the cost to the economy of Tunisia for the relief labor force is a constant amount, regardless of whether their work is of high or low productive nature. In light of this, and in order to provide an adequate safeguard against excessive canal maintenance costs, the Medjerda Valley Authority may find it advisable to negotiate an agreement with the work relief program to the effect that their share of the payment toward these relief salaries will be based not on a per day salary basis, but rather on the cubic meters of sediments excavated or on a given canal. Under such an agreement, the Tunisian work relief program would then subsidize the relief salary of each man up to the established level given to all relief laborers. Perhaps the Medjerda Valley Authority can afford to pay the work relief program an amount equal to the average cost of cleaning sediments with the tractor and backhoe plus an additional 25 percent. Should it develop that such arrangements cannot be made with the work relief program, it would then seem advisable for the landowners to organize work groups among themselves and use the "Ahmed Davis Shovel" to clean those canals which are not accessible to the tractor and backhoe.



Cleaning a drainage canal with ordinary hand shovels.
Below: Laborers transfer mud from one shovel to another



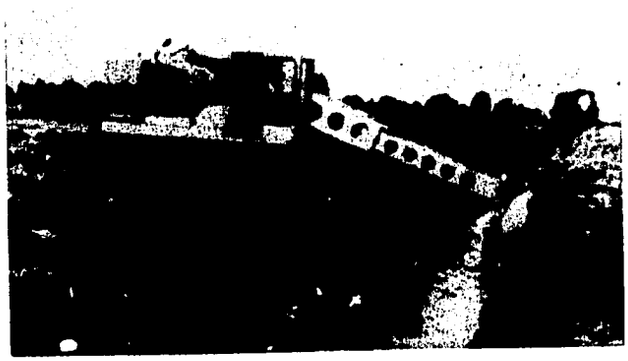
Cleaning a drainage canal with the Ahmed Davis shovel. A group of laborers push the shovel into the mud from one bank, and another pull it from the opposite bank. Note that the detachable poles remain in the water, (below, lower left).

Rubber tired tractor with backhoe attachment cleaning small drainage canal.

Rubber tired tractor with backhoe attachments excavating trench.

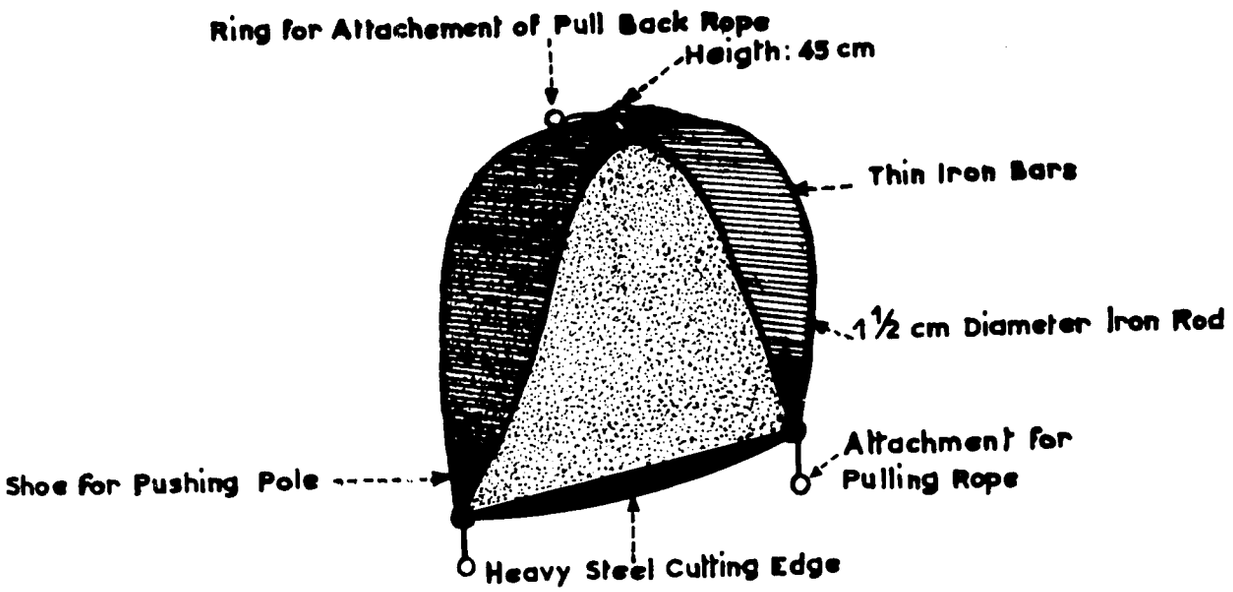
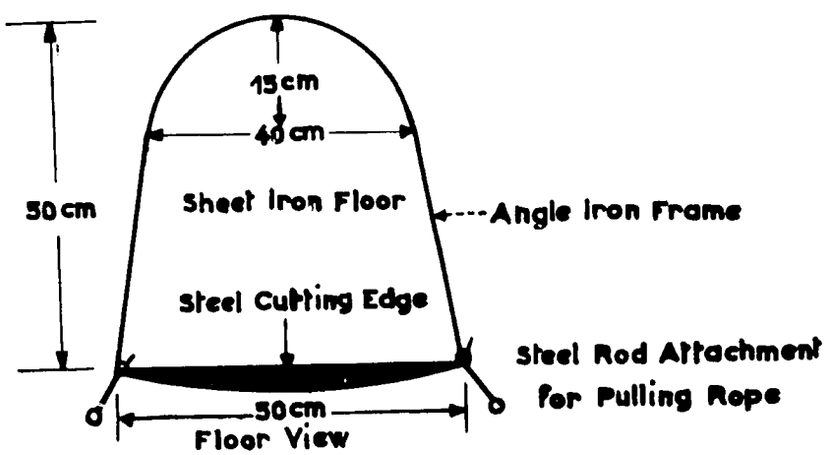
A relatively new "backhoe" type machine. Its telescopic boom, which extends approximately 8 meters, and its 2.30 m. wide canal cleaning bucket make this machine extremely versatile.

The pictures below show this type of equipment in action:



Small drainage canal cleaning operation with short boom arm. (5 meter extension boom arms are available). Note that the machine moves parallel to the canal and doesthe cleaning work at the side.

The same equipment moving over rough terrain. It is reported that this machine is able to climb 40% inclines.

THE AHMED-DAVIS DRAINAGE SHOVEL

MODEL N: II