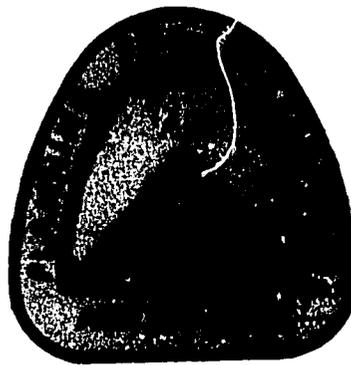


PD - AAT - 621 45598

**ON FARM WATER MANAGEMENT  
DEVELOPMENT PROJECT**

**ANNUAL PROGRESS REPORT  
1978-79**



3910413

**DIRECTORATE OF  
ON-FARM WATER MANAGEMENT DEVELOPMENT PROJECT**

**L A H O R E**



## P R E F A C E

About two and half years of implementation of On-Farm Water Management Programme in certain selected areas of the Punjab has resulted in an imperative need for expansion of the existing On-Farm Water Management Development Project to all the irrigated areas of the Province. Tangible achievements in terms of water savings through water-course improvements, precision land levelling and farm water management extension services have created an awareness amongst the farmers to adopt the On-Farm Water Management techniques to improve their crop yields, cropping intensities and cropping patterns through improvements in existing irrigation efficiencies. The exemplary achievements under On-Farm Water Management Development Project in the field have also diverted the attention of many national and international agencies to launch similar programmes on large scale.

The progress of the On-Farm Water Management Development Project in the Punjab is very encouraging particularly during the year under report. If the same pace of progress is maintained in future the achievement of overall goals of the programme will be made during the stipulated time span.

(MUHAMMAD SADIQ CHEEMA)  
DIRECTOR  
OFWM DEVELOPMENT PROJECT

Lahore, the 22nd July, 1979,

## ON-FARM WATER MANAGEMENT DEVELOPMENT PROJECT

### I- INTRODUCTION:

#### BACKGROUND:

The use of water on scientific lines is desirable as it helps to eliminate certain major agricultural problems. The excessive use of water beyond permissible limits will give rise to water logging, which ultimately affects the productivity of fertile soils. On the contrary, limited water supplies lead to growth retardation of crops and salinization of soils, due mainly to transportation of dissolved salts by water and subsequent surface accumulation by evaporation process.

Pakistan has one of the largest and most complex irrigation system; a system of dams, barrages, canals, distributories, minors and watercourses of different capacities, conveying water to farmers fields. The irrigation network of the Indus Basin consists of 3 large dams, 12 link canals, 18 weirs and barrages, 48 canal systems and 87,500 watercourses. The total potential of the canal irrigation system is estimated to be 124 MAF. Tubewells add 33 MAF of water to the irrigation system annually. The Water reaching at mogha outlet is 92 MAF. The rains contribute 13 MAF annually. The net crop use is 59 MAF. It indicates that irrigation system operates at a very low irrigation efficiency i.e. about 35 percent only. The water losses in the canal system are estimated as 32 MAF i.e. 25 percent. The water losses in the watercourses are very alarming and have been estimated

51 MAF i.e. 41 percent annually. The losses at the farm level due to undulated fields and over irrigation practices have been estimated to be 15 MAF i.e. 20 percent annually. The water losses beyond the canal outlets through watercourses and undulated fields amount to about 66 MAF annually, which is a great national loss, resulting water shortage problems at the farm level as well as the twin menace of water logging and salinity. This colossal loss of water in the irrigation system as a whole, and beyond the mogha level in particular as given in Chart-I, indicates an imperative need for the implementation of On-Farm Water Management Programme for an improvement in the irrigated agriculture.

The magnitude of these losses has been high-lighted during the last few years through research and development work carried out by Water Management Research & Precision Land Levelling Dev. Projects initiated by the Punjab Agri:Department in early 70's. The source of water losses in the irrigation system beyond canal outlets were clearly identified through the implementation of two above said experimental Projects. The findings of these Projects motivated the Government of Pakistan to implement a comprehensive On-Farm Water Management Development Programme in the country.

The Punjab, On-Farm Water Management Development Project was commissioned during the year 1976-77 on a Pilot Programme basis in 7 Tehsils namely; Faisalabad, Toba Tek Singh, Samundri, Jaranwala, Chiniot, Khanewal and Sahiwal with total cost of Rs.190.6 millions. The Project is being implemented with

the technical and financial assistance of United States Agency for International Development under a loan agreement. A map of the Project area is added as Annexure 'A'. It is planned to improve 900 watercourses, to precisely level 2.5 lac acres of land and to provide training to technical personnel, bankers, contractors and farm operators in precision land levelling and watercourse improvement techniques.

OBJECTIVES:

Following are the main objectives of On-Farm Water Management Programme :-

1. To achieve an increase in agricultural production through optimum use of water by minimization of watercourse losses and efficient application of water on precisely levelled fields.
2. To introduce an integrated programme of improvement of watercourses and precision land levelling to minimise delivery losses and to permit uniform application of water to all parts of the field.
3. To undertake training programmes of field personnel, contractors, bankers and farmers in various disciplines of On-Farm Water Management technology.
4. To develop an institutional infrastructure at various levels including organization of Water User's Associations for a subsequent nation wide Water Management Programme.

II- ORGANIZATIONAL SET-UP:

Secretary to Government of the Punjab, Agriculture Department is the Administrative Head of the Project. Director, On-Farm Water Management is

responsible for implementation of the programme under the direct supervision of the Director-General Agriculture(Field), Punjab. One Deputy Director stationed at Lahore is supervising the training and research activities of the Project. He has been provided with Specialist Officers of various fields. The Water Management Coordinators(Area Team Leader) are responsible for supervising field activities of the programme. They have been provided with the necessary technical and auxiliary staff. Fifteen (15) Field Teams are in position by now. Each field team comprises of one Water Management Specialist, two Watercourse Development Officers, 5 Land Dev. Officers and one Agricultural Officer for undertaking watercourse improvement and precision land levelling work. Organizational Chart is attached at Annexure 'B'. The services of two Advisors from U.S. Department of Agriculture, Soil Conservation Service, have also been placed at the disposal of the Project. These Advisors, one Irrigation Agronomist and another Irrigation Engineer provide technical guidance in organizing the training programmes in addition to technical guidance to the field teams in watercourse design, precision land levelling techniques and follow-up assistance programmes.

### III- PROJECT ACTIVITIES:

Major activities under the On-Farm Water Management Development Project are; training of manpower, watercourse improvement, precision land levelling, establishment of water user associations, applied research and demonstrations. Overall physical and financial targets of Project are given in Annexure 'C' whereas achievements during

the year under report against targets are given in Annexure 'D' and upto date achievements are given in Annexure 'E'. Different Project activities as well as progress during the year are discussed as under :-

A) Training of Manpower:

To provide an adequate training in various techniques of On-Farm Water Management, a Training & Research Institute has been established at Lahore. This Institute provides training to the technical personnel of Field teams and Area Teams, Private Contractors, Bankers, Field Staff of the Extension Wing of the Agriculture Department, Farm Operators and Farmers in Precision Land Levelling, Watercourse Improvement and Irrigation Extension Techniques. All the training courses offered at OFWM Training Institute are field oriented. A Training-cum-Demonstration & Research Farm has been established near Lahore in order to provide practical field training to the trainees; to demonstrate impact of the various OFWM techniques and to conduct an applied research.

At present, the training facilities at the Institute are not adequate due mainly to accommodation problem and it is not possible to hold training course of more than 30 trainees at a time. However, in order to cope with an increased training demand, especially for timely establishment of On-Farm Water Management Field Teams as well as for meeting the requirements of future On-Farm Water Management Projects to be implemented with the assistance of World Bank,

U.K. and other International Agencies, a full-fledged Training & Research Institute is under construction. The construction of buildings has been scheduled to be completed within next six months. Thereafter the number of trainees in each training session will be increased.

Achievements:

Significant achievements have been made regarding training of manpower under the On-Farm Water Management Programme. The targets fixed in this regard have been surpassed. During the year 1978-79, 100 technicians, 304 members of para-staff of various nation building departments, contractors and farmers, and 643 tractor operators have been trained in different OFWM techniques at the Training Institute. Moreover, the impact of various OFWM techniques has been demonstrated to the farmers by organising 7 Field Days/Farmers Rallies.

B) Watercourse Improvement:

Watercourse improvement is an important component of OFWM programme as loss of irrigation water from the existing watercourses is very high. It has been observed that the watercourse conveyance losses from watercourses are mainly due to faulty design, poor maintenance, narrow banks, over topping, silting, seepage, vegetation and animal crossings. The watercourses are redesigned after conducting necessary engineering surveys such as topographic and profile surveys etc. The watercourse improvement is carried out

through the active participation of water users by constituting their informal Water User Associations. They provide all necessary labour for removal of trees for demolishing and reconstruction of watercourses according to the standard engineering design. The Project bears the material cost on account of placement of structures (Nakkas, Culverts, buffalo-wallow, etc.) and partial lining. The share-holders also provide masons for construction work.

Achievements:

Tangible achievements have been made under watercourse improvement component of the programme and the targets fixed for the purpose have been surpassed. During the year under report, 151 watercourses have been improved, whereas 14 watercourses are near completion. This includes 62.43 Kilometer (39 miles) lining, 655.7 Kilometers (410 miles) earthen improvement of watercourses and 6,425 structures, (Nakkas, Culverts etc.). It is worth-while to mention here that the total length of improved watercourses has also exceeded the target specified in the Project PC-I.

For the improvement of these watercourses an informal Water Users Association is organized at each watercourse. During 1978-79, 214 Water Users Associations have been organized in the Project area.

The farmers have very much liked and praised the watercourse improvement programme since such improvements have increased water supplies at

field nakkas resulting in an increased agricultural production. Recent studies conducted on improved watercourses show an annual average water savings of 243 acre feet per watercourse.

(C) Action Programme for Renovation of Watercourses;

Under the direction of the Advisor to Governor, for Agriculture, Irrigation, Cooperatives and Rural Development Deptt., an ACTION PROGRAMME was prepared by the On-Farm Water Management Project for renovation of all the watercourses with the involvement of Irrigation and Rural Dev. Departments. These renovations include heavy cleaning, removal of silts and vegetation including trees from watercourses and straightening of their banks. The field staff of the Rural Development, Irrigation and Agriculture Departments was provided necessary training by the On-Farm Water Management Project experts. The renovation of watercourses is undertaken through the establishment of 'KHAL COMMITTEES'. This renovation programme is being carried out in collaboration with these departments. The monitoring of watercourse renovation programme is being done by the On-Farm Water Management Development Project. So far 7500 watercourses are reported to be renovated in the irrigated areas of the Punjab.

(D) Precision Land Levelling:

The farmers fields are generally undulated resulting the uneven application of water, fertilizer and seed. This uneven application of inputs adversely affects crop yield as well as leads to wastage of water. Precision land levelling is the only remedy for elimination of the above mentioned problems. Precision land levelling is an integrated component of On-Farm Water Management Dev. Project whereby small farms are redesigned after conducting necessary surveys. The land levelling equipment i.e. scrapers, land planes, chisel ploughs and border disc etc. are provided to the farmers on very nominal rental rates. An incentive as cost-sharing @ 50 per cent of the total cost upto 5 acres per farm is allowed to introduce the innovation amongst the farming community.

Achievements:

Precision land levelling is a new technique , wherein the existing layout of the field and irrigation system is totally changed from the level basin irrigation system to level border irrigation system. Strenuous efforts were made by the On-Farm Water Management Teams to introduce this aspect of the programme among the farming community. In spite of many constraints, regarding implementation of precision land levelling phase, 6885 acres have been precisely levelled during the period under report. The achievements regarding precision land levelling

are comparatively low as against the targets fixed in the PC-I Scheme.

**BOTTLENECKS:**

Following are the major bottlenecks responsible for comparatively low achievement of precision land levelling which if removed may help a lot to improve the progress in this regard :-

1. **Establishment of Private Contractors;**

The private contractors were to be established from amongst small farmers by providing tractors through banks. These contractors were to undertake about 25 percent of the fixed precision land levelling targets. The idea of providing the tractors to the contractors was to make available the tractors to the small farmers for precision land levelling work on easy terms. The contractors have not been established as yet and the matter is under consideration with the Banking Council. The non establishment of contractual services has adversely affected the achievement of precision land levelling targets.

2. **Small and Fragmented Holdings:**

- a. Most of the farm holdings in the Project area are very small and fragmented. The existing layout of the fields, resources, cropping pattern and high cropping intensity do not allow the small farmers to adopt this innovation even on the provision of cost-sharing incentive.

- b. The purpose of providing subsidy/incentives for precision land levelling under the Project PC-I is to popularise the innovation amongst the farmers. It is an admitted fact that such innovations are adopted more quickly by the progressive groups as compared to the laggards.
- c. Farmers have to make 100 percent initial investment for precision land levelling which is re-imbursed by the Project upto 50 percent after completion of work. The small farmers cannot afford to make such investments.
- d. The limited resources of small farmers do not allow them to engage tractors and other land levelling machinery for the purpose.
- e. The cropping pattern and high cropping intensity adopted by the small farmers in the project area do not allow them to keep their fields fallow for doing precision land levelling during any time of the year.
- f. The farmers' fields are already divided in smaller blocks for which farmers do levelling after every crop so they are reluctant to make investment on precision land levelling just for changing their field layout.

3. Ceiling of Holdings:

Under the existing PC-I, a farmer holding land more than 25 acres is not eligible for cost-sharing under precision land levelling. As already indicated that the farmers below 25 acres do not have tractors and other resources required for doing precision land levelling. So they are reluctant in accepting the innovation even on cost-sharing basis. The studies have indicated that precision land levelling technique is economical at comparatively large farms as

compared to small farms. The ceiling of 25 acres for eligibility of cost-sharing is impeding the pace of progress in popularising the precision land levelling among progressive farmers.

Moreover, the limit of paying cost-sharing upto 5 acres is also impeding the progress of precision land levelling in the field. There is a need for removing the limit of 5 acres for cost-sharing for precision land levelling. This will encourage the small farmers to do precision land levelling at their farms.

4. Establishment of Field Teams:

The achievements in the precision land levelling as compared to the fixed targets are also low on account of late establishment of field teams. The Field Team establishment is delayed for want of the completion of procedural formalities for recruitment, training and posting of the field personnel. The experience in this regard reveals that only 25 percent of the time of the newly established team is utilized for doing field work during the year of its establishment. This has also adversely affected the achievement of precision land levelling targets.

5. Unrealistic Targets:

It is worth-while to mention that the targets for precision land levelling were not fixed on the basis of any practical field experience.

Field experience under the On-Farm Water Management Development Project reveals that it is not possible for a Land Development Officer to level more than 240 acres annually, whereas in PC-I the targets for each Land Development Officer in a year for precision land levelling have been fixed as 466 acres.

The matter was taken up with the Planning & Development Board for revision of targets for implementation of realistic targets. The Planning & Development Board recognized the bottlenecks mentioned as above and is considering favourable revision of targets i.e. 1,07,000 acres as against 2,50,000 acres fixed in the PC-I.

(E) DEMONSTRATION & RESEARCH FARM:

A, 74 acres piece of land has been taken on lease near Lahore to provide a field training laboratory for the On-Farm Water Management Trainees and also to demonstrate the effect of different On-Farm Water Management practices to the farmers and the trainees. Moreover, the provisions for conducting applied research on precision land levelling and Watercourse improvement techniques, equipment testing and improved agronomic practices have also been made at the farm. The farm has been completely developed through Precision Land Levelling and Watercourse Improvement by the trainees during the year under report. Besides, some applied research activities were also carried out at the farm by the staff of the Training & Research Institute. Three Field Days/Farmers Rallies were arranged at the farm to demonstrate the effect of improved On-Farm Water

Management practices to the farmers during the year under report.

(F) APPLIED RESEARCH & EVALUATION:

To conduct an applied research on various aspects of On-Farm Water Management technology for implementation in the field, a Training-cum-Research Institute has been established at Lahore. Different applied research studies and evaluation surveys pertaining to different field problems were carried out by the staff of the Institute. The recommendations of these research studies have lead the Government towards implementation of the On-Farm Water Management Development Project in the Punjab on sound footings.

Following applied research and evaluation studies were carried out by the On-Farm Water Management Training & Research Institute during the year under report. Printed reports are also available about these studies :-

1. Water Losses from Watercourses:

The main purpose of the study was to know the extent of watercourse losses during conveyance of water from mogha to the farmers fields. It was also envisaged to find the problem watercourses in Sahiwal Tehsil in order to assign the priority for their improvement under On-Farm Water Management Dev.Project. The second purpose of the study was to determine the average delivery efficiency of watercourses in an area with progressive farmers like Sahiwal Tehsil. The ultimate aim of the study was to get the farmers and the water management programme implementation agencies realise about the magnitude of the watercourse delivery losses for starting watercourse improvement/renovation programmes on large scale.

The watercourse delivery losses study on watercourses in Sahiwal Tehsil has lead to the following conclusions and recommendations :-

- i. There are considerable water conveyance losses in the watercourses i.e. 33.20 percent on an average per watercourse in a progressive tehsil like Sahiwal. These losses indicate the steady state condition of flow in the watercourse. The operational losses on watercourses will be higher than those of the present study.
- ii. More than 50 percent of the watercourses in Sahiwal Tehsil are carrying more water than their capacity which results in high delivery losses. Re-construction of these watercourses is needed.
- iii. There is a great potential for watercourse improvement in Sahiwal Tehsil as it will save about 242 acre feet of water annually per watercourse on an average even with earthen improvement and partial lining having 85 percent delivery efficiency. This can successfully grow an additional crops of about 125 acres of wheat and about 100 acres of cotton per watercourse command annually.

## 2. Cost of Precision Land Levelling (Time & Motion Study):

The objective of the study was to determine the cost of doing precision land levelling under farmers conditions. Accordingly two case studies one at Sahiwal and other at Khanewal were conducted. The data were analysed. The results are as under :-

- i. Volume of earth moved by 48 H.P. Tractor with scrapers of 5 ft. or 6 ft. sizes and by 64 H.P. Tractor with 8 ft. size comes out to 15.80 M<sup>3</sup> and 22.54 M<sup>3</sup> per hour. The length of run in both the cases was 120.4 and 129.4 meters respectively. It means that if length of run is similar the efficiency of 64 H.P. Tractor with scrapers of 6 ft. to 8 ft. sizes is more.
- ii. In different precision land levelling operations the percentage of time spent on an average is as follows:

1. Scraping	=	56.25 percent
2. Chiselling	=	13.11 percent
3. Land Plane	=	10.59 percent
4. Idle	=	9.58 percent
5. Change of equip;=		6.27 percent

iii. The cost of precision land levelling without technical guidance comes out to Rs.4.48 per cubic meter of earth moved while the technical guidance cost is Rs.0.33 per cubic of earth moved. It shows that the total cost is Rs.4.81 per cubic meter of earth moved both for technical guidance and for equipment and labour etc.

### 3. Impact of Watercourse Improvement on Farm Production:

The main objective of the study was to determine the impact of watercourse improvement on farm production through :-

- i. Cost analysis of watercourse improvement.
- ii. Increase in watercourse delivery efficiencies and water savings.
- iii. Increase in cropping intensities.
- iv. Increase in per acre yields of major crops.

Following conclusions are drawn from the study to assess the impact of watercourse improvement on farm economy :-

- i. Time saving to irrigate an acre comes out to 38 minutes or 28.36 percent after watercourse improvement.
- ii. Cropping intensity has increased by 19.95 percent after watercourse improvement.
- iii. Farmers are changing cropping patterns to grow crops requiring high delta of water. Additional areas under the major crops were also observed.
- iv. Increase in the yield of major crops through package deal (fertilizer and water) with increased supplies of water has been recorded as 26.32 percent, 21.50 percent, 17.28 percent and 18.53 percent in case of sugarcane (Gur), Cotton, Maize and Wheat respectively.

v. Cost benefit ratio works out to 1:2.67.

4. The Effect of Chemical & Traditional Weed Control Method on the Yield of Wheat:

The study was carried out at the On-Farm Water Management demonstration and research farm with the following objectives :-

- i. To demonstrate to farmers that chemical herbicides can be an effective tool in controlling weeds in wheat.
- ii. To compare traditional Vs. herbicide methods of weed control and their effects on yield.
- iii. To screen the available herbicides as to their spectrum of weed control and optimum dose.
- iv. Determine the economics of traditional and herbicide weed control methods.

A weed control demonstration was conducted using three herbicides at two rates and three traditional methods of weed control. Excellent weed control was achieved with 'Dicuran' which averaged about 97 percent. Hand hoeing weed control ranged from 74-76 percent while bar harrow ranged from 47-50 percent.

The greatest net return was also received by the same three treatments. The net return was calculated using only the cost of the weed control treatment. It was Rs.1869 per acre for Dicuran at 2.23 lb. per acre and only Rs.1119 per acre when no weed control measures were taken. This is a Rs.750 per acre increase in return from Dicuran compared to no weed control. When the returns were compared to hand hoeing or bar harrowing they were Rs.650/- and Rs.401/- per acre respectively for the same Dicuran treatment.

5. Economics of Watercourse Improvement:

The main objective of this study was to know the costs of watercourse improvement carried out under On-Farm Water Management Dev. Project. These improvements include earthen re-construction of watercourses, placement of structures and partial lining with bricks. It was also envisaged

to observe the comparative savings of irrigation water through improvements to determine the relative benefit cost ratio. The watercourse improvement is being undertaken by the On-Farm Water Management Development Project field personnel through the participation of farmers through their water user's association. Materials of construction viz. Cement, Bricks and Pre-cast Makkas etc. are provided by the Project as an incentive whereas farmers provide all skilled and semi skilled labour (Masons) for re-construction of their watercourses.

Following are the findings of the study which have lead the On-farm water management dev.project to make policy decisions regarding investments on watercourse improvement :-

- i. Increase in cropping intensity. 50.2 percent
- ii. Decrease in length of watercourse 14.13 percent after improvement.
- iii. Cost of earthen improvement of Rs.3.17/meter watercourse.
- iv. Cost of lining of water-course. Rs.99.62/meter
- v. Cost per control structure. Rs.212.30
- vi. Cost per culvert. Rs.925.01
- vii. Cost per buffalo wallow. Rs.3,427.31
- viii. Total cost of watercourse improvement under On-Farm Water Management Dev.Project. Rs.14.01/meter

6. Detailed Soil Survey of Watercourse Command Areas:

Detailed soil survey of watercourse command areas of watercourse No.89480/L Thikriwala and 47300, Chak No.239/GB, Jaranwala, Faisalabad was carried out. The primary objectives of the survey were :-

- i. To execute a farm water management extension programme in the following manner :-

- a) To guide Land Development Officers in planning of farm layout and to determine the tolerable depth of cut for precision land levelling.
  - b) To enable Watercourse Development Officers for making decisions about portions and alternatives for lining of watercourses.
  - c) To enable the Agricultural Officers in guiding the farmers to irrigate their fields according to the water requirements of crops and soils.
- ii. To determine the potential and problems fieldwise.
  - iii. To suggest crop management practices as suited to various kinds of soils.
  - iv. To suggest reclamation and improvement measures for the problem soils.

Five different kinds of soil ranging from silty clay loam to sandy loam were found in the area. Some of these have the problems of salinity and alkalinity, water logging, permeability and excessive drainage. Various soils were delineated on the map of individual watercourses and the main characteristics of various soils were recorded along with their limitations and suggestion for improvement. The scope of the study is being extended to other watercourse commands through detailed soil surveys.

7. Comperative Study on Inter-Row Spacing on the Growth and Yield of Wheat:

The study to see the effect of inter row spacing on the growth and yield of wheat variety 'Fawan' was conducted. The treatments of the experiment comprised of two row spacings i.e. 9 inches and 18 inches. Total yield per acre was 44.15 mds. and 46.27 mds. respectively in case of treatment No.1 and 2. This means that by adopting 18 inches row spacing not only the yield can be increased but also helps in easy weeding, inter-cultural practices, aeration, application of irrigation water, and utilization of more nutrients due to more area available for plants.

8. Role of Improved Water Management Practices on Yield of Wheat:

This was an attempt to find out the better results under the package deal of optimum irrigation doses of fertilizer on different series of soil in command area of improved watercourse and precisely levelled fields under a demonstration programme in Field Teams. The average yield in 10 cases at different tehsils comes out to 43 mds. per acre as compared to existing average yield of 30 mds. per acre in these areas. This means that there is a great potential for adopting improved water and soil management practices. These demonstrations will be continued in all the On-Farm Water Management Field Teams during Kharif 1979 for cotton and maize crops to see the impact of improved On-Farm Water Management practices on the yield of these crops.

9. Development of Watercourse Cross-Sectional Pattern for Different Field Conditions:

Difficulties had been faced in bringing the cross-section of such earthen watercourses exact to the pre-determined design dimensions. Every time the Field Officers have to refer to the original design to bring the cross-section of earthen length to proper dimensions which certainly results in wastage of time and efforts particularly during cleaning process. It was a dire necessity to frequently inspect/check the cross-section at different points to achieve the desired degree of accuracy according to design for good quality work.

The need was, therefore, felt to design and fabricate a most handy, quick method or ready working tool for the field staff for prompt checking of their completed watercourses or As-Built Design.

The designs for varying discharge, gradient, bottom width and side slope were developed from the interactive simplified design procedure for earthen watercourse improvement utilizing the Mannings Equation.

Two designs for side slopes 1:1 and 1.5:1 each were prepared separately keeping in view the actual field conditions pertaining to type of soil. Each design accounts for discharge from 30(LPS) Litres Per Second to 90 LPS with an interval of 15 LPS. Accordingly, three adjustable bottom widths were fixed as 30 cms, 40 cms and 50 cms on the basis of above mentioned prevalent conditions. The gradient also varies from watercourse to watercourse according to field conditions. The steel cross-sectional patterns were, therefore, got fabricated keeping the three gradients i.e.  $5 \times 10^{-3}$  m/m,  $10 \times 10^{-4}$  m/m and  $15 \times 10^{-4}$  m/m for use by the Field Teams in construction and cleaning of improved watercourses.

10. Development of Precision Land Levelling Equipment:

To solve the problems of field equipments, a research work was carried out under the technical supervision of USAID/CSU Agri. Engineer. The problems in the field equipment were delineated and thus the need was felt for fabrication/re-designing of existing precision land levelling equipment i.e. Bullock driven Scraper and Land Leveller etc. Moreover, bed shaper was also fabricated to solve the problems of over-irrigation on maize and cotton fields on the precisely levelled fields and following studies were undertaken :-

DEVELOPMENT & FABRICATION OF BED SHAPER:

The purpose of the design and fabrication of bed shaper was to allow the crop to be grown on the top of a narrow bed (2' to 3') and the irrigation water delivered in small ditches (6" -8" deep and 10" x 14" wide) between leeds with the following advantages :-

1. The field does not have to be as precisely levelled fields for uniform irrigation as with the level basin system.
2. There is no need of existing furrow irrigation.

3. In case of heavy rain the ditches provide some field storage of rain water and thus prevent drowning of the crop.
4. The salt will propagate to the centre of the bed by capillary action keeping it away from the crop on the bed edges.
5. The field can be irrigated with lower heads of water as compared to the level basin system of irrigation.

The bed shaper developed is very simple in design, un-expensive and requires a minimum of power to full. It is made as an attachment to go on the harrow frame commonly used in Pakistan. A proto-type bed shaper was got fabricated at the workshop and the design drawings were given to M/s Danishmand & Company, Faisalabad for manufacturing.

Additional development work is being done on planters and cultivators to be used with the bed shapers.

#### DEVELOPMENT AND FABRICATION OF BULLOCK DRIVEN SCRAPER:

Several farmers have indicated a need for a bullock powered scraper and land plane for doing precision land levelling on small farms. A small machine has been designed for this purpose. It is in the testing stage at this time. Early test results indicate its function well at scraping and planning. It remains to be examined whether an average pair of bullocks can operate it and whether it can be used in the typical small fields. Finally the matter of production cost will be determined after its continuous testing at the Demonstration & Research Farm.

#### (G) PUBLICITY:

Concerted efforts have been made to introduce the On-Farm Water Management Programme amongst the planners, policy makers and farmers through seminars,

press and other mass media such as Radio, Television and Farmers' Rallies. Following seminars were held regarding On-Farm Water Management in Pakistan :-

<u>Seminars</u>	<u>Sponsoring Agency</u>
1. National Seminar on Water Management, Lahore Jan:1973.	USAID
2. Seminar on Water Management for Irrigated Agriculture, Lahore, november, 1977.	ESSO Pakistan
3. Seminar on Water Users Association, June, 1978, Faisalabad, Peshawar, Quetta, Hyderabad, Islamabad.	Ministry of Food & Agriculture/ USAID.
4. Annual On-Farm Water Management Review Conference at Peshawar, Islamabad & Karachi.	USAID

Pamphlets, Brochures, Leaflets, Booklets etc., were prepared for distribution among the farmers and other concerned. Moreover, regular talks are also being delivered at Radio to provide effective publicity to the programme. Farmers rallies/days are arranged by the field teams at improved water-course sites and at Demonstration & Research Farm and demonstration plots to give wider publicity to the Project activities.

(E) VISITORS:

The Project has been visited by quite a few foreign as well as local delegations. The names of the important visiting missions/visitors are as follows :-

<u>Foreign</u>	<u>Local</u>
1. World Bank Mission.	1. Governor of the Punjab, visited Research & Demonstration Farms.
2. Asian Dev. Bank Mission.	2. Advisor to Governor of Punjab, for Agriculture,
3. F.A.O. Team.	3. Advisor to Governor of Punjab, for Irrigation.
4. U.N.D.P. Delegation.	4. Chairman, Planning & Dev. Development Board.
5. Nigerian Delegation.	5. Director, OFWM, NWFP.
6. Egyptian Delegation.	6. Staff of OFWM Sind.
7. U.S. Delegation.	7. Representative of MINFA.
8. British Delegation.	8. Chairman Punjab Inspection Team.
9. Canadian Delegation (CIDA).	
10. U.S. Counsel General.	
11. Directors of USAID Mission.	

#### IV- CONCLUSIONS AND SUGGESTIONS:

The results of the On-Farm Water Management Dev. Project in the Punjab are very encouraging and programme has gained a real momentum. There have been many problems at initial stages of the implementation of the programme, such as, establishment of field teams, formulation of service rules, release of funds, opening of personal ledger account and Fixed Amount Re-imbursment (FAR) claims from USAID. All these problems have been sorted out well in time and proper remedial measures were adopted for an efficient implementation of the Project. This was only possible due to the keen interest of the Chairman, planning and development board and the Secretary Agriculture in the programme. It would not be out of place to mention here that the Government of Sind and NWFP also started the OFWM Projects in their respective provinces simultaneously. They have yet to cross so many obstacles in this regard and the result is that they have been able to achieve only a fraction

of the targets. There are better prospectus of On-Farm Water Management Programme in Punjab as compared to other Provinces as has repeatedly been mentioned by the USAID Mission Directors and other dignatories during their visits to our field work.

The physical achievements of the Project indicate that the results regarding training and watercourse improvement aspects of On-Farm Water Management Programme are very encouraging. The pace of progress regarding watercourse improvement and training of manpower is exemplary. However, the progress regarding precision land levelling component of the programme is comparatively low on account of numerous problems/bottlenecks as already mentioned. Recently, there has been an improvement regarding precision land levelling in the Project area. A fleet of 10 tractors from Agril. Engineering Directorate has been provided exclusively for precision land levelling in the Project area as a result of personal interest of the Secretary Agri:. It is, therefore, expected that the provision of this fleet of tractors will improve the efficiency of the work in future.

SUGGESTIONS:

Following suggestions are made for further improving the efficiency of work in On-Farm Water Management Dev. Project. Immediate decisions are required to be made at high-level in this regard to achieve an affective implementation of the On-Farm Water Management Programme:-

1. Over 25 percent targets regarding precision land levelling are required to be achieved through the establishment of private contractual services by the commercial banks. Pakistan Banking Council may immediately be directed to establish such private contractors for doing precision land levelling in the Project area by providing tractors and Precision Land Levelling Machinery on easy terms and conditions.
2. Ceiling of 25 acres holdings for providing precision land levelling services on cost-sharing basis may be removed for popularizing the innovation amongst the farmers.
3. The farmers have to make 100 percent initial investment for precision land levelling. To achieve speedy payment of cost-sharing to the farmers on account of precision land levelling the operation of cost-sharing funds through commercial banks instead of treasuries should be allowed as envisaged in the PC-I. The Finance Department may be directed for implementation of the operation of cost-sharing funds through commercial banks.
4. The targets regarding precision land levelling are needed to be revised to make them more workable and realistic. The revised targets based on actual field experience have already been accepted by the P&D Department in principle.

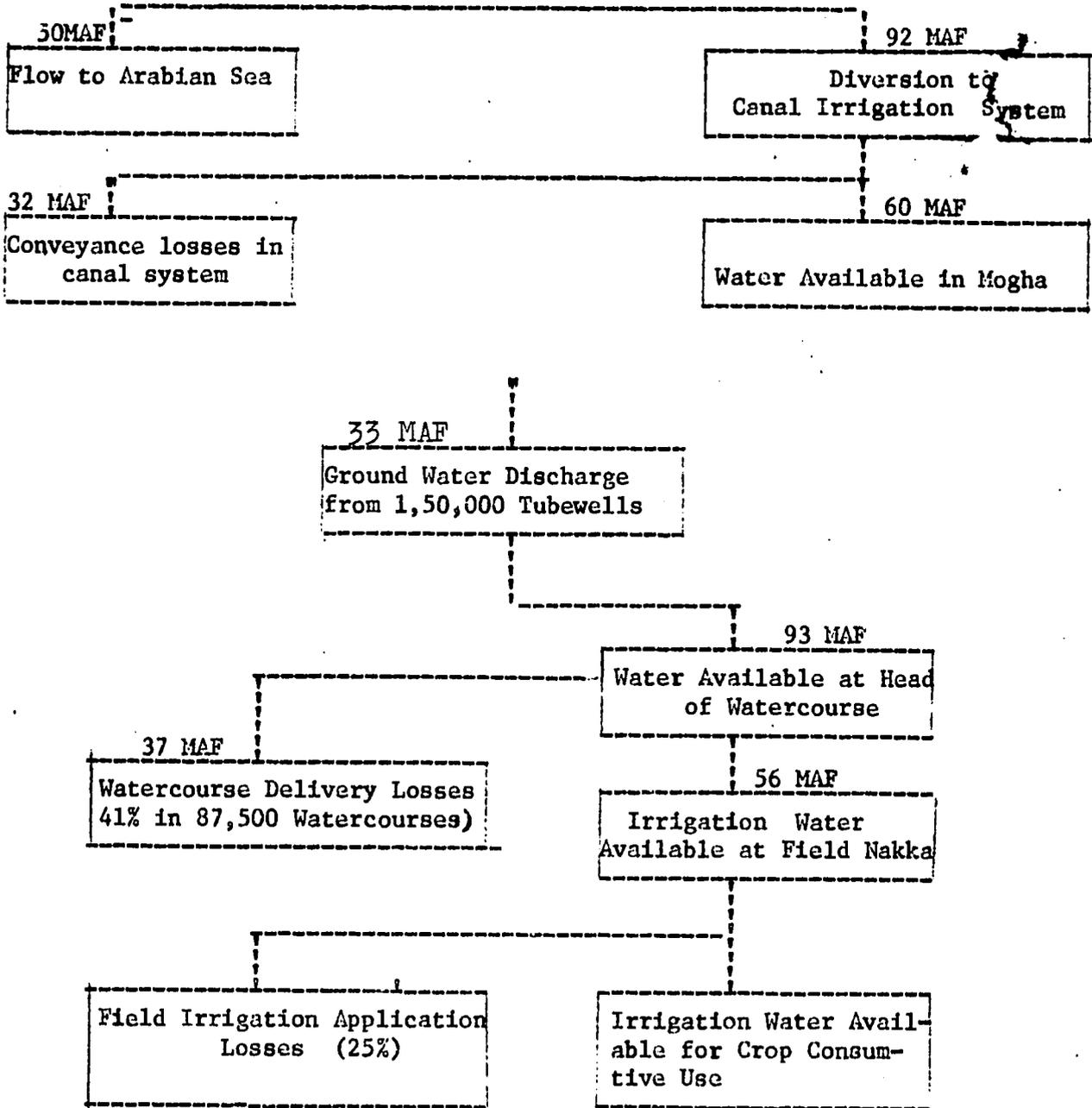
5. The informal Water User Associations presently organized under On-Farm Water Management Development Project are required to be legalized. The powers presently being exercised by the Irrigation Department beyond canal outlet may be entrusted to the Water User Associations through the implementation of some new enactment. The proposal for new enactment for Water User Associations has already been submitted to the Government. The implementation of enactment will definitely improve the working conditions on the watercourses and will help a lot in solving the disputes like alignment, delineation of right of way and removal of trees and placement of structures on the watercourses. The follow-up maintenance programme on improved watercourses will only be effective provided the Water User Associations are legalized and given necessary mandatory powers.
  
6. The powers exercised by the Irrigation Deptt: beyond canal outlet as envisaged in Canal & Drainage act 1873 if transferred to On-Farm Water Management on improved watercourses will increase the working efficiency and will help to solve disputes on the site. A high level decision may be taken in this regard to legalize the Water User Associations and entrusting the Administrative control of improved watercourses to On-Farm Water Management Development Project.

  
(Khalid)

FLOW CHART OF INDUS BASIN WATER SUPPLY SYSTEM

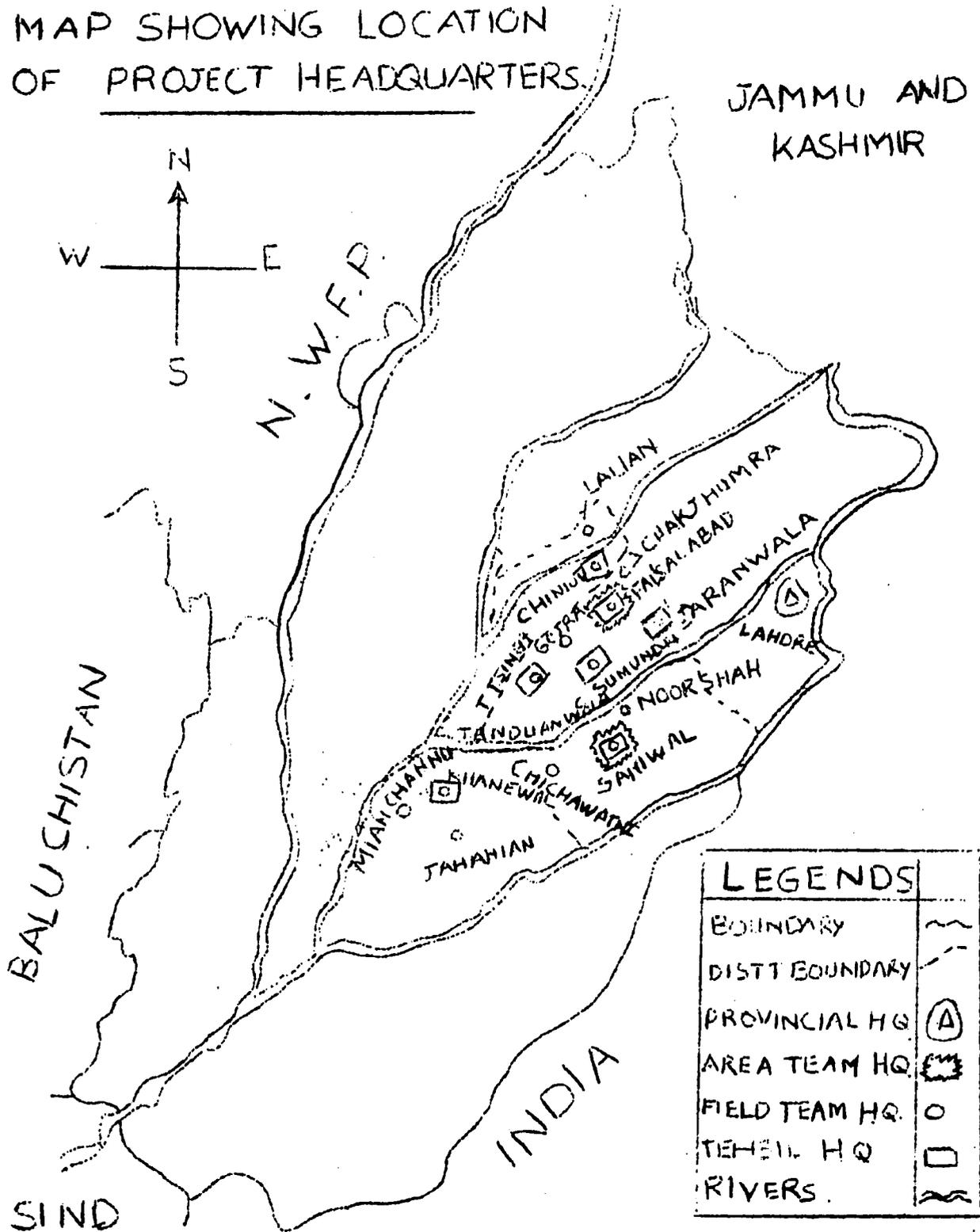
142

Annual Flow Available in Rivers



# ON FARM WATER-MANAGEMENT DEV. PROJECT PUNJAB

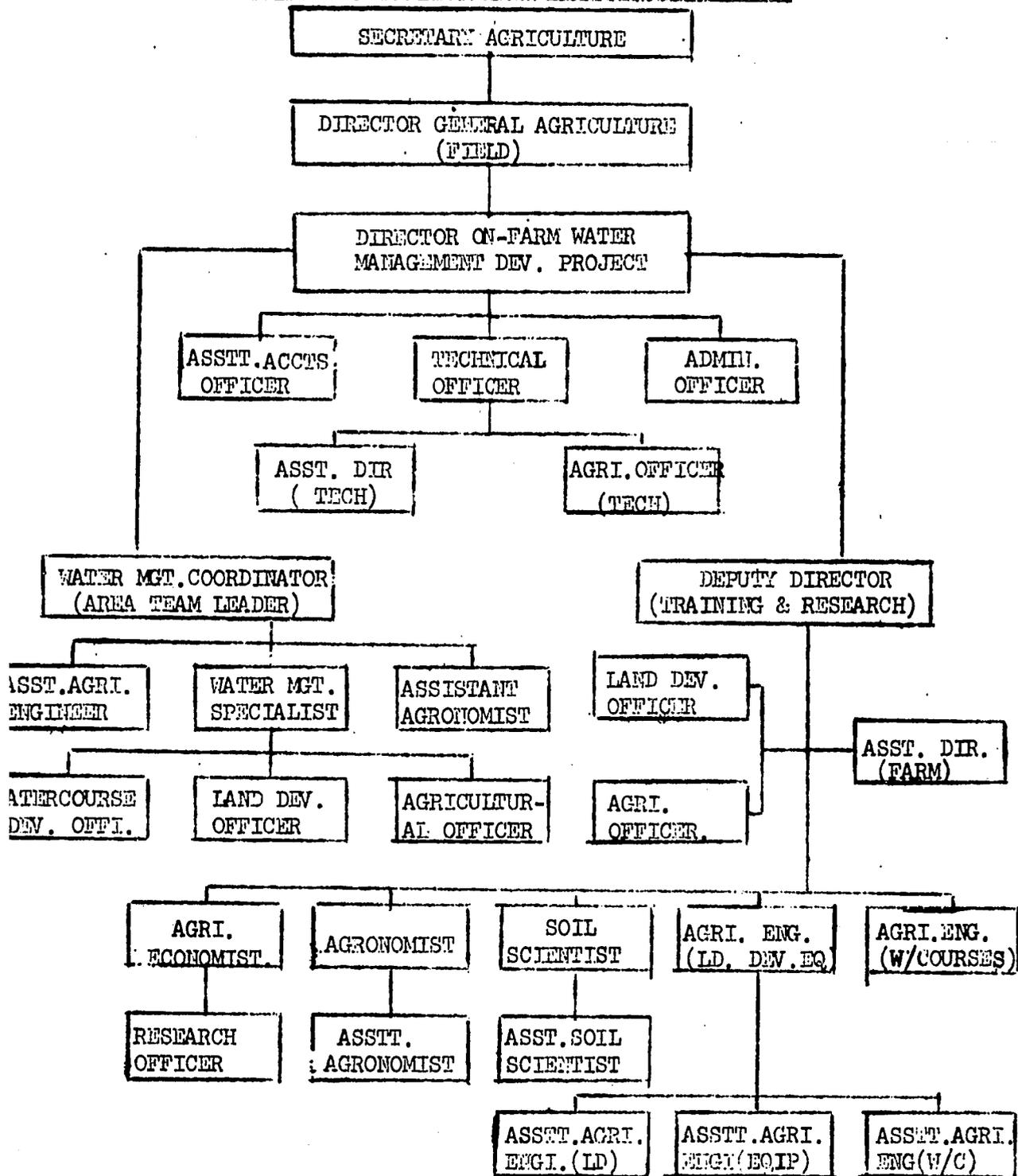
MAP SHOWING LOCATION  
OF PROJECT HEADQUARTERS.



ORGANIZATIONAL CHART

ANNEXURE "B"

ON-FARM WATER MANAGEMENT DEVELOPMENT PROJECT



## ANNEXURE 'C'

PHYSICAL AND FINANCIAL TARGETS

## I- PHYSICAL:

S. No.	Particulars	1976-77	77-78	78-79	79-80	80-81	81-82	Total
1.	No. of Field Teams (Cumulative)	5	10	15	25	35	40	40
2.	No. of watercourses to be improved.	5	70	120	185	250	270	900
3.	Precision Land Levelling:							
	a. By OPWM Project	1000	15000	26000	40000	47000	58000	1,87,000
	b. By private Contractors		3000	9000	15000	18000	18000	63,000
	Total (a+b)	1000	18000	35000	55000	65000	76000	2,50,000
4.	Training Programme:							
	a. Technicians and Officers training in Precision Land Levelling and Watercourse improvement.	40	80	80	80	80	80	440
	b. Private Contractors, 10 bankers and farmers training.		30	30	30	30	30	160
	c. Para Staff, Field Assistants and farmers training in Water-Management techniques.	10	50	50	70	70	70	320
	d. Tractor drivers on-the-job training.	20	200	400	400	500	500	2,020
	e. Refresher Courses	2	5	5	8	10	10	40
II-FINANCIAL (In Lacs)		36.83	397.93	241.69	352.51	418.70	452.94	1900.60

## ANNEXURE 'D'

**PHYSICAL AND FINANCIAL TARGETS AND ACHIEVEMENTS  
DURING 1978-79**

---

<b>I- <u>PHYSICAL:</u></b>	<b><u>Targets</u></b>	<b><u>Achievements</u></b>
1. Establishment of Field Team.	15	15
2. <u>Watercourse Improvement:</u>		
A. <u>No. of Watercourses:</u>		
a. Improved	120	151
b. Under improvement	-	14
B. <u>Length Improved (In meters):</u>		
a. Pucca	-	62,430
b. Katcha	-	6,55,730
C. Structures Installed (All types)	-	6,455
D. Water User's Associations Organized-		214
3. <u>Precision Land Levelling (In acres):</u>		
A. By OFWI Project	26,000	6,885
B. By Private Contractors	9,000	Not yet establi- shed.
<b>Total (A&amp;B)</b>	<b>35,000</b>	<b>6,885</b>
4. <u>Training Programme:</u>		
A. Technicians & Officers training	80	100
B. Private Contractors, Bankers & Farmers Training:	30	7
C. Para Staff, Field Assistants & Project Managers training:	50	297
D. Tractor drivers on-the-job training:	400	643
E. Refresher Courses Organized	5	2

**II-FINANCIAL (IN LAC):**

1. Funds allocated	=	300.00
2. Funds released	=	292.60
3. Funds utilized	=	289.32

---

ANNEXURE 'E'

ACHIEVEMENTS UPTO 30/06/1979

I- <u>PHYSICAL:</u>	<u>ACHIEVEMENTS</u>			
	<u>1976-77</u>	<u>77-78</u>	<u>78-79</u>	<u>Total</u>
1. Establishment of Field teams (cumulative)	5	10	15	15
2. <u>Watercourse Improvement:</u>				
<u>A. No. of Watercourses:</u>				
a) Improved	5	46	151	202
b) Under improvement	-	-	14	14
<u>B. Length improved (in meters):</u>				
a) Pucca	-	14,875	62,438	77,313
b) Kacha	9,124	2,29,534	655,730	8,94,388
C. Structures Installed (All types)	31	2,023	6,455	8,509
D. Water Users' Associations organized.	6	98	214	318
3. <u>Precision Land Levelling (In acres):</u>				
A. BY OFWM Dev:Project	555	6,461	6,885	13,901
B. BY Private Contractors	NOT	YET	ESTABLISHED	
Total (A+B)	555	6,461	6,885	13,901
4. <u>Training Programme:</u>				
A. Technicians & Officers training.	50	123	100	273
B. Private Contractors, Bankers & Farmers' training.	-	6	7	13
C. Para Staff, Field Asstts; & Project Managers training.	-	17	297	314
D. Tractor Drivers on-the-job training.	82	598	643	1,323
E. Refresher Course organized.	3	10	2	15
II- <u>FINANCIAL (IN LACS):</u>				
1. Fund Allocated	50.00	100.00	300.00	450.00
2. Funds Released	38.35	99.89	292.60	430.84
3. Funds Utilized	33.41	99.55	289.32	422.28