PN-AAT-976
42524

Publication No. 125

PAKISTAN
WATER AND POWER DEVELOPMENT AUTHORITY

ANNUAL RESEARCH PROGRAMME
MONA RECLAMATION EXPERIMENTAL PROJECT

1982-83

MONA RECLAMATION EXPERIMENTAL PROJECT
SURVEY AND RESEARCH ORGANIZATION
PLANNING DIVISION,
MONA COLONY, WAPDA,
BHALWAL.

JULY, 1982

P R E F A C E

Agriculture in Pakistan is facing water-logging and salinity problems which are hindering the realisation full production potential of the irrigated area. In order to over-come these problems, major efforts were initiated in late fiftees under the title: "Salinity Control and Reclamation Projects" (SCARPS). With the implementation of SCARP-I, many new problems cropped up which required solution in order to achieve full benefits from the SCARPs. At that stage initiation of research was considered imperative to find their solutions. With that background, Mona Reclamation Experimental Project was established during 1965 over a part of SCARP-II. Since then it is conducting applied research on various problems of irrigated Agriculture to develop appropriate solutions.

The Project covered a gross area of 1,10,000 acres upto February 1979 when 67,000 acres in Shahpur Unit-I were placed under its control, thus expanding the scope of research. The project research efforts are now spread over a gross area of 1,77,000 acres which is served by 308 SCARP tubewells. Perennial, non-perennial and un-commanded areas are represented in the project. To facilitate research, the SCARP tubewells are being operated by the project on behalf of Irrigation and Power Department, Government of Punjab.

In order to develop better techniques for efficient conveyance and utilisation of irrigation water, Water Management Research was intensified at the project in 1973 with the signing of Ist agreement with US-AID. US-AID provided technical and financial assistance for the development of watercourse improvement technology which is currently under implementation throughout the country. Since then US-AID is providing financial assistance to the project to maintain continuity of research activities.

The PARC is collaborating with the project for conducting research on two Cooperative research programmes. "Maize, Sorghum and Millet" and "Water Use Crop Production Technology and Consumptive Use of water in the Northern Punjab Zone of Pakistan". Respective coordinators in PARC remain in touch with the project staff to conduct research on correct lines.

This programme has been formulated in the light of approved schemes to achieve the laid targets for each scheme. The programme comprises of four chapters.

CHAPTER-I : Review of Progress for the year 1981-82.
CHAPTER-II : Mona Reclamation Experimental Project.
CHAPTER-III : US-AID Financed Water Management Research.
CHAPTER -IV : Research in Collaboration with PARC.

The Programme was approved by "Advisory Committee on Water Management Research at Mona" constituted by Government of Pakistan, in its 9th meeting held at Lahore on 6.6.1982. The programme as presented hereafter contains detailed research plans for 71 studies. It has been prepared for the guidance of research staff.

(Muhammad Abdullah Khan)
Project Director

July, 1982

TABLE OF CONTENTS

CHAPTER	TITLE	PAGE
I	REVIEW OF PROGRESS FOR THE YEAR 1981-82	(1-4)
II	MONA RECLAMATION EXPERIMENTAL PROJECT	(5-67)
	Soil and Reclamation	6
	Soil & Water Testing Laboratory	22
	Agronomy	25
	Agricultural Economics	38
	Agricultural Extension	41
	Hydrology & Water Management	49
	Statistics	65
	Tubewell Operation	67
III	WATER MANAGEMENT RESEARCH	(68-102)
	Watercourse Improvement & Management	70
	Water, Soil & Crop Management	77
	Extension of Water & Crop Management	85
	Economics of Water & Crop Management	94
	Groundwater Management	97
	Tubewell Operation, Maintenance and Management.	100
IV	RESEARCH IN COLLABORATION WITH PARC	(103-114)
	Co-operative Research Programme on Maize, Jowar and Bajra.	105
	Consumptive Use Project	111

CHAPTER-I

REVIEW OF PHYSICAL PROGRESS - 1981-82

This chapter has been included under advice from Advisory Committee to apprise the members about the progress achieved in relation to the targets for the year. Since annual research programme is prepared under three different heads, the review has been presented here-under accordingly.

1. MONA RECLAMATION EXPERIMENTAL PROJECT

Research was proposed on a total number of 37 studies, 24 on-going and 13 new. Work was continued on all the on-going studies besides iniation of research on 10 new studies. The remaining 3 new studies could not be taken up due to financial and staff constraints as funds ~~were~~ not provided for the year according to the PC-I provision. Staff shortage was also felt in Hydrology and Water Management Section during first half of the year.

The Agri. Economics Section completed collection, tabulation and analysis of the data for three studies. Tentative conclusions drawn for these are reported as under:

Study: Economic Comparison of Private/Public Tubewells in Mona Project Area.

* The annual growth rate of private tubewells in Mona Project area is 11.0%.
* Public tubewells are more beneficial because of high rate of utilization and uniform distribution of water to all farms but private tubewells supply assured and timely irrigation.

Study: Economics Of Crop Production

* Benefit cost ratio of citrus, rice, sugarcane, rabi fodder, Mehdi (Hena), wheat, cotton and kharif fodder were calculated as 2.38, 1.71, 1.50, 1.50, 1.41, 1.38, 1.32 and 1.32 respectively.

Study: Overtime Resource Adjustment Pattern Of Farms Using Brackish and Sweet Water.

* More irrigation water is being applied to all crops at brackish tubewells.
* Farmers are using higher seed rate for crops at tubewells of brackish water quality.
* Farms with sweet irrigation water supplies are receiving 13% higher gross income compared with those receiving brackish water.

According to the approved PC-I, Rs.6.736 million were to be provided for the year but Rs.5.8 million were initially allocated and the allocation was later increased to Rs.6.2 million. Combined effect of inadequate allocation and staff shortage was that the following three new studies could not be initiated.

1. Distribution of flow among watercourse branches and modification of warabandi.
2. Re-use of drainage water for crop production.
3. Use of solar powered micro pumps for irrigation.

Problem in procurement of solar pumps was another factor responsible for defferment of work on study No. 3.

2. WATER MANAGEMENT RESEARCH

The last year annual research programme covered 25 studies, 19 on-going and 6 new. Research was conducted on all the on-going studies and was completed on 3 studies. Out of 6 new studies, three were also taken up but the remaining 3 new studies (1-ground water management and 2-tubewell operation, maintenance and management) could not be brought under execution. The study under ground-water management research was deffered as it was to be modified on the basis of on-going research in this field which was not making smooth progress. The remaining two studies were deffered due to staff shortage. Tentative conclusions drawn from the 3 completed studies are given as under:

Study: Testing The Use Of Herbicides In Cleaning And Maintenance Of Watercourses.

* Out of the herbicides tested(gramaxone,trefalon,metaven and afalon) gramaxone when applied at the rate of 6 lit/ha gave better weed control which remained affective upto 40 days after application.Rest of the weedicides did not prove their effectiveness.

Study: Convincing The Farmers To Adopt Soil Reclamation Measures.

* Where the farmers ownership consisted of good as well as salt affected land,cultivation was confined to good land only. Such a type of farmers could be motivated to plant kallar gross over small parts of the salt affected lands as a demonstration so that fodder production from kallar gross could be used as a base for further extension of reclamation work.

* A farmer whose total landed property at one place was badly affected with salinity/sodicity was motivated to carry out proper reclamation measures on about 20 acres.His iniative generated sufficient interest in the surrounding area for reclamation of salt affected lands.

Study: Economics Of Watercourse Improvement

* The most profitable method of watercourse improvement is earthen reconstruction which gives 7:1 benefits cost ratio. However lining of 10 to 20% of the most intensively used section of total watercourse is economically feasible.

3.RESEARCH IN COLLABORATION WITH PARC

PARC is collaborating with this project on execution of research on two co-ordinated research programmes namely "Maize,Sorghum and Millet" and "Consumptive Use Requirements of Crops".Progress achieved for each project is presented as under:

i) Maize, Sorghum and Millet:

Research was continued on two out of three proposed studies as the 3rd study could not be continued due to problems in seed procurement. Tentative conclusions drawn for the two studies which remained under execution are given in Chapter-IV.

ii) Consumptive Use Research:

Research was continued on estimation of consumptive use requirements of berseem and sorghum crops. Work was also initiated on citrus garden during the year. Progress on all crops was according to schedule. Conclusions drawn on the basis of one year data are given in Chapter-IV.

CHAPTER-II

MONA RECLAMATION EXPERIMENTAL PROJECT

PC-I for this programme stands approved by CDWP for a total sum of Rs.19.867 million for 3 years period commencing from July 1980. It covers main component of the research under execution at the project. Objectives proposed to be achieved under the PC-I cover the following:

* Developing methods and procedures to achieve effective use of water and land resources and reclamation of saline land.
* Detailed ground water hydrologic studies to determine the effect of ground water management, water quality changes and tubewell performance.
* Tubewell operation, maintenance, rehabilitation and replacement.
* Management of water supplies.
* Determining optimum cropping input-output relationships and
* Transferring knowledge to farmers and inducing its application.

This programme covers the 3rd and the final year of the approved PC-I. Research work was initiated on 28 studies in the last two years which will be continued during the current year. In addition 10 new studies will be taken during the year. Section-wise distribution of on-going and new studies is given as under:

Discipline	No. of studies		
	On-going	New	Total
Soil and Reclamation	13	-	13
Soil and water testing laboratory	2	1	3
Agronomy	9	2	11
Agri. Economics	1	2	3
Agri. Extension	-	2	2
Hydrology	3	3	6
	28	10	38

Detailed research plan for each study is presented in the following pages. Improvements where necessary have been made in on-going studies. Schedule of completion for each study and tentative conclusions drawn from the on-going studies are also presented.

SOIL AND RECLAMATION

Low levels of agricultural production in the Indus Basin are mainly due to the problems of water-logging and salinity, improper use of fertilizer and poor on-farm land and water management practices. Agricultural production can be substentially increased if these constraints are either totally removed or at least minimized to the possible extent. With a view to find a solution of these constraints, this section is carrying out research and investigation on the reclamation and management of salt affected lands, use of marginal quality water for crop production, use of gypsum to improve high sodium waters, use of fertilizer on saline soil and under saline irrigation conditions and the determination of salt tolerance of different crops.

In the light of above stated objectives, research was taken up on the following 13 studies, which will be continued during the year.

1. Development of cropping pattern on different water quality base (Study No.7 of PC-I).
2. Impact of using high magnesium waters on soils and crops (Study No.8 of PC-I).
3. Estimation of boron contents in ground water and soils (Study No.9 of PC-I).
4. Monitoring the quality of drainage waters for their possible use in crop production (Study No.10 of PC-I).
5. Salinity-fertility interaction (Study No.20 of PC-I).
6. Biological reclamation of salt affected soils (Study No.21 of PC-I).
7. Interaction of soil depth and chemical amendments on the reclamation of saline-sodic (non-gypsiferous) soils (Study No.22 of PC-I).
8. Effect of different gypsum grades for the reclamation of saline-sodic (non-gypsiferous) soils (Study No.23 of PC-I).
9. Role of zinc application in saline-sodic soils for rice cultivation (Study No.24 of PC-I).
10. Role of $CaCO_3$ in soil reclamation (Study No.26 of PC-I).
11. Determination of reclamation requirements and salt movement pattern for salt affected soils under different watertable depth (Study No.29 of PC-I).
12. Effect of high SAR tubewell waters on coarse and fine textured soils and crops.
13. Efficiency of different reclaments in the reclamation of saline-sodic (non-gypsiferous) soils.

Study No.1: Development of Cropping Pattern On Different Water Quality Basis.

OBJECTIVE

* To develop an appropriate cropping system for the efficient utilization of the available farm land and water resources.

PLAN OF WORK

The study will be carried out in the project area being served with irrigation water of different qualities. A questionnaire will be developed to collect information on water quality/quantity supplied to the area, soil salinity/sodicity status, soil textural class, major crops being grown and cropping pattern followed, cultural practices adopted, farm inputs like fertilizers and seed used, water-table depth and insect pest measures adopted by the farmers. The tubewell waters will be categorised as safe, marginal and hazardous according to following criteria:

Sr.No.	Description	TDS(ppm)	SAR	RSC(me/l)
1.	Safe	Less than 1000	Less than 10	Less than 5
2.	Marginal	1000 - 2000	10 - 15	5.0 - 7.5
3.	Hazardous	More than 2000	More than 15	More than 7.5

Based on this information, different cropping patterns will be developed for different areas for economical use of the limited resources available for better farm-economy and the results will be compared for yield and cost/benefit for the purpose of evolving the most suited cropping patterns for a given set of conditions.

COMPLETION SCHEDULE

The study will be completed upto Rabi 1984-85.

Study No.2: Impact Of Using High Magnesium Waters On Soils And Crops.

OBJECTIVE

* To determine the effect of high Mg waters on soil properties and plant growth.

PLAN OF WORK

On half hectare field of normal soil will be selected under the command of three different tubewells in Mona Project. The tubewell

waters will be selected where TDS,SAR parameters are almost uniform but calcium/magnesium ratios of 2:1, 1:1 and 1:2. The following treatments will be tried.

Treatments

i.	Soil	1 (normal and medium textured)
ii.	Ca/Mg ratio	3 (2:1, 1:1 and 1:2)
iii.	Crop rotation	1 (Wheat-rice)
	Replications	3
	Total plots	=1x3x1x3=9

PROCEDURE

The selected 1/2 hectare field will be divided into 9 equal plots on each tubewell. Initial soil samples will be taken from 0-30,30-60, 60-90 and 90-120cm depth for ECe,Ca,Mg,Exch.Ca and Mg.SAR,$CaCO_3$ and textural analysis.The crop will be sown at the normal planting season with optimum level and crop management practices. An optimum dose of NPK fertilizer will be applied.Pure tubewell waters will be used for crop irrigation. Subsequent soil sampling will be done after each crop for analysis.The data on crop yield,rainfall,irrigation applied,insect pest check measures taken and soil infiltration rate will be collected for experiment evaluation.

TREND OF RESULTS

It was first year of the experiment. High Ca/Mg ratio did not show any toxicity to rice crop.

The study is of three years and will be completed during Rabi 1983-84.

Study No.3: Estimation Of Boron Contents In Ground-water And Soils

OBJECTIVE

* To find out boron levels in soils and waters to solve nutritional problems of crops.

PLAN OF WORK

The soil and water samples from the project area will be collected, covering all types,for boron analysis.The water samples will consist of tubewell and drainage waters.

The data from soil and water samples will be processed to determine the deficiency or excess of boron contents in order to establish boron levels for improved farm production.

TREND OF RESULTS

The boron contents ranged from 0.1 to 1.5 ppm in the tubewell waters of Shahpur Unit-I.

COMPLETION SCHEDULE

The study will be completed upto 1983-84.

Note: Boron-free glassware will be used for this study.

Study No.4: Monitoring The Quality Of Drainage Waters And Their Use In Crop Production.

OBJECTIVES

* Evaluating the quality of drainage waters.
* Feasibility of using drainage water for crop production.

PLAN OF WORK

Water samples will be collected in each quarter from the drains and analysed for water quality evaluation. When the water is considered marginally suitable for irrigation, 0.5 hectare area of medium or fine textured non-saline, non-sodic soil will be selected for conducting experiment. Three different leaching requirements will be tested.

Treatments

i. Leaching requirement	3(0,15,30% over and above the crop water requirement)
ii. Crop rotation	1(Wheat-sorghum)
iii. Replications	3
Total No. of plots	=3x1x3=9

PROCEDURE

1/2 hectare of normal soil (medium textured) will be selected where marginal drainage water will be applied for irrigation. Initial soil samples will be collected from 0-30, 30-60, 60-90cm depths and will be analysed for ECe, SAR and Physical analysis. Crops like wheat and sorghum will be grown. Subsequent soil sampling will be carried out after harvesting of each crop.

Data on crop yield, soil properties and infiltration rate will be collected for evaluation of the experiment.

TREND OF RESULTS

Data for first year wheat crop is being collected.

COMPLETION SCHEDULE

The experiment commenced during Rabi 1981-82 and will be completed during Kharif 1984.

Study No.5: Salinity Fertility Interactions

Salinity/sodicity cause significant reduction in crop yield over considerable area in the Indus Basin. Research has been conducted at Mona Project on the development of efficient and economical technology for the reclamation and management of salt affected soils. However, it appears impossible at this stage to carry out reclamation of all the salt affected land due to the non-availability of suitable reclamation means. It is, therefore, necessary to investigate the possibility of raising economical crops on saline sodic soils. The application of fertilizers may be beneficial for crop growth on salt affected lands because the interaction of different fertilizer material with soil salts may improve its physico-chemical properties, thus, increasing the uptake of useful nutrients by crop plants for better growth.

OBJECTIVES

* To determine the fertilizer use efficiency under saline irrigation conditions.
* To work out the best combination of different fertilizer sources under varying irrigation salinity/sodicity.

PLAN OF WORK

One hectare field of medium and fine textured normal soils will be selected in the Project Area. The following fertilizer treatments will be tried:

Treatments

i. Nitrogen levels	3 (75, 135, 175kg/ha. N as Urea)
ii. Phosphorus level	4 (0, 50, 100, 150 kg/na P_2O_5 as SSP).
iii. Potash levels	1 (50 kg K_2O as K_2SO_4)
iv. Crop rotation	1 Wheat-Rice
Replications	=3
Total No. of plots:	=3x4x1x1x3=36

PROCEDURE

Each field will be divided into 36 equal plots. The fertilizer treatments will be applied at random. Wheat and rice crops will be sown at normal planting season with optimum land and water management practices. Insect pest control measures will be taken as and when required. The initial soil sampling will be done from 0-15, 15-30, 30-60 and 60-90 cm depths, before the experiment is initiated, for salinity and fertility analysis. Subsequent soil sampling will be done after each crop is over for salinity and fertility analysis. The analysis includes estimation of ECe, SAR, $CaCO_3$ contents, NPK contents and physical analysis.

The observations like crop yield, soil infiltration rate and rainfall etc. will be recorded for evaluation.

TREND OF RESULTS

i) At high water salinity (TDS 2000 ppm) the nitrogen dose @ 75 lbs/acre gave better wheat grain yield as compared to other doses i.e. 125 lbs. and 175 lbs/acre.

ii) Crop yield increased with increase in fertilizer dose where irrigation waters of 1344 and 1472 ppm TDS were used for irrigation.

COMPLETION SCHEDULE

The study will be completed upto Rabi 1982-83.

Study No. 6: Biological Reclamation Of Salt Affected Soils.

OBJECTIVE

* To evaluate economics of biological reclamation of salt affected soils in comparison with chemical amendments.

PLAN OF WORK

I hectare field of badly salt affected (saline sodic non-gypsiferous) soil will be selected. The following treatments will be tested:

Treatments

i. Soil	1 (badly salt affected)
ii. Crops	3 (i. Kallar grass) (ii. Jantar followed by barley) (iii. In the plots of 50% GR rice-whe rotation will be followed.
Replications	=3
Total No. of plots	=1x3x3=9

PROCEDURE

1 hectare field of saline-sodic non-gypsiferous soil will be selected in the Sahiwal area, district Sargodha. The selected area will be precisely levelled and initial soil samples will be taken from 0-15, 15-30, 30-60, 60-90 and 90-120cm depth for ECe, Ca, Mg. SAR and pH determinations and textural analysis. The crops will be grown at their normal planting season with optimum levels of fertilizers and crop management practices. Canal/tubewell water will be used for irrigation purposes. Subsequent soil sampling will be done after each crop is over for chemical analysis. The data on crop yield, soil characteristics, soil infiltration rate will be collected for the evaluation of different treatments.

TREND OF RESULTS

The results indicate that pH, ECe and SAR of soil was considerably decreased where 50% gypsum(rice-wheat) treatment was applied which was followed by Jantar-Barley and Kallar grass.

COMPLETION SCHEDULE

This study is of 3 years period starting from 1981-82.

Study No.7: Interaction Of Soil Depth And Chemical Amendments On The Reclamation Of Saline-Sodic(Non-Gypsiferous) Soils.

OBJECTIVE

* To determine the best combination of soil depth and chemical amendments for accelerated reclamation of saline-sodic soils.

PLAN OF WORK

1 hectare field of saline-sodic (non-gypsiferous) soil will be selected and following reclamation treatments will be tried.

<u>Treatments</u>

i. Gypsum	=3 (0,50,100% GR of soil).
ii. Depth to which gypsum will be mixed with soil.	=3 (15,30,45cm)
iii. Crop rotation	=1 (rice-berseem-rice-wheat)
Replications	=3
Total No. of plots	=3x3x1x3=27

PROCEDURE

One hectare field will be divided into 27 equal plots. The gypsum treatments will be allotted at random. The desired quantity of gypsum will be broadcast and ploughed to the desired depth for proper mixing of gypsum with soil. The crop rotation rice-berseem-rice-wheat, will be tested. An optimum dose of NPK will be applied to each crop. Canal/pure tubewell water will be used for irrigation. The soil samples will be collected from 0-15, 15-30, 30-60, 60-90 and 90-120cm depth for pH, ECe, SAR, ESP, $CaCO_3$ and physical analysis. Infiltration rate of soil will also be monitored to evaluate treatment effect. The data on crop yield, rainfall of the area, insect pest measure taken etc. will be recorded for evaluation of the experiment.

TREND OF RESULTS

During the first year of experimentation, the crop failed due to high initial salinity/sodicity.

COMPLETION SCHEDULE

The study will be completed upto rabi 1984-85.

Study No.8: Effect Of Different Gypsum Grades For The Reclamation Of Saline-Sodic(Non-Gypsiferous) Soils.

OBJECTIVE

* To evaluate the feasibility and economics of different grades of gypsum for soil reclamation.

PLAN OF WORK

1/2 hectare field of saline-sodic (non-gypsiferous) soil will be selected and the following grades of gypsum will be tried.

Treatments

i.	Gypsum grades	5 (0, powder on 50% GR of soil, powder on 50% GR applied in standing water, 2" and 4" size gypsum stones @ 50% GR of soil.
ii.	Crop rotation	1 (Rice-wheat)
iii.	Replications	3
	Total No. of plots	=5x1x3=15

PROCEDURE

The selected field will be divided into 15 equal plots. The gypsum treatments will be allotted at random. Initial soil physico-chemical characteristics will be monitored. The crop rotation rice-wheat will be followed. Canal water will be used for irrigation. Soil samples will be collected from 0-15, 15-30, 30-60 and 60-90cm depth for pH, ECe, SAR, Na, Ca+Mg determinations. Infiltration rate will also be observed. The data on crop yield and soil characteristics will be used for experiment evaluation.

TREND OF RESULTS

i) Maximum yield of rice was obtained where Gypsum @ 50% GR (Powder) in standing water was applied, followed by 50% GR(Powder) in soil.

ii) The ECe and SAR of soil was considerably decreased in all the treatments.

COMPLETION SCHEDULE

The experiment commenced during 1981-82 and will be completed during 1983-84.

Study No. 9: Role Of Zinc Application In Saline-Sodic Soils For Rice Cultivation.

OBJECTIVES

* To determine the appropriate dose of zinc for rice cultivation under saline sodic conditions.
* To evaluate the role of zinc application for economical crop production.

PLAN OF WORK

Different doses of zinc in the form of zinc sulphate at the rate of 0, 10, 20, 40 lbs. per acre will be applied to the rice crop being grown on 0.4 hectares of saline-sodic (non-gypsiferous) soils under reclamation experiment. The zinc application will be made to the soil. Soil samples will be collected before the application of zinc for estimating the zinc contents of the soil. Subsequently the soil and plant samples will be collected for Ca, Mg, Na, K and zinc estimation to evaluate the effect of applied zinc. The data on soil infiltration, crop yield, irrigation water applied and rainfall pattern will be collected for evaluating the experiment.

TREND OF RESULTS

The yield of rice increased with the application of zinc. Maximum yield of 277.21 kg/ha was obtained by applying zinc sulphate @ 10 lbs/acre followed by 20 lbs/acre, 40 lbs/acre and control.

COMPLETION SCHEDULE

The study will be completed upto 1983-84.

Study No.10: Role Of $CaCO_3$ In Soil Reclamation

OBJECTIVE

* To improve the solubility of $CaCO_3$ in soil to accelerate reclamation.

PLAN OF WORK

1/2 hectare of saline-sodic soil containing sufficient quantity of $CaCO_3$ will be selected in the project area. The following treatments will be tested.

Treatments	
i. Soil	1 (saline-sodic calcareous)
ii. Treatments	5 (Gypsum @ 0,25 and 50% requirement basis. H_2SO_4 @ 200 and 400 litres/ha).
iii. Crop rotation	1 (rice-wheat)
Replications	3
Total No. of plots=1x5x1x3=15	

PROCEDURE

1/2 hectare field will be properly levelled before the experiment starts and will be divided into 15 equal plots. Initial soil sampling from 0-15, 15-30, 30-60, 60-90 and 90-120cm depths will be done for ECe, SAR, Ca, Mg, Na and $CaCO_3$ contents determinations. In addition to chemical analysis textural class of the experimental soil will also be determined. Canal water will be used for growing the crops and rice-wheat crop rotation will be followed. All the cultural operations will be normal and recommended for the area.

Commercial grade of H_2SO_4 will be used once in three years before transplanting of rice. Subsequent soil samples will be collected after harvesting of each crop. The data regarding crop yield, soil properties and infiltration rate will be collected to evaluate the impact of different doses of H_2SO_4 in comparision with gypsum.

TREND OF RESULTS

i) Maximum yield of 280 kg/ha was obtained with the application of gypsum @ 50% GR. It was followed by H_2SO_4 @ 400 lit/ha, gypsum @ 25% GR and H_2SO_4 @ 200 lit/ ha. and control respectively.

ii) Significant decrease in ECe and SAR of soil was also observed in all the treatments.

COMPLETION SCHEDULE

This study commenced during 1981-82 and will be completed during 1983-84.

Study No. 11: Determination Of Reclamation Requirements And Salt Movement Pattern For Salt Affected Soils Under Different Water Table Depths.

OBJECTIVES

* To monitor the salt movement in a soil profile under different crops and irrigation levels.
* To determine the actual water requirements for salt affected soils to bring the soil salinity within acceptable limits.
* To evaluate the role of excess leaching on salt contents of the ground-water and salt distribution pattern under different water table depths.

PLAN OF WORK

One hectare field of salt affected soil will be selected under the command of three different tubewells having safe, marginal and potentially hazardous water quality. The following treatments will be tested:

i.	Soil	1 (badly salt affected)
ii.	Water table depth	2 (1,2 metres)
iii.	Crop rotation	1 (Rice-berseem-rice-wheat)
iv.	Water quality	3 (safe, marginal and hazardous)
	Replications	3
	Total plots	=1x2x1x3x3=18

PROCEDURE

1/2 hectare field will be divided into 3 equal plots on each water table depth. Initial soil samples will be collected from 0-30, 30-60 60-90 and 90-120cm depth for ECe, SAR, $CaCO_3$, ESP, CEC and physical analysis. The crop rotations rice-berseem and rice-wheat will be tried. The crops will be irrigated with tubewell water. An optimum dose of NPK fertilizer and insect pest control measures will be adopted. Subsequent soil sampling will be done before second irrigation is applied to monitor salt movement in soils under different crops and water table depths. The rainfall of the area will be recorded for experiment evaluation.

TREND OF RESULTS

i) A saline sodic gypsiferous soil having ECe, 75 and SAR 175 was reclaimed by simple leaching with 200cm of tubewell water application which was of poor quality having TDS 1728 ppm. The water table depth was below 5 ft.

ii) A considerable decreasing trend in pH, ECe and SAR of soil was observed with the use of saline ground water, having TDS 2368 (ppm) SAR 31.30 and RSC 13.8 (me/l). The water table at this site was about 3.3ft.

COMPLETION SCHEDULE

The study will be completed upto Rabi 1983-84.

Study No.12: Effect Of High SAR Tubewell Waters On The Coarse And Fine Textured Soils And Crops.

OBJECTIVES

Sodium is considered to be one of the major factors governing water quality as indicated by its effects on the soil and plant. Sodium not only causes toxic effects but also imbalances plant nutrition. Increasing proportions of sodium relative to calcium and magnesium in ground waters widely used in SCARP Areas, also affects soil properties. When the exchangeable sodium in soil exceeds above 10% of the CEC in fine textured soils or 20% in coarse textured soils, soil structure deteriorates and the soil becomes impermeable to water and air. In non-saline sodic soils the decrease in exchangeable calcium and magnesium may cause calcium and magnesium deficiencies.

Information about the behaviour of tubewell waters of different SAR values on coarse and fine textured soils and crops under Pakistan conditions is inadequate. It is, therefore, proposed to investigate the effect of high sodium waters on soils and crops.

Treatments

i. Soil	2 (Non-saline, non-sodic coarse and fine textured).
ii. SAR	2 (10 and 15 with TDS of water approximately uniform).
iii. Gypsum	4 (0, 50, 75 and 100% GR on water quality basis).
Replications	3
Total plots	= 24 for each soil type

PLAN OF WORK

1/2 hectare field of each soil type; non-saline, non-sodic will be selected and divided into 24 equal plots. Complete randomized block design will be followed for layout. Wheat-rice-crop rotation will be followed. Optimum dose of NPK fertilizer will be applied to each crop.

Irrigation

Crops will be irrigated at one bar tension i.e. approximately 50% depletion of available soil moisture.

Soil analysis

Soil samples will be collected from each plot from 0-15, 15-30, 30-60 and 60-90cm depth. Subsequent soil sampling will be done before sowing and after harvesting a crop. Soil samples will be analysed for field capacity, textural class, CEC, pH, ECe and SAR.

Water samples

Periodical water sampling from selected tubewells will be done for analysis of all possible cations and anions in order to account for any changes in quality of the tubewell waters.

Crop observations

Germination, crop stand, nutrient deficiency and sodium toxicity symptoms will be studied and crop yield will be estimated.

Infiltration rate

Infiltration rate will be measured to see the effect of high sodium waters on physical properties of the soil i.e.,permeability.

TREND OF RESULTS

i) Gypsum application on water quality basis showed a significant effect on the yield of rice.Maximum yield of rice was obtained with the application of gypsum @ 75 GR,followed by 100% GR.

ii) Infiltration rate of soil decreased in control plots as compared to gypsum treated plots.

COMPLETION SCHEDULE

The study will be completed during 1983-84.

Study No.13: Efficiency of Different Reclamants In The Reclamation Of Saline Sodic(Non-gypsiferous) Soils.

OBJECTIVE

* To investigate the efficiency and best combination of different reclamants for -reclaiming saline-sodic(non-gypsiferous) soils.

PLAN OF WORK

Selection of site:

An area of 0.4 hectare of saline-sodic(non-gypsiferous) soil will be selected in Sahiwal Town,District Sargodha. Land will be properly levelled before the start of the experiment and canal water will be used for irrigational purposes.Following treatments will be tested:

Treatments

i. Control
ii. 100% gypsum on gypsum requirement of soil.
iii. $CaCl_2$ eq. to 100% gypsum requirement of soil.
iv. H_2SO_4 eq. to 100% gypsum requirement of soil.
v. HCl eq. to 100% gypsum requirement of soil.
vi. $CaCl_2$ eq. to 1/4 GR+3/4 $CaSO_4$.
vii. H_2SO_4 eq. to 1/4 GR+3/4 $CaSO_4$.
viii. HCl eq. to 1/4 GR+3/4 $CaSO_4$.
ix. 50% Gy.+F.Y.M. @ 20 tons/acre.
x. $CaCl_2$ eq. to 50% GR+F.Y.M. @ 20 tons/acre.
xi. H_2SO_4 eq. to 50% GR+F.Y.M. @ 20 tons/acre.

xii. HCl eq. to 50% GR+F.Y.M. @ 20 tons/acre.

2. Soil	1 Saline sodic(non-gypsiferous)
3. Crop rotation	1 (Alfalfa-Rice)
4. Replications	3
Total No. of plots	= 12x1x1x3=36

Layout

0.4 hectare will be divided into 36 equal plots and plot bunds will be constructed. All the treatments will be randomized and each treatment will be replicated thrice.

Soil sampling

The first soil sampling will be carried out as soon as the layout is completed. The soil samples will be taken independently from each plot from 0-15,15-30,30-60,60-90 and 90-120cm depth. Samples for each depth will be composited from 12 sites randomly located from each plot. Subsequent soil sampling will be done twice a year i.e. before a crop is sown and after the same crop is harvested.

Application of amendments

Calculated quantities of all the amendments will be applied to the respective plots. Gypsum will be calculated on gypsum requirement of soil basis.

Crop cultivation

Alfalfa will be the first crop sown, which will be followed by rice. Fertilizer and irrigation requirements of each crop will be met.

Soil analysis

Soil samples will be analysed to determine change in salinity/sodicity status of soil during the reclamation process.

Infiltration rate measurement

Infiltration rate of soil in each plot will be measured before the start of the experiment. Subsequent measurements of

infiltration rate of soil will be carried out once a year during the months of January and February. The standard ring method of measuring infiltration rate will be followed.

Evaluation of results

The evaluation of reclamation methods will be made on chemical analysis of soil,crops yield and infiltration rates etc.

COMPLETION SCHEDULE

The study was started during Rabi 1981-82 and will be completed upto 1984-85.

SOIL AND WATER TESTING LABORATORY

Laboratory plays a vital role in planning and execution of research in the fields of soil reclamation, agronomy, hydrology and consumptive use. The project laboratory is well equipped with necessary apparatus including electronic instruments. The provision of boron determination has further enhanced the research activities as for as reclamation of salt-affected and water-logged soils is concerned.

Laboratory mainly caters to the analytical requirements of the project. Analytical facilities have also been extended to differen formations of WAPDA for instance SCARP Construction Circle, Sargoo... Watercourse Monitoring and Evaluation, Lower Indus Reclamation Project and Government and Semi Government Agencies. In addition to this, facilities have also been extended to private sector on payment basis. Aside from routine analysis of soil, water and plant, research is also conducted on soil and water problems with special emphasis on salinity.

Following experiments shall be conducted during the year.

Study No.1: Interaction Of Zinc With Different Sodicity Levels.

OBJECTIVE

* To evaluate salt tolerance and optimum dose of zinc in rice.

PLAN OF WORK

The study will be conducted in glazed pots measuring 26x26 cm. Sandy clay loam soil shall be used and artificially salinized to give 4 sodicity levels. Appropriate dose of zinc will be applied at suitable time.

Following treatments shall be tested:

i. Sodicity levels	4 (i.e. SAR 10,15,20 and 25). Sodicity will be produced by mixing NaCl, Na_2SO_4, $CaCl_2$ and $MgSO_4$ in such a way that Ca:Mg ratio remains 2:1 and Cl:SO_4 1:1.
ii. Zinc levels	4 (0,5,10,15 kg/ha)
Replications	2
Total No. of pots	4x4x2=32

COMPLETION SCHEDULE

It is proposed to be completed during 1983-84.

Study No.2:Effect Of $CaCl_2$,$MgCl_2$,$MgSO_4$,NaCl and Na_2SO_4 On Rice Cultivation.

OBJECTIVE

* To evaluate comparative effect of these salts on rice.

PLAN OF WORK

Normal soil(loamy) shall be collected from the project area for this study. Germination will be tested under the same set of conditions before starting the experiment. The soil shall be artificially salinised using different salts @ 2,4,6 and 8 meq/l and their effect will be studied. The experiment shall be conducted in glazed pots of 26x26cm size. Ten kgs soil shall be taken in each pot. Rice shall be transplanted when the salts attain equilibrium.

The treatments to be tested shall be as under:

i.	Salts	5
ii.	Salt doses	4
iii.	Replications	2
iv.	Total No. of pots	=5x4x2=40

COMPLETION SCHEDULE

It is proposed to be completed during 1983-84.

Study No.3: Salt Tolerance In Sunflower

OBJECTIVES

* Sunflower is one of the most important oilseed crops. Edible oil expelled out of the sunflower seeds ranks on the top among all the edible oils on sale as for as nutrition value and cooking quality is concerned. Its soothing influence on human health has been well recognized by international health organizations. It supplies a suitable balance of vitamins, fats and mineral constituents and is a rich source of energy.

* The recent trend towards domestic use of edible oils has been of sky high significance. Considerable emphasis has been laid on the cultivation of oilseed crops. Despite of the fact that favourable environmental and soil conditions prevail, much stress has not been laid on popularizing its cultivation among the farmers. As a consequence, we have been in a position to

meet only a fraction of the gross requirements of the country. A considerable extent of foreign exchange has, therefore, been expended on the purchase of edible oils to feed the oil industry.

* A compaign has, therefore, been waged throughout the country to increase the area under cultivation of oilseeds. The experiment given here under is a part of that compaign. It has been planned to evaluate the performance of sunflower under project conditions.

Treatments

i.	ECe levels	4(ECe 2,6,10,14).
ii.	Varieties	2
iii.	SAR	2(10 and 15)
	Replications	2

Total No. of treatments: 4x2x2x2=32

COMPLETION SCHEDULE: 1983-84.

AGRONOMY

Agronomy means field management. It is a science and art of putting all the production factors, such as varieties, fertilizers, irrigation with soil and crop management in such a manner that most favourable conditions are provided for maximum plant growth. As high yielding varieties, fertilizer, pesticides etc. are commonly available, there is an imperative need to continuously develop better farm production technology for attaining higher yields. This guiding principle has been used to formulate this programme. Further as a matter of policy attention has been focussed on development of technology for the efficient utilization of irrigation water. Specially the following objectives are proposed to be achieved.

i. To develop appropriate farm production technology for major crops of the project area.

ii. To evaluate ground water contribution towards crop production in high water-table areas.

iii. To determine optimum cropping input-output relationships.

iv. Amplification effect of salinity on moisture stress and crop production.

v. Trials on promising varieties of major crops.

Keeping in view the above objectives, research on the following eleven studies nine on-going and two new is proposed to be conducted.

1. Amplification effect of salinity on moisture stress and crop production (Study No. 3 of PC-I).
2. Water distribution and saving as affected by different shapes of fields (Study No. 5 of PC-I).
3. Evaluation of water requirements for sugarcane grown on soils of different water-table depths (Study No. 6 of PC-I).
4. Carry-over of water in rice fields for wheat production (Study No. 12 of PC-I).
5. The relation between plant population, pest management and nitrogen fertility on cotton production (Study No. 13 of PC-I).
6. Optimum management studies on major crops (Study No. 14 of PC-I).
7. Paddy yield and plant population as affected by salinity (Study No. 27 of PC-I).

8. Fertilizer use efficiency under high water-table conditions (Study No.31 of PC-I).

9. Effect of different rates of nitrogen on the yield and quality of sugarcane.

10. Cotton yield in relation to phosphorus application(New).

11. Performance of cotton strains at high water-table(New).

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Study No.1: Amplification Effect Of Salinity On Moisture Stress And Crop Production.

OBJECTIVE

* Crop yields are reduced if they are exposed to moisture stress during their life cycle. Presence of salts further amplify the moisture stress but very little research has been conducted in Pakistan to quantify this impact. This study, has been designed to quantitatively evaluate the amplification effect of salinity on moisture stress and crop production.

PLAN OF WORK

Field work was initiated on wheat crop as originally proposed and a lot of effort was made to select a field in the range of 6-8 ECe. Due to variations in soil salinity, the results were erratic hence it was decided to conduct further work under controlled conditions in pots. Irrigation will be applied at 40,60 and 80% depletion of available soil moisture in upper 15cm soil layer for first irrigation after sowing and 30cm for subsequent irrigation to wheat crop.

For cotton, irrigation will be applied at 50,70 and 90% deplition. Initial soil salinity will be 4,8,12 and 16 mmhos/cm and medium textured soil will be used.

Observations to be recorded:

i. Soil salinity at sowing, before and after each irrigation and at harvest.

ii. Usual plant observations and crop yield.

iii. Irrigation delta to each crop.

iv. General behaviour and crop performance under each treatment.

COMPLETION SCHEDULE

This study was initiated during Rabi 1980-81 on wheat crop under field conditions. In modified form, it will be taken up during Kharif 1982 on cotton and Rabi 1982-83 on wheat and continue for three crop seasons on each crop.

Study No.2: Water Distribution And Saving As Affected By Different Shapes Of Field.

OBJECTIVE

* Generally the field size is 67x60m which is divided into two equal parts for irrigation. The work done on precision levelling and re-shaping of fields in the recent years has indicated that irrigation water can be saved by re-shaping the fields which also ensures its uniform distribution to all parts in a field. However no data on water saving, its distribution and impact of these factors on crop production is available under local conditions. This study has been designed with a view to compare the yield response, and the water saving as affected by differently shaped fields.

PLAN OF WORK

The following three field shapes will be tested:

i. 67x30m = ½ acre
ii. 134x15m = ½ acre
iii. 201x10m = ½ acre

TREND OF RESULTS

Trend of results cannot be reported as data collection for the first crop has not been completed.

COMPLETION SCHEDULE

This study was started during Rabi 1981-82 and will be completed by June, 1984.

Study No.3: Evaluation Of Water Requirement For Sugarcane Grown On Soils Of Different Water Table Depths.

OBJECTIVE

* Irrigation water is a limiting factor for raising crop yields in most parts of the country, but the situation is better in SCARPs due to supplemental supply from tubewells. In most cases, growers apply total delta of water recommended for a particular crop, irrespective of water-table depth and

other factors resulting water requirements resulting in excessive wastage. This study has been planned to find out water requirements of sugarcane at different water-table depths to save undue wastage of irrigation water.

PLAN OF WORK

Treatments:

i. Traditional irrigation.
ii. Irrigation at 3 bar moisture tension.

This experiment will be laid out at four different locations having an approximate water-table depth of 0-1,1-2,2-3 and 3-4m from the ground surface. There will be three replications. Fertilizer dose will be kept 200-90-56 kg NPK/hect. Entire dose of P_2O_5, K_2O and ½ of N will be applied at sowing while remaining ½ N at closing in. Irrigation to 3 bar moisture tension treatment will be provided on development of this stress in upper 30cm soil depth. The depth of irrigation to be applied will vary with the change in water table depth. For 0-1m water-table depth, the deficit will be replanished by bringing the soil moisture contents back to field capacity. This deficit will be worked out for the upper soil layer over-lying the saturated soil. For other water-table depths, the deficit for the upper 1m soil depth will be replenished. Siphons will be used to apply measured amount of water to each treatment. Traditional irrigation will be applied according to farmer's practice.

Observations to be recorded:

i. Depth of water applied at each irrigation to each treatment.
ii. Millable and non-millable tillers/unit area.
iii. Cane height and cane weight.
iv. Total delta applied at each water table depth.
v. Weekly water table depth at each site.

TREND OF RESULTS

Irrigation application at 3 bar moisture tension gave significantly higher cane yield than the farmer's practice. The farmers applied 6-7 irrigations as compared with optimum requirement of 9-10 irrigations

COMPLETION SCHEDULE

This study was undertaken in Kharif 1980 and will be completed in June, 1983.

Study No.4: Carry-over Of Water In Rice Fields For Wheat Production.

OBJECTIVE

* Wheat follows rice in a considerable acreage. Rice crop generally vacates the land somewhere by the middle of November. Thus very short time is left for planting of wheat, Since rice fields remain under constant flooding for an approximate period of three months,the soil is compacted and is rendered hard for cultural operations.However,rice fields are believed to be in possession of a fair amount of residual moisture. Commonly these soils are ploughed to restore normal soil structure.Due to this sometimes wheat sowing is delayed considerably which,in turn, effects the yield.This study has been proposed to test the concept of minimum tillage and utilization of stored soil moisture in rice fields to ensure timely sowing of wheat and its effect on yield level.

PLAN OF WORK

One acre field representing normal soil will be selected after harvesting rice.It will be divided into four equal parts to test the following treatments.

i. Thorough preparation of seed bed for wheat planting without soaking irrigation.
ii. Minimum tillage for wheat planting without soaking irrigation.
iii. Thorough preparation of seed bed for wheat planting with soaking irrigation.
iv. Minimum tillage for wheat planting with soaking irrigation.

This study will be carried out at 1 to 2 different sites.

Observations to be recorded:

i. Planting dates with and without soaking irrigation.
ii. Number of plants/unit area.
iii. Number of tillers/unit area.
iv. Saving of irrigation water.
v. Grain yield
vi. Cost of minimum tillage compared with optimum tillage.

TREND OF RESULTS

Thorough preparation of seed bed fairly eliminates the need of soaking irrigation.

COMPLETION SCHEDULE

This study was undertaken during Rabi 1980-81 and will be completed by June, 1983.

Study No.5: The Relation Between Plant Population, Pest Management And Nitrogen Fertility On Cotton Production.

OBJECTIVES

Optimum plant population and adequate fertilizer inputs are essential for potential crop yields. Dense population and luxurient vegetative growth provide favourable conditions for insect multiplication which enhances the need for greater plant protection. In this study these three production factors have been combined to evaluate their interactions in terms of seed cotton yield.

PLAN OF WORK

Treatment

	Location		
	A	B	C
Plant population level(No./ha)	25000	37500	50000
Nitrogen dose(Kg/ha)	0	0	0
	70	70	70
	140	140	140
Pest management	Low	Low	Low
	Medium	Medium	Medium
	High	High	High

Pest Management

Low pest management will represent farmers' practice, medium departmental recommendation and high-absolute pest control.

Observations to be recorded:

i. Extent of pest infestation under each pest management.
ii. Actual number of plants under each treatment.
iii. Number of flowers and bolls/plant.
iv. Productive and un-productive bolls/plant.
v. Seed cotton yield.
vi. Number of sprays/administration of insecticides and their cost.

TREND OF RESULTS

Cotton responded to increasing levels of Nitrogen and improvement in pest management.

COMPLETION SCHEDULE

This study was taken up during Kharif,1980 and will be completed in June,1983.

Study No.6: Optimum Management Studies On Major Crops:

OBJECTIVES

Although majority of Pakistan's population is engaged in agriculture yet the production has not reached the desired level.The major cause for this situation is that majority of farmers do not practice the improved agronomic practices with the result that the yields have remained much low,compared with the production potential.There is much to be done in this direction to bridge this production gap.This study has,therefore,been proposed to test and demonstrate improved management practices to the farmers and convince him for adoption of new technology.

PLAN OF WORK

The study will be conducted under actual field conditions on well levelled fields at two to three different sites.Well drained, salt free soil and good quality water will be used for irrigation.The following treatments are proposed to be tested:

Sugarcane(2nd crop)

1. Low fertility,traditional irrigation,No plant protection.
2. Low fertility,irrigation at 3 bar moisture tension,low plant protection.
3. Low fertility,irrigation at 3 bar moisture tension,optimum plant protection.
4. Recommended fertilizer dose,irrigation at 3 bar moisture tension,low plant protection.
5. Recommended fertilizer dose,irrigation at 3 bar moisture tension,optimum plant protection.

Cotton(First crop)

1. Traditional sowing-Low fertility-Low plant protection and traditional irrigation.
2. Traditional sowing-Recommended fertilizer-Low plant protection-traditional irrigation.
3. Line sowing-Recommended fertilizer-Low plant protection-traditional irrigation.
4. Line sowing-Recommended fertilizer-optimum plant protection traditional irrigation.
5. Line sowing-Recommended fertilizer-optimum plant protection-improved irrigation.

Observations to be recorded:

This study was started in Kharif 1981 on sugarcane and cotton is proposed to be included this year. Demonstration-cum-research will be completed by end of 1983 and 1984 for sugarcane and cotton respectively.

Study No.7: Paddy Yield And Plant Population As Affected By Salinity.

OBJECTIVES

Plant to plant spacing of 23cm is generally recommended for rice production in a normal soil. Since plant growth may be impaired by salinity the normal recommended spacing may not be suitable for salt affected soils. In order to find out optimum space requirements of rice in a saline soil this study has been proposed.

PLAN OF WORK

Soil will have ECe in the range of 4-6 mmhos/cm, since salinity of 7-8, last year resulted in crop failure. Plant to plant spacing proposed for testing will include the following:

i.	Plant to plant and line to line distance	15 cm.
ii.	-do-	23 cm.
iii.	-do-	27 cm.

Observations to be recorded:

i. Number of tillers per plant.
ii. Productive and un-productive tillers.
iii. Final plant population per unit area.
iv. Paddy yield.
v. Salinity status of soil before and after cropping

COMPLETION SCHEDULE

The crop failed during the first year of the study i.e.Kharif 1981. It will be conducted on a soil of low salinity during Kharif 1982 to decide future programme.

Study No.8: Fertilizer Use Efficiency Under High Water Table Conditions.

OBJECTIVES

Physiochemical behaviour of a poorly drained soil may be different from a well drained soil due to saturated profile conditions.Crops grown on high water table soils make much use of ground water.However high water table may favour uptake efficiency of nutrients due to restricted leaching and valatilization. However no research has been conducted under local conditions to know the correct situation.This study is therefore,proposed to determine suitable corelation between irrigation delta and fertilizer rate for wheat crop grown on soil having high water table.The importance of this study can be judged from the fact that about 1.2 million acres out of 21 million acres surveyed during 1977-78, had water table depth within 0-1 metre.

PLAN OF WORK

Initially,work will be confined to wheat and if results are encouraging, extended to other crops.The experiment will be carried out in an area of 0.4 ha. having watertable within the range of ½m. Normal soil having low N and P contents with good groundwater will be selected and the following treatments will be tested:

A-Irrigation(Main treatments):

i. One irrigation at tillering

ii. Two irrigations each at tillering and grain development.

iii. Three irrigations each at tillering,bcoting and grain development.

B-Fertilizer(NPK kg/ha) (Sub Treatments):

i. 0 - 0 - 0
ii. 40 -50 - 0
iii. 80 -50 - 0
iv. 120-50- 0
v. 160-50 - 0

Time of Application

i. Normal practice i.e.50% N at sowing and 50% with Ist irrigation.

ii. 25% N at sowing and 75% with Ist irrigation.

All the phosphorus will be applied as basal application during preparatory tillage. Standard wheat variety using recommended rate of seeding will be planted during the middle of November.

Observations:

i. Soil analysis before and after cropping.

ii. Water table behaviour during crop season.

iii. Usual plant observations and crop yield.

iv. N use efficiency for each treatment

COMPLETION SCHEDULE

This study was started during Rabi 1981-82 and will continue for a period of 3 years.

Study No.9: Effect of Different Rates of Nitrogen On The Yield And Quality Of Sugarcane.

OBJECTIVES

Fertilizers play a key role in exploiting the full yield potential of different crop varieties. This is equally applicable to sugarcane and very high yields are obtained with the balanced use of fertilizers. It is apprehended that cane quality may suffer due to high dose of nitrogen and increase in yield may be off-set with decrease in sucrose contents. Very little research has been conducted on this issue, therefore, this study has been planned to find out the effect of higher doses of N on yield and quality of sugarcane.

PLAN OF WORK

The experiment will be conducted on nutritionally exhausted soil in an area of 0.4 and the following treatments will be tested:

Levels of NPK(kg/ha):

0 -100-50
70 -100-50
140 -100-50
210--100-50
280 -100-50

Each treatment will have three replicates in completely randomized block design.

Observations to be recorded:

i. Soil analysis before and after cropping.
ii. Total number of tillers/unit area.
iii. Millable tillers/unit area.
iv. Stalk height and weight.
v. Cane yield.
vi. Brix's analysis.

COMPLETION SCHEDULE

The study was started in Kharif 1980 and will be completed by the end of Kharif 1982.

Study No.10: Cotton Yield In Relation To Phosphorus Application(New)

OBJECTIVES

Application of phosphorus to cotton crop has become a controversial issue. The point was discussed at a high level meeting last year where some workers stressed that like other crops cotton needs fresh application of this nutrient while others did not favour the opinion and invalidated the previous recommendations. This study has been designed to confirm whether cotton crop needs phosphorus for potential seed cotton yield or not.

PLAN OF WORK

The experiment will be conducted on soil with poor to moderate phosphorus contents in an area of 0.2 ha in three repeats. Following levels of P_2O_5 will be tested with usual N and K_2O applicable to cotton crop.

Levels of P_2O_5 0,25,50,75 and 100 kg/ha.

Full dose of P_2O_5, K_2O and half of the total N will be applied as basal application while second half top dressing at flowering stage.

Cotton variety B-557 will be sown during the IInd half of April in lines spaced 75cm. Hoeing, weeding, plant protection measures and other cultural operations will be as per requirements and recommendations for the area.

Observations to be recorded:

i. Soil analysis before and after cropping in respect of phosphorus.

ii. Usual plant observations and seed cotton yield.

iii. General crop condition and performance.

iv. Root length and compactness at harvest.

Study No. 11: Performance Of Cotton Strains At High Water-table (New)

OBJECTIVES

Physico-chemical behaviour of high water-table soil may be different from a soil of deep water-table and different varieties may show varied performance under these conditions. In northern punjab cotton acreage is gradually decreasing as a consequence of rise of ground-water table and poor yields. So it becomes imperative to evolve and select those cotton varieties which can withstand these conditions to perform better. In this study new cotton strains are proposed to test for their performance under high water-table.

PLAN OF WORK

The experiment will be conducted on non-saline, non-sodic medium textured soil where the quality of ground water is good. Ten cotton strains will be sown at watertable depth of 0-½, ½ to 1 and 1 to 2 metre from the surface in an area of 0.2 ha. at each site. Each treatment will have three replications in randomized block design.

Fertilizer

Only 50 kg Nitrogen per ha. will be applied at flowering stage. No basal application will be made to check high vegetative growth.

Irrigation will be applied as per crop requirements. Hoeing weeding, plant protection and other operations will be common to all the treatments according to general recommendation for the crop.

Observations to be recorded:

i. Plant emergence and initial crop stand.

ii. Plant stand before monsoon and at harvest.

iii. Water table behaviour.

iv. Usual plant observations, final plant height and seed cotton yield.

v. Pest and disease incidence.

vi. General crop condition and performance during the growth period.

AGRICULTURAL ECONOMICS

The Agricultural Economics Section is responsible to evaluate impact of different developmental programmes, identify socio-economic constraints in Agriculture production process and suggest measures to remove the constraining factors as to boost up agriculture production and work out economics of water management and land reclamation methods developed at the project. For achieving these objectives research is proposed to be conducted on following studies.

1. An evaluation of the Socio-economic impact of Mona Reclamation Experimental Project.
2. Socio-economic factors restraining crop yields in SCARP Areas.
3. Economics of Land Reclamation Methods(Study No.28 of PC-I).

Study No.1: An Evaluation Of The Socio-Economic Impact Of Mona Reclamation Experimental Project.

OBJECTIVES

* Measurement of the changes brought about in different agricultural aspects viz; cropping patterns,intensities level and use of farm inputs,farm costs,gross and net income.
* Computation of the annual project costs and estimation of the benefits accrued from the project implementation.
* Identification of the factors associated with the success/failure of public tubewell projects.

BACKGROUND

The Mona Reclamation Experimental Project was initiated in 1965 with a view to overcome the factors hindering the development of agriculture in SCARPs and conduct research for improving planning and implementation of future SCARPs. For this purpose a very sound and concrete information base was provided through conducting socio-economics survey during the year 1965-66. Later on,the results of this survey served as the basis of project evaluation studies conducted during the year 1970-71 and 1975-76. Although the impact of the project has already been measured twice,it is imperative to repeat these periodic surveys after 5 years interval to direct the agricultural economy on the right path.The need of re-conducting

evaluation studies is also felt because of changes in the utilization and efficiency of public tubewells as well as changes in the socio-economic conditions of farmers and their adoption behaviour.

PLAN OF WORK

The project area comprising 1,10,000 acres spread over 83 villages, will be stratified on the basis of source of irrigation. From these strata, the same 14 villages, selected for bench mark survey in 1965 will be selected as sample for the study. Further the same tenure and size of holdings (taken for bench mark survey) will be taken to have a uniform scale for evaluation. A representative number of similar farm holdings will be picked up from the non-project area to isolate the real impact of the project. Economic analysis of the project would be furnished and report will be submitted at the end of PC-I period.

COMPLETION SCHEDULE

Data collection was started during 1981-82 and report will be completed by April, 1983.

Study No. 2: Socio-Economic Factors Restraining Crop Yield In SCARP Areas(New).

OBJECTIVES

* To find out socio-economic factors restraining crop yields.
* To suggest measures to remove the constraints as to boost up agri; production.

BACKGROUND

Nature has gifted Pakistan with suitable climate and abundant resources like land, labour and water. Variety of crops can successfully be grown in this part of the world. Reffering to the particular area (Sargodha), Major crops being grown are:- Citrus, Sugarcane, Rice, Wheat, Forage etc. When we compare per hectare yields of major crops with developed and some developing countries we find Pakistan at the bottom. Definitely there are some bottle-necks which handicap our farmers to attain the desired level of crop yields. This important question has never been attempted to come up with accurate answer.

PLAN OF WORK

A survey will be conducted in Mona SCARP Area. Stratified random sample will be drawn. Responsis of sampled farmers will be recorded on pre-planned and tested questionnaire. Data will be analysed using statistical techniques.

COMPLETION SCHEDULE

This study will be completed during 1982-83.

Study No. 3: Economics Of Land Reclamation Methods(New)

OBJECTIVES

* To find benefit cost ratio of various land reclamation methods.
* To find out most effective and profitable methods of land reclamation.

BACKGROUND

The soil and reclamation section of the project has done considerable research for combating salinity by using different bio-chemical techniques. Special attention has been directed to establish physical relationship of different soil and reclamation techniques. Mostly economic problem has been ignored. This research study is an effort to work economics of all reclamation techniques and suggest the most profitable methods for adoption.

PLAN OF WORK

Data concerning physical relationship of alternative methods and soil reclamation is available with Soil and Reclamation Section of the project. Cost and amount of amendments used for reclamation is also available. Economic analysis using present worth formula will be applied.

COMPLETION SCHEDULE

Report will be completed by the end of 1982-83.

AGRICULTURAL EXTENSION

Extension is an informal educational process which aims at teaching rural people how to improve their standard of living by their own efforts, through making a wise use of the natural resources at their disposal in better systems of farming and home making, for the benefit of the individual, the family, the community and the nation. Through the educational and service approach they are stimulated to make changes that result in more efficient production and marketing of farm products, conservation of natural resources, more comfortable living, improved health, and more satisfying family and community life. The extension section of the project is employing the known extension techniques to disseminate the latest farm technology to the farmers of the project area besides development and testing of new extension techniques. Specifically the programme cover the following:

A-EXTENSION ACTIVITIES

1. Demonstration plots in farmer's fields.
2. Agricultural schools.
3. Seed distribution scheme.
4. Farm libraries.
5. Introduction of improved implements.
6. Farmer's contact scheme.
7. Monthly circular.
8. Special survey.

B-PLANT PROTECTION

1. Adoption of other than chemical control measures.
2. Chemical control.
3. Demonstration of plant protection measures.

.....

A-DEMONSTRATION PLOTS IN FARMER'S FIELDS

The demonstration plots as detailed below will be laid out in farmer's fields to provide physical evidence in support of recommended practices.

Type of demonstration	No. of plots under				
	Sugarcane	Cotton	Rice	Wheat	Total
Maximum potential	10	10	20	20	60
Method of sowing	10	10	-	20	40
Irrigation scheduling	20	20	-	20	60
Total:-	40	40	20	60	160

Each of the maximum potential demonstration plot will be divided into two portions one to be sown by the extension staff applying all the departmental recommendations and the other by the concerned farmer according to his usual practice. The superiority of the recommended practice right in the farmer's own field would induce him and the adjoining farmers for its adoption. Research results of consumptive use study will be used for irrigation scheduling.

In addition to demonstration plots, demonstration blocks each extending over 4 to 25 acres will be developed. These blocks would ensure demonstration over a large area and would have both direct and indirect impact by increasing the percentage of area under improved farming.

A-2: AGRICULTURAL SCHOOLS

As an important extension tool, 19 agricultural schools already running in the under mentioned villages would continue functioning where lectures will be delivered by the Agri. Officer once every month on the farm operations to be carried out during the following month. Use of simple audio-visual aids at the monthly agricultural schools and other farmer's meetings, shall be utilized. These aids may be slides, charts, pictures, diagrams etc.

1. Chak No. 15 N.B.
2. Hazoorpur
3. Jagatpura
4. Nabi Shah Bala
5. Chak No. 10 M.L.
6. Chawa.
7. Khan Muhammad Wala
8. Thathi Walana
9. Chakramdas
10. Chak 6 M.L.
11. Jewanwal
12. Rattokala
13. Wadhan
14. Miani
15. Dewanpur
16. Pind Mokko
17. Sardarpur
18. Bhera
19. Chak No. 7 M.L.

A-3: SEED DISTRIBUTION SCHEME

Under this scheme, seed of improved varieties of major crops will be purchased from various agencies which will be issued to the farmers free of cost at the time of sowing and then taken back at harvest with 10% extra to cover shortage, handling and storage costs.

Seed of the improved varieties shall also be multiplied at the farm of some of the progressive farmers of the project. The seed of the newly evolved promising varieties of cotton, rice and wheat is proposed to be distributed during the year.

In order to ensure purity of seed of improved varieties, extension staff shall make occasional visit of the standing crops of these varieties in their respective areas, and where ever needed they would induce the concerned farmers to remove weeds and off plants.

A-4: FARM LIBRARIES

There are 20 farm libraries established within the project area. A farm library is a collection of booklets, leaflets, brochers, pamphlets journals and other periodicals which are received mostly free of cost from the publishers. Farm library is housed, at a convenient place like village shop, SCARP tubewell, etc. which ever is within easy reach of the farmers. Efforts would be continued to equip these libraries with more of free as well as priced literature during the year from the following agencies:

i. Department of Agriculture, Punjab.
ii. University of Agriculture, Faisalabad.
iii. Co-operative Department.
iv. Animal Husbandry Department.
v. Agricultural Development Bank of Pakistan.
vi. Private Firms like, PSO, Agmore, Jaffar Brothers, Ciba Geigy, etc.

Regular additions of the following periodicals to these libraries could continue.

i. Zarri Digest.
ii. Shaoor-i-Nau.
iii. Zaraat Nama.
iv. Dehi Razakar.

A-5: INTRODUCTION OF IMPROVED IMPLEMENTS

Four sets of improved implements, four tractor drawn Rabi Drills and one scraper, one deep tiller, one disc plough, one disc harrow have already been purchased. To popularise these equipments, practical demonstrations shall be held in the demonstration plots. Such demonstrations will also continue at the farmer's gatherings and regular agricultural schools. In this connection feasibility of holding farmer's days/Field Days, which are known to be very effective extension method, shall be explored.

A-6: FARMERS CONTACT SCHEME

This extension technique has been modified in order to make it more effective and useful. Under the modified version, each Field Assistant will select 30 farmers/deras in his area and will contact five farmers on alternative day. Thus each field assistant will contact 30 farmers in a fortnight and 600 farmers shall be contacted by all the twenty Field Assistants each month. If there were other pressing engagements, they could even reduce the visit once each month. Bench mark survey of all the selected farmers will be conducted at the time of selection to document the level of adoption of improved farming technology by each farmer.

A-7: MONTHLY CIRCULAR

The publication of a monthly circular, "Aeen-e-Nau" would be continued for distribution to the project cultivators. It would contain recommendations and other details on current operations of agricultural interest. Efforts would also be made to make this circular more popular.

A-8: SPECIAL SURVEY

The extension staff will also undertake crop cutting surveys to ascertain the impact of its own activities and that of other facilities provided by the project. Statistical technique will be employed for the selection of fields for yield estimation. Two marla plots will then be harvested in each field for all major crops.

In order to estimate the impact of extension activities, yield estimation of crops like cotton, sugarcane, rice, maize, fodder, wheat,

berseem would be carried out. Eighty plots of each crop, spread all over the project will be selected and harvested. This survey is being conducted on regular basis since 1965.

PROCEDURE FOR SELECTION OF SAMPLING UNITS FOR YIELD ESTIMATION SURVEY

Perennial, Non-perennial and Un-commanded Areas

In the "murabba bandi" areas of perennial and non-perennial strata, the following procedure for selection of sample unit will be adopted.

1. Collect outlet-wise area under crop i.e. cropped area during the previous year.
2. Collect outlet-wise culturable area i.e. C.A.
3. Compute ratio of cropped area to culturable area (per 1,000)
4. Arrange the ratios in ascending order.
5. Make the frequency table as under:

Cropping of ratios	No. of outlets	Cropped area of outlets	% cropped area
Less than 50	-	-	-
50-100	-	-	-
100-150	-	-	-
150 and above	-	-	-

6. Determine the number of outlets to be selected according to the percentage given under the column "% cropped area" for each grouping ratio, the total number of sampling units already determined in the ratio of 2:1 for perennial and non-perennial strata.
7. Select outlets by simple random method for each group. An outlet has a chance to be select more than once.
8. Consult Chak Bandi Maps and select a square for each outlet by random.
9. Select one killa (acre) number by random for each selected square. Move to the next killa if the crop is not found there.
10. Harvest a plot of 16½'x33' according to the procedure laid down by the Agriculture Department.

Non-perennial and Un-commanded Areas

In the non-perennial and uncommanded areas where there is no 'murrabba bandi' the following procedure will be adopted.

1. Substitute tubewell in place of outlet in the above procedure.
2. Prepare a tree map of all fields under the crop for each tubewell by walking down stream and recording first the fields to the right side and then to the left.
3. Select a field by random from such a tree map for a tubewell.
4. Harvest a plot of 16½x33' from the selected field according to the standard procedure.

B-PLANT PROTECTION

B-1:ADOPTION OF OTHER THAN CHEMICAL CONTROL MEASURES

The chemical method of controlling insect pests and diseases is not only sure but quick. Still,according to an estimate 65% of the pest incidence and disease infestations can be avoided by physical, cultural and biological control methods.Many of these methods are instance in case of cultural control measures nothing extra is involved in carrying out proper ploughing,hoeing,irrigation,manuring, removal of infested plants or parts thereof,removing of weeds and stubbles,and the adoption of "clean cultivation". Efforts would be made to induce the farmers for timely execution of these operations.

B-2:CHEMICAL CONTROL

Efforts will be made to ensure adequate and regular supply of insecticides for use of the project farmers.In the field a gange type arrangement will be made to tackle the pest problems effectively. Full cost of insecticides/pesticides will be recovered in advance before spraying.Technical advice and equipment will be provided free of cost.

B-3:DEMONSTRATION OF PLANT PROTECTION MEASURES

To make the farmers self reliant in carrying out the plant protection operations,their training is very essential.The extension staff will continue to bridge this gap by laying out demonstration plots and by arranging talks and lectures in farmers gatherings and

regular agricultural schools. The evenues of farm libraries would also be fully availed of for this purpose.

C-ANNUAL TARGETS

Activity	Targets
1. Demonstration plots	160
2. Agri. school lectures	150
3. Seed distribution	100(acres)
4. Contacts with project farmers:	
a) Officers contacts	600
b) Field Assistants	4800
5. Monthly circular	12
6. Yield estimation survey:	
a) Cotton	104
b) Rice	104
c) Sugarcane	104
d) Wheat	104
e) Fodder crops	104
7. Plant protection	
a) Garden	500(acres)
b) Crop spraying	500(acres)
8. Eradication of weeds	2000(acres)
9. Removal of stubbles of cotton, rice and sugarcane.	5000(acres)
10. Staff refresher courses	12

D-RESEARCH

Study No.1: Integrated Development Of Watercourse Command Area At MN-93

The watercourse has been improved with the participation of farmers. Cleaning and maintenance of farmers branches is in progress. Basic data regarding crop varieties and inputs being used has been collected. Crop water requirements on the basis of consumptive use requirements has been worked out. Irrigation advisory service has been started to increase the cropping intensity to 150%. Dissemination to improve technology on pattern of T&V has been initiated to increase the crop yield. The impact of integrated efforts will be evaluated on annual basis in terms of over all increase in production.

Study No.2: Package Application of T&V, Water Management And Soil Reclamation On Crop Yields.

Objectives:

* To measure the effect of three packages of extension technology for the improvement of crop yield.
* To best utilize these packages of technology alone and in combination and to compare which one is appropriate under project conditions.

PLAN OF WORK

Administratively, the Mona Project area is divided into four sections, each headed by a Jr. Agri. Officer Extension. Each Jr. Agri. Officer has selected four watercourses in his area where these packages will be applied in the following manner.

i. Treatments = 4

a. Control
b. T&V
c. T&V + Water Management
d. T&V + Water Management + Soil Reclamation

ii. Replications = 4

iii. Total No. of watercourses = 4x4=16

The treatments will be randomly applied to 16 selected watercourses. Dissemination of improved technology on the pattern of T&V will include advice on crop production only. As a first step, basic data regarding crop varieties, irrigation and agronomic practices, fertilizer dose, plant protection and crop yield is being collected.

Water Management will cover watercourse improvement/cleaning and maintenance, plus advice on precision land levelling and efficient use of water. Reclamation part will also cover advice and motivation on reclamation of salt affected land.

To compare the effectiveness of various packages of technology with the pre-programme conditions the following data will be collected from each crop season during the study period.

i. Cropped area, cropping pattern and cropping intensity.
ii. Crop varieties, No. of irrigations, fertilizer, plant protection, and crop yields.
iii. Watercourse conveyance losses in improved and un-improved watercourses.

COMPLETION SCHEDULE

The study will be completed in three years time i.e. July, 1982 to June, 1985.

HYDROLOGY AND WATER MANAGEMENT

Pakistan has deficient water supplies for a fully productive agriculture. Inadequate irrigation supply is one of the main factors responsible for low crop yield. Normally a flow rate of one cusec is being supplied to over 300 acres, which is totally insufficient for peak daily requirements even if only half the land is put under crops. Measurements made during the past few years have shown that substantial water supply can be obtained through improvement of over 89,000 watercourses in the country. Average loss of 45% during conveyance from Mogha to the field and 30% during field application indicates a huge loss of this scarce resource. This gives an overall irrigation efficiencies of about 38% from the watercourse head to the crop root zone. It has been estimated that at the present level of irrigation system management, about 35 MAF of water is lost in watercourse delivery and another 15 MAF is lost at the farm which further aggravates the problem of waterlogging and salinity. Although a colossal loss yet it identified a huge potential for delivering more water to the fields. Previous work has shown that supply of water to the farmers fields can almost be doubled by improving the delivery efficiency of farm channels and agricultural production can be increased manifold by adopting improved land and water management technology.

Efforts are being made to prevent salinity and waterlogging in the country. These efforts which are mostly curative in nature, are being concentrated in reclaiming the soils already gone waterlogged and saline. For this purpose a large number of tubewells have been installed which help in lowering the water-table. But once the water table has been lowered, it should not be allowed to built up again, if we want a permanent solution of this problem. This can be done by improving our prevalent irrigation practices.

Mona Project which has been assigned the basic responsibility of research for better use of available land and water resources,

successfully developed solution of many problems facing irrigated agriculture. These efforts need to be continued to further improve the farm technology for increased crop production. Hydrology and water management section plans to undertake the following studies during the year 1982-83. Some of these studies will be in continuation of previous research efforts for their logical conclusions while new studies have been included to tackle problems encountered during research and investigations. The programme covers the following 6 studies:

1. Evaluation of various irrigation methods(Study No.1 of PC-I).
2. Re-use of drainage water for crop production(Study No.10 of PC-I).
3. Feasibility study on integrated development of watercourse command area(Study No.11 of PC-I).
4. Use of Solar powered micro pumps for irrigation(Study No.35 of PC-I).
5. Skimming multiple well point type tubewells(Study No.36 of PC-I).
6. Low head jet pump for improved irrigation in SCARP Areas, Study No.37 of PC-I).

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Study No.1: Evaluation Of Various Irrigation Methods

OBJECTIVE

* Determination of water application efficiencies under various irrigation methods and feasibilities of their adoption under local conditions.

BACKGROUND

Extensive research efforts made in the field of irrigation have resulted in better understanding of water,soil and plant relationship, generally termed as irrigation management. As such under and over-irrigation may impair the productivity of soil and consequently the crop yields,the knowledge of water management at farm level helps look for suitable irrigation methods,to suit the specific field conditions.The common irrigation application methods are:

i. Flooding borders and check basins,thus wetting the ground surface.

ii. Furrows and corrugations, in which soil is wetted partly.

iii. Sprinkler application of water on the pattern of rainfall.

iv. Trickle/drip, whereby water is delivered only close to the well-spaced plants at low pressure through on ooz-out mechanism(emitters).

v. Sub-surface irrigation, in which water is made available in root zone by sub-surface saturation.

The main purpose of irrigation is to replenish the soil moisture in the root zone. To achieve the objective, any technique adopted to apply a least possible amount of water required to bring the root zone upto field capacity is considered most appropriate and efficient irrigation method. However, the applicability of various irrigation methods is subjected to the specific field conditions, such as soil texture and structure, available quantity of irrigation water, cultural practices, technical know-how available, economic feasibility and financial capacity of the irrigator etc.

At present the command method of irrigation being practised on the flat Indus Basin fields is by controlled flooding i.e. level borders and check basins. The other known method is furrow irrigation which is mainly adopted for vegetable growing. In order to introduce the other, irrigation methods, it is necessary to test and evaluate these for the degree of efficiency which can be achieved. This study will also help to know the comparative cost, technical know-how for proper operation and recommendations for any modifications if required, for their applicability under local conditions.

PLAN OF WORK

For evaluating irrigation methods, a number of experimental locations will be selected within the project area. At each place, provision will be made for practicing two or more methods at a time under identical soil, topographic and other related specific conditions. Data required to determine the relative water application efficiency and degree of uniform distribution is given as under:

i. Amount of water applied at the time of irrigation.

ii. Soil moisture requirement at the time of irrigation.

iii. Topography of the ground surface.

iv. Precise information about the advance and recession of ponded irrigation water to determine the opportunity time required for the infiltration of the water applied in the borders of check basins,etc.

v. Infiltration rate of the soils to be irrigated.

The above data will be utilized for developing the design criteria of various systems.Moreover for economic evaluation of each system information about the installation and operating cost will also be collected.

Study No.2: Re-use Of Drainage Water For Crop Production

OBJECTIVE

* Design of an appropriate system for re-use of drainage water for irrigation purposes.

BACKGROUND

For an agricultural country like Pakistan,where precipitation is low,hardly any agricultural activity could have survived without artificial application of irrigation water.In this part of the sub-continent,during the last one hundred years about 34 millions acres of land has been brought under intensive irrigation by making available a fabulous irrigation canal net work.Because of the introduction of this new development,the artificial recharge to the aquifer accelerated rising of water table.

The phenomenon of rising water table and increasing salinity has become a major constraint in agricultural development.In order to combat the twin menace of waterlogging and salinity during the last two decades,facility of vertical drainage by installing tubewells has been provided over more than 3 million acres of land.However, where the saline water has been pushed quite close to the surface or fresh ground water layer overlying the saline water is too thin,the tubewell drainage does not seem to be an attractive,successful and economical alternative.It is therefore,essential to look for other sub-surface drainage options such as deep open drains and tile drainage system which can also be put into use handling the surface run-off.

Many countries such as USA,Holland,Germany,Egypt and Iraq have been using this form of horizontal drainage for a long time.In Pakistan there is also a dire need and wide scope for such drainage In view of the large extent of the area which will require integrated surface and sub-surface drainage either in the form of deep open drains or buried tiles, it is proposed to take up the research programme on pilot basis.This study is very essential as there exists hardly any experience in this field and hence for application and execution of the mentioned horizontal drainage it is an appropriat time to search for basic information about the limits of the design parameters.Similarly research efforts are also required for testing different design techniques based on certain assumptions,such as steady state or transient conditions.As almost all such design procedures were developed under different set of conditions,the study about their relative applicability in this part of the world can be considered,perhaps,the most appropriate beginning. Moreover,as the horizontal drainage does not have the problem of upward movement of saline fresh water interface.The possibility can also be searched out for the reuse of relative fresh water,skimmed from the top layer of the aquifer.

PLAN OF WORK

For designing the horizontal sub-surface drainage system,the primary information required to fit in either in steady state or transient formula,is about variables like drainage medium,drainage coefficient,depth of soil layers,vertical and horizontal permeability, surface topography,drainable surplus,depth of water table,depth and spacing between open deep drains of the lines etc.

Field data will be collected pertaining to the above mentioned variables,including ground water contour maps,topographic map,profile of flow patterns,soil investigations,sub-soil exploration ground-water investigation,irrigation practices and requirements etc.The information collected will be utilized for designing the proper spacing and depth of drains.However to determine the applicability of various design procedures,based on steady state and trasient conditions at

selected locations will be tested. Later arrangements will be made for constant monitoring of each design procedure adopted. Moreover, information about the quality of drained water will also be gathered for its possible reuse/recirculation either alone or by mixing with available canal supplies. In order to test the comparative cost, applicability and desirability of different tile drainage materials such as burnt clay, concrete and PVC are proposed to be tried.

This study was included in the annual research programme for the year 1981-82 but could not be initiated due to the non-availability of funds. The study will be taken up during the current year.

Study No. 3: Feasibility Study On Integrated Development Of Watercourse Command Area.

This study was included in the Annual Programme of year 1980-81 but because of non-availability of funds, it could not be started as scheduled. During the year 1981-82 the study was initiated and improvement including lining and earthen renovation of various optimum length of watercourse system was completed. This study will be continued during the year 1982-83

OBJECTIVE

* To evaluate the quantitative impact of farm land, water and crop management technology on crop production.

PLAN OF WORK

In order to demonstrate the benefits which can accrue from application of farm-land-water use technology on watercourse command area having 400 to 600 acres will be selected in the project area. Following multi-disciplinary activities will be applied to evaluate their potential impact on crop production.

i. Improvement, including lining, earthen renovation and cleaning and maintenance etc. of various optimum lengths of the watercourse system on the technology developed in Mona.

ii. Land levelling and land-re-shaping of the command area to improve the application efficiencies and distribution of water.

iii. Estimation of crop water requirements and their comparison with present supplies to identify the shortages and surpluses.

iv. Construction of storage tanks for storing surplus supplies and installation of fractional wells at suitable points to meet the crop water deficiency.

v. Dissemination of improved technology on the pattern of "T&V" system.

vi. Establishment of demonstration plots(4-6 acres in size) at head, middle and tail to demonstrate the impact of improved farm technology on crop production.

vii. Providing irrigation advisory service to the farmers.

viii. Demonstration of soil reclamation, technology to the farmers and inducing its application.

Study No.4: Use Of Solar Powered Micro Pumps For Irrigation

OBJECTIVE

* To test and evaluate the feasibility of solar powered micro-pumps for low lift irrigation in Pakistan.

BACKGROUND

The uncommanded patches of land within watercourse command areas shallow wells, useable quality of water flowing in the surface drains and flood channels all offer an excellent opportunity for the application of low lift irrigation. The traditional way of lifting the water has been "Jhalars" and persian wheels driven by animal power. The other conventional means for lifting the water are tubewells. The first alternative being tedious, time consuming and uneconomical, has become almost obsolete. The second option, in the light of energy crisis and price hike has gone out of financial reach of the small farmers. With the nature of technology presently available few small farmers have been able to invest profitably in private tubewells and benefit from vast ground water resources. However, the recent development about the use of solar energey for running the low lift micro-pumps present an attractive alternative for small farmers. Moreover, considering the clear weather during critical period (when short

irrigation supplies occur) the use of solar powered pumps can play important role for the uplift of the majority of agricultural community.

PLAN OF WORK

The testing of solar low lift micro-pumps is only possible at locations where water is at shallow depth and of good quality. These devices are designed for a lift of 6 to 12 ft. and their capacity ranges from 3.5 to 10.5 acre inches per week. As the discharge varies from 0.04 to 0.12 cusecs, it seems necessary to construct storage tanks for collection at least week-long discharge of the solar pumps. Later on, to achieve a required working head or irrigation water over the field storage tank can be operated to divert water at required flow rate for an efficient field application.

It is proposed to install five sun pump's of SP-I type at suitable locations in the project area. Two of the pumps will be deployed to lift water from drains for re-use for irrigation purposes. The remaining three pumps will be used to skim fresh water from shallow wells in skimming well experiments being carried out around Sakesar village, in the project area. The proposed study would provide basis for analysis of the field efficiency and practical utility of pumps for low lift irrigation on large scale, both in private and public sector.

This study was included in the annual research programme of the year 1981-82. The study could not be initiated because the solar powered micro pumps could not be arranged from the local agencies. The Agricultural Development Bank is dealing with Solar pumps who has been contacted recently in this regard. The Solar micro powered pumps as and when arranged through the Agri. Development Bank will be installed and tested under this study in the Project area during the year 1982-83.

Study No. 5: Skimming Multiple Well Point Type Tubewells

OBJECTIVES

* To develop type and depth of tubewells and test of pumping which will produce the maximum discharge of good quality water at the least cost, for various aquifer properties and fresh water thickness.
* To test the feasibility of multiple well point arrangement for skimming the top of this layer of fresh water, overlying the saline water in the aquifer.

BACKGROUND

The SCARP programme, which was initiated with the objective to lower the water table and to increase the irrigation supplies has been found quite effective in the areas where the fresh water layer (overlying the saline water) in the aquifer is at least 500 feet thick. However, in areas where the thickness of fresh water layer was between 200 and 500 ft. the quality of pumped water has been deteriorating as due to continuous pumping more of the saline water is moving up into the vicinity of the pump. In such areas many tubewells have been closed to avoid damage to crops and land.

In areas where the thickness of the fresh water layer is less than 200 ft. the water produced by the common size of tubewell is often saline. In such areas either the SCARP programme has not been started or the installed tubewells have not been helpful in augmenting the irrigation supplies.

Limited studies carried out at Mona Project have shown that in such area (fresh water layer less than 200 ft. thick), good irrigation water can be extracted without disturbing the salty water with properly designed shallow, low discharged skimming wells. Only two types of skimming tubewells namely (i) Multistrainer tubewell and (ii) compound tubewells were tested at the Project. Both these experiments, although not very conclusive, have provided useful information which can form basis to plan future experimentation and development of skimming wells which have great potential for areas with thinner layer of fresh water (50-200 ft). There is, therefore, a definite need to continue further investigations on skimming wells

to determine the missing links and limits of parameters to ensure their successful operation.

PLAN OF WORK

The plan of work involves two types of experiments to achieve the above objectives. Each experiment will be carried out at least at three different locations in the project areas for meaningful conclusions.

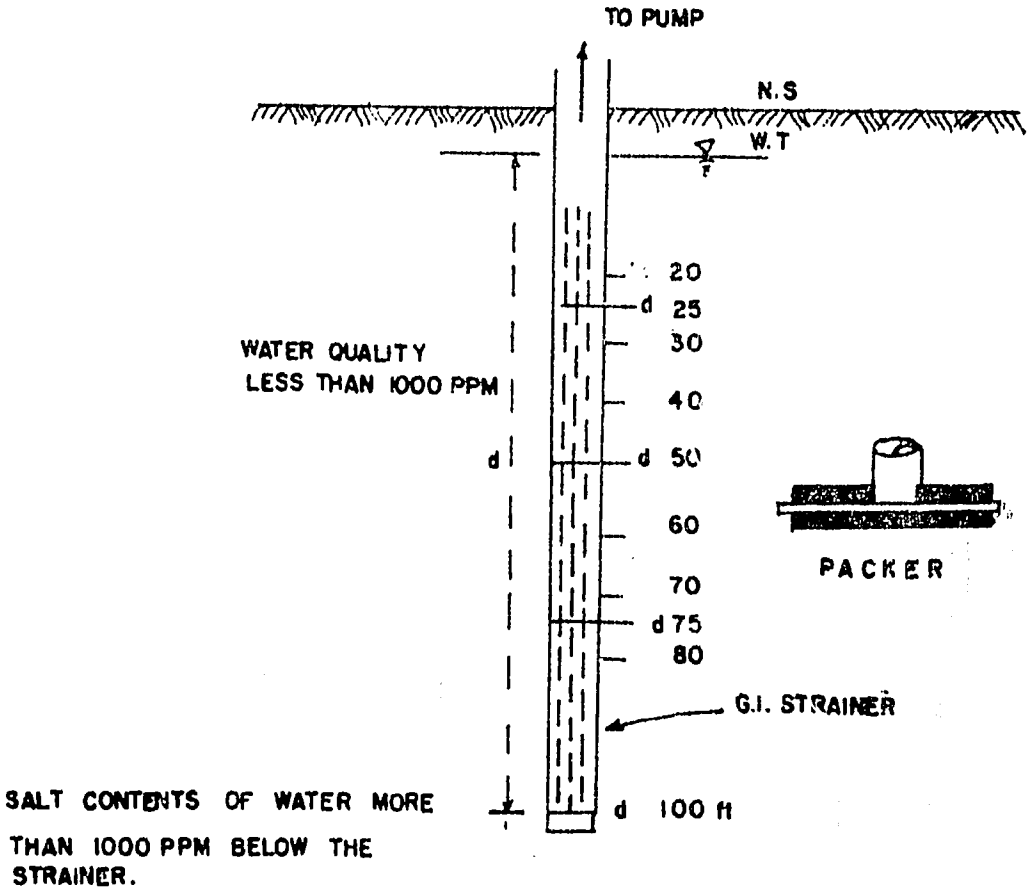
Experiment No. 1

The quality of skimmed water depends upon the penetration of tubewell strainer into the water bearing formation of a given quality, rate of pumping and time for which it is operated. This experiment has, therefore, been planned to determine the optimum penetration of tubewell strainer to skimm water of given quality during a known pumping period.

In order to check both these parameters related to the penetration of strainers in water bearing formation and operating time, it is suggested to search a site which has a saline ground water of a given quality lying at a depth say 100 feet. Let the quality at this depth be 1000 ppm with salinity increasing with depth.

A tubewell will be installed with strainer starting about 5 feet below water table and ending at the saline water interface. It will be so arranged that any length of strainer can be cut off by fixing two iron plates with rubber insertion as shown in Fig. 1. It will be forced to any desired depth in the strainer. Supposing it is fixed cutting off 75% and 50% and 25% length of strainer, the tubewell at each setting will be operated continuously for several days. The output depression head and the water quality will be observed continuously. The studies will indicate the safe length of penetration of the strainer and continuous pumping time period, after which the quality changes.

FIG_ 1.



SINGLE SKIMMING WELL WITH PACKER ARRANGEMENT

The installation of two tubewell under this study has been completed during the year 1980-82 and will be replicated at two more sites during 1982-83. For site selection the test drilling has been carried out and bench mark data collected for installation of above mentioned tubewell.

Experiment No.2

This experiment involves the use of well points instead of relatively longer strainer(s) for skimming fresh water. The tentative arrangement is shown in Fig.2.

The well point arrangement appears suitable for skimming maximum fresh water from relatively thin layers without disturbing the underlying salty water.

Under this study installation of multi-strainer tubewells have been completed at tubewell SHP-26, SHP-20, MN-116 and Ground Water Management Site-II. The tubewell installed at SHP-26 comprises five well points each 31 ft. deep, having 16 feet blind pipe and 16' of strainer, while installations at tubewell SHP-20, MN-116 and GWMR Site-II include 16' blind pipe and 3' strainer at each site. This study will continue during next year to find the effect of pumping water on the position of interface with these pumping arrangements.

Study No.6: Low Head Jet Pump For Improved Irrigation In SCARP Areas.

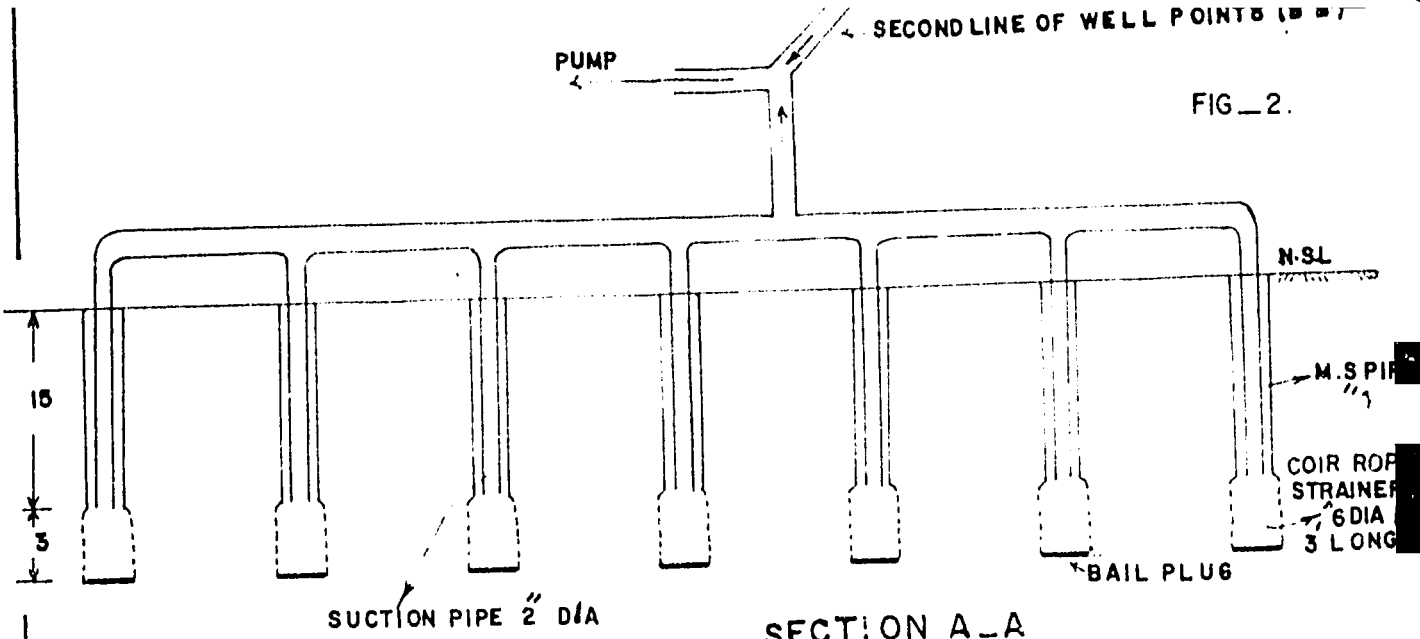
OBJECTIVES

* To determine the optimum design parameters for efficient working of low head jet pump.
* To test the use of different materials for fabricating various elements of the jet pump.
* To test the performance of low head jet pump under different conditions, such as the case where tubewell water is bifurcated to supplement the supplies of two separate watercourses.

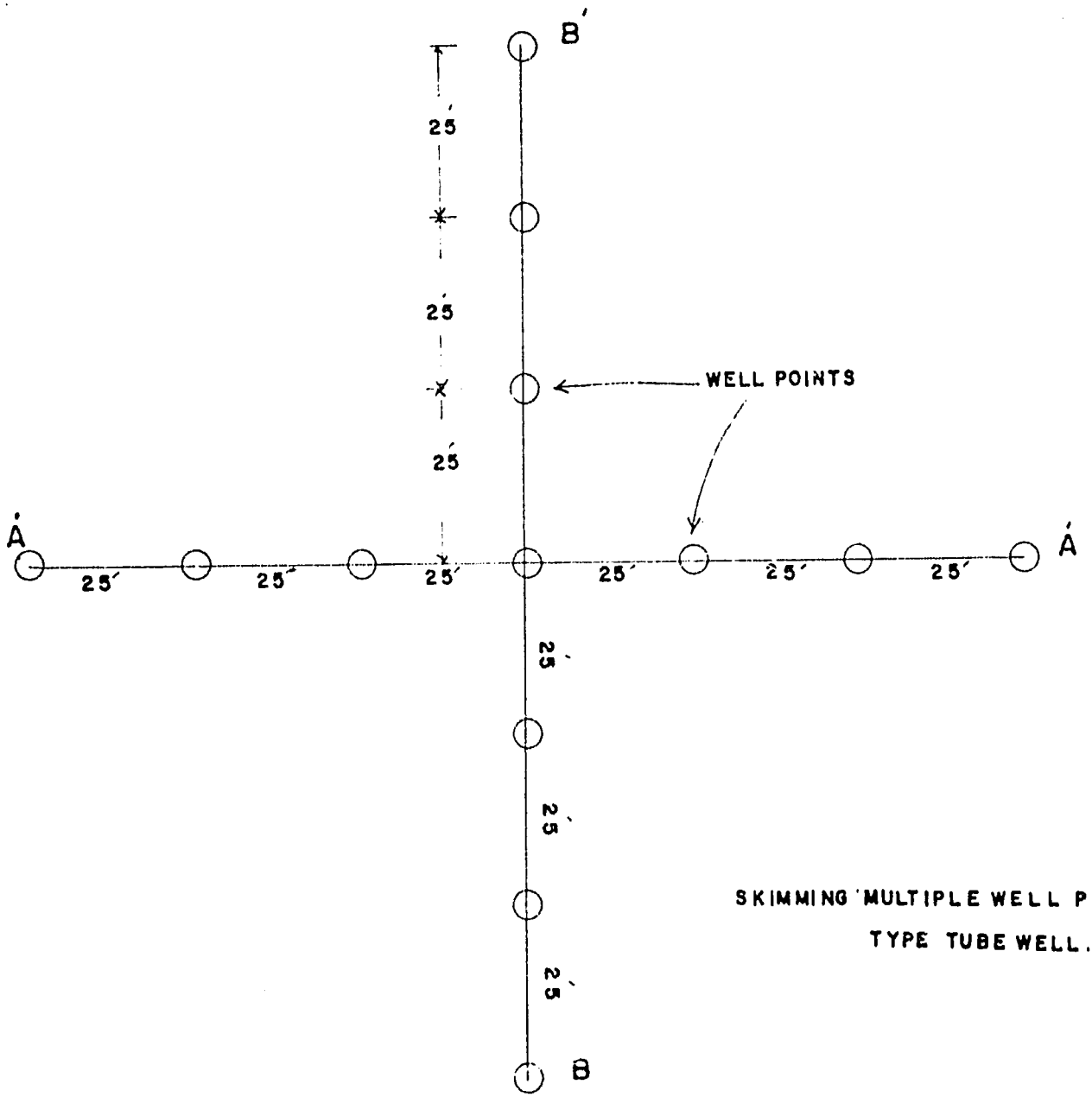
BACKGROUND

Submergence of canal outlets is a common problem in SCARP areas. A number of reasons, such as choking of watercourse due to accumulation of silt and growth of vegetation, back effect of tubewell water, the practice of forbed irrigation of uncommanded area, etc. are responsible

FIG_2.



SECTION A_A



SKIMMING MULTIPLE WELL POINT TYPE TUBE WELL.

PLAN

for this state of affairs. The problem is obviously more severe in SCARP areas where due to rise of water level in the watercourse, with the addition of tubewell water, the outlet no more remains modular and thus fails to draw the location canal supply. The problem was indentified during research at Mona Project where it was found that in some cases the submergence was so severe that farmers were even losing a part of their tubewell water which was going back into the distributory. The submergence problem does not only cause reduction in the authorized canal supply but the quality of the mixed water (canal+tubewell) is also affected.

Having identified the problem, efforts were made at Mona project to develop methods to eliminate the mogha submergence so as to ensure authorised canal supply and maintain the desired quality of mixed water. In the begining it was assumed that the process of watercourse improvement will help eliminate the problem. However, it was found that although watercourse improvement helps reduce the submergence to some extent, the problem could not be eliminated entirely. Efforts were therefore, directed to find out ways and means to achieve efficient mixing of tubewell and canal water to eliminate the back water effect of the combined flow which causes submergence of the mogha, After a number of trials a device named "Low Head Jet Pump" was successfully developed and tested to overcome the problem. In this device the energy available in the form of hydraulic head at the tubewell is utilized to lift water in the watercourse which eliminates submergence of outlet and also helps to irrigate higher fields. This device has been successfully installed on six project tubewells where outlet submergence has been eliminated and authorized canal supply restored to the farmers for the first time since the installation of the tubewells.

PLAN OF WORK

As the "Low Head Jet Pump" described above, has the potential for an immediate and wider application on SCARP tubewells, further research is essential to determine its design parameters, improve

upon its design to make it more efficient and to make it cost-effective by using cheaper material for its construction.This study was included in the programme for 1980-82,but only 6 out of 10 proposed jet pumps could be installed due to paucity of funds.It is,therefore, proposed to continue the installation of the device on project tube-wells during the current year to test its working under different conditions and to determine the following:

1.Optimum Design,Parameters:

a. To determine the optimum location of the jetting nozzle from the down-stream throat of the suction pipe.For this purpose three settings of nozzle at 3,6 and 9 inches will be tested.Efforts will also be made to develop some techniques for an adjustable arrangement to further optimise its setting through fractional distance.

b. Optimum length,diameters of both ends and shapes of edges etc of the nozzle will be determined.

c. Different lengths of suction pipe,mixing chamber diffuser suction will be tested.Possible effect on performance of the device with an without diffuser pipe will also be tested.

2.Fabrication Materials:

a. At present only re-inforced concrete is being used for fabrication of suction,mixing and diffuser sections. However,to further reduce the cost,the use of low cost arrangements will be tried.

b. So far steel has been used for the construction of jetting nozzle. Since steel is very costly,it is proposed to test concrete,PVC and fiber glass nozzles and compare their costs and performance.

3. The use of low head jet pump on tubewells whose water is bifurcated to augment the supplies of two different watercourses will be tested. In such cases the problem is little complicated. It is proposed that first the available energy of the tubewell water will be utilized to lift the canal supply of two outlets and then the mixed water will be divided proportionately through a specially designed diversion structure. This arrangement will be tried when the two outlets are submerged or when only one of them is submerged. This study will be continued during the year 1982-83. It is proposed to install Low Head Jet Pump on all the sites in the Project Area where the outlets are submerged.

STATISTICS

The statistics section is responsible to prepare plans and designs for various studies being conducted by Agronomy, Soil Reclamation and Water Management Sections.

The samples will be drawn for various surveys by using sampling techniques. The section will help all the disciplines to draw meaningful result from the research data. All the results will be analysed, interpreted and presented in form of graphs, charts and diagrams to make the comparison more comprehensive and revealing the results at a glance. Mathematical models will be established to show input-output relationships. The regression techniques will be used to find out the trend of various results obtained from various research studies.

Programming is another important assignment of this section. The research programme conducted at project generates quite a lot of data. The section will code the data and then frame the programme for computer analysis.

DATA COLLECTION

Statistics about the area under all crops by outlets and tubewells are collected. These will be consolidated by command of perennial, non-perennial canals and uncommanded areas at project levels. Cropping intensities are worked out for Kharif, Rabi season for each year. The acreage statistics is used to select the sample for crop cutting survey of major crops.

CROP CUTTING SURVEY

The crop cutting survey will be conducted in collaboration with Extension Section. The survey is carried out regularly each season to monitor trends of major crop yields.

Multistage stratified random sampling procedure will be adopted for the selection of sample fields. The project area has permanent feature of being divided into three distinct irrigation regions i.e., perennial, non-perennial and uncommanded. This division serves as stratification. From each command, outlets will be selected on the

basis of probability proportionate to the area under crop in the previous season. From each selected tubewell or watercourse, square and then field will be selected at random.

CROP PRODUCTION AND GROSS VALUE OF PRODUCTION

On the basis of crop yield obtained from crop cutting survey of major crops, agricultural production of the project will be worked out for the current year. Gross value of production based on the harvest prices will be worked out for annual report.

In addition to the above engagements, this section intends to undertake a new study explained below:

Study No. 1: Data Bank

OBJECTIVE

* To consolidate and preserve research data in original form for future use and reference.

BACKGROUND

All research sections of the project provide data to statistics section for analysis. After statistical analysis, mostly summary tables and results derived are given in the report. But original information which is a valuable asset is not preserved properly. Statistics Section has made a programme to establish a data bank. All research data will be consolidated and a report will be issued each year. This report will provide information to all research workers for future use.

PLAN OF WORK

Each section involved in research activities will be asked to provide upto date research information to statistics section. This research data will be properly organized and compiled into a report.

TUBEWELL OPERATION

Mona Reclamation Experimental Project is responsible for Operation and Maintenance of 290 tubewells, located in Mona Unit of SCARP-II(120), Shahpur SCARP Unit-I(161) and Saline Zone (9). on behalf of the Irrigation and Power Department, Government of Punjab. This responsibility has been assigned as a special case to facilitate execution of research at project. These tubewells are operated to lower the water table and to provide supplemental irrigation supplies for raising crop production and reclamation of salt affected soils. In addition to meeting the irrigation requirements of research studies, these tubewells will continue to be managed to achieve the following:

i. Compilation of complete record of the tubewell operations indicating hours lost due to different faults.

ii. Distribution of water supplies.

iii. Observation of sub soil water levels and draw-down of selected tubewells at regular intervals.

iv. Major and minor repairs of pumps and motors and replacement of defective pumps.

v. Treatment of deteriorated wells.

vi. Study the causes of corrosion and incrustation to find their remedies.

vii. Investigate methods to improve the operation of tubewells.

CHAPTER-III

WATER MANAGEMENT RESEARCH

This chapter deals with the research programme approved under a separate PC-I. The primary objective of this research is to develop techniques for efficient conveyance and utilization of water for raising agriculture production under varying project conditions. Specifically the scheme objectives are:

* Development and testing of various materials for watercourse rehabilitation and the feasibility of their adoption in Pakistan
* To measure and analyse the effects of improved water management practices on irrigation efficiencies, crop production, labour use and socio-economics factors.
* To measure the seepage and other losses from existing and improved watercourse systems.
* To develop, test and analyse procedures of watercourse system operation which will result in optimum use of water.

Research is proposed to be continued on 23 studies, 17 on-going and six new. One study under the head Water, Soil and Crop Management and two studies under Extension Of Water and Crop Management were completed during the year 1981-82. Subject-wise distribution of these studies is given as under:

Discipline	No. of studies		
	On-going	New	Total
Watercourse improvement and management	4	3	7
Water, soil and crop management	5	1	6
Extension of water and crop management	3	-	3
Economics of water and crop management	1	2	3
Ground water management	2	-	2
Tubewell operation, maintenance and management	2	-	2
	17	6	23

Entire cost of this PC-I is being financed by US-AID, During the initial two years of this PC-I, advisory services were also provided by US-AID for execution of work on proper lines. Due to termination of agreement between CSU and US-AID towards the middle of 1979, the advisors left the country and the gap could not be filled so far which caused some problems in the execution of research in the field of ground water management. Subject-wise detail of research plans alongwith the schedule of completion are given in the following pages.

WATERCOURSE IMPROVEMENT AND MANAGEMENT

Despite the fact that Pakistan has one of the World's largest irrigation system its yields rank among the World's lowest. The causes are, no doubt, numerous and include social, economic agronomic and engineering constraints. However, recent research implies that one of the contributing causes is the water less from watercourses.

Mona Reclamation Experimental Project has initiated a watercourse improvement research programme to reduce the water losses and to increase the delivery efficiencies. The work done so far has indicated that watercourse delivery losses could be substantially reduced depending upon the type of improvement applied. For example the construction of Line Channels' presents one obvious alternative, but costs involved are high. To develop new and economical techniques for watercourse improvement and 'On Farm Water Management' the following studies are proposed for the year 1981-82.

Study No. 1: Testing And Evaluation Of Improvement Techniques

OBJECTIVE

To continue testing and evaluation of various watercourse improvement techniques so as to refine them and establish their useful life and to develop new concepts more suited to conditions and resources of the farming community.

PLAN OF WORK

Studies are in progress on the effectiveness and cost of various low cost channel linings, installation of impervious cores in the banks and earthen improvement of watercourse. These studies will be continued and extended to include chemical soil sealants for seepage reduction. Channel sections treated with above techniques will be evaluated for loss rates, durability, succeptability to animal damage, erodability, resistance to cleaning damage and cost benefit ratio etc. During the year 4-5 watercourses will be lined/improved by using some of the following techniques and their costs and performance evaluated.

i. The brick masonry lining by incorporating the concept of "Broad bed watercourse" where possible, in rectangular and trapezoidal design with following bed treatment:

a) Brick masonry
b) Concrete lining
c) No. lining

ii. Concrete lining in bed and on slope in trapezoidal section.

iii. Precast lining with different sizes of R.C.C. slab, semi-circular clay pipe etc.

iv. Impervious cores burried in banks of the watercourse.

v. Polythlene sheet lining.

vi. Lining with P.V.C. sheets.

vii. Lining with cement sand plaster and chicken wire.

viii. Lining of watercourse with 9" thick mud masonry plastered with 1:3 C.M.

The lining will be applied mostly to the main watercourse or to branches in sandy soil using optimum length of lining scheme where the cost of lining is compared to the value of water saved. The authorized branches will be improved through earthen reconstruction while the farmer's branches will be improved using the technique of " Heavy Cleaning and Maintenance". Effect will be made to improve the entire system of the selected watercourse by rationally combining the various improvement alternatives described above, instead of confining to the improvement process to the main watercourse only.

Study No.2: Improved Structures Design

OBJECTIVE

To develop leak-proof, durable economical, light and easy handling irrigation control structure.

PLAN OF WORK

The design of check and turn out structures is an important component of watercourse improvement research. While good progress was made in designing leak proof nakkas in the last two years, there still exists sufficient scope for improvement as the nakkas lids tend to check during handling. In addition, nakkas lids are frequently difficult to place and remove.

Research will be continued to develop,economical, light durable and more leak-resistant and easy handling structures. For check structures main consideration will be given to avoid head-loss. Design improvement will also be extended to culverts,buffalo baths, drop structures etc.

Study No.3: Monitoring Of Improved Watercourses

OBJECTIVE

To determine the changes in loss rates and designed cross sections as a function oi time.

PLAN OF WORK

Presently little information is available about the duration and benefits attributed to the watercourse improvement.Therefore, monitoring of selected improved watercourse will be done once a year to determine the changes in the loss rates and designed cross-sections as a function of time.Comparison will also be made between the improved watercourses which have an organized cleaning and maintenance programme and those without such programme.The gathered information will be presented in the form of a technical report at the end of the year.

Study No.4: Equipment Development

OBJECTIVE

To develop equipment required for water management and agricultural farm machinery for small farmers.

PLAN OF WORK

Farm machinery,suited to small farmers like bullocks drawn harvestor,thresher etc.will be developed under this study during the current year.

Design of equipment like ditches,cut throat flume for a easy installation will be done.Installation of flumes in flowing channel is always difficult and time consuming job.Some attachments are proposed to be developed to allow rapid installation,levelling and changing flume elevation to alter the degree of submergence.Flumes with minimum head loss will also be developed for use in flate water courses.

Study No.5: Surface Drainage

OBJECTIVE

During the monsoon season excess water commonly damages crops and reduces yields of Kharif crops because of lack of surface drainage. Crop damage increases during years of heavy rains and such drainage has been specially observed in case of cotton,maize and kharif fodder in the Mona Project Area.

Research work is proposed to be conducted on a 12 acres farmer's land in the project area.The watercourses will be designed to use them for conveyance of water to the fields and drains to remove the excessive water if required.

Study No.6: Calibration Of Irrigation Control Structures/Measurement Devices.

OBJECTIVE

The hydraulic calibration tank will be used to achieve the following:

i. The volument ric calibration of water measuring devices such as flumes,flow meters,weirs,orifices etc.

ii. Measurement of friction head loss and flow characteristic through culverts,checks and outlet structures and constructed channels of all types.

PLAN OF WORK

Accurate measurement of flowing irrigation water in watercourses is essential to document conveyance losses and to prepared cropping plans and irrigation schedules for its efficient utilization. The hydraulic tank constructed at the project will be used to calibrate various types of structures and water measuring devices.

Study No.7: Development Of Non-conventional Energy Resources For Rural Areas.

OBJECTIVE

To improve design and carry out research on Bio-gas plant for evolving,efficient,durable economical and reliable unit for common use in the rural area of Mona Project.

PLAN OF WORK

Bio-gas has been heavily promoted throughout 1970s as a major break through in energy and food producing technology in the Asian-pacific region. The main stimulus for this thinking was the Chinese bio-gas programme, which is, by any standard impressive. By 1979 there were reported to be 7 million bio-gas digesters in China with a target of 20 million by 1985.

Energy needs of the rural areas of Pakistan are being met by non-commercial energy resources like animal dung, wood, charcoal, farm waste and to some extend by Kerosene oil. The burning of animal dung which if added to the soil would increase the productivity of the farm considerably, is a national loss. It has been estimated that more than 25% animal dung is wasted by brning for cooking meals etc. in irrigated areas whereas in rainfed areas almost 50% animal dung is burnt and wasted. In areas where fire wood is burnt for fuel, the percentage of erosion is increasing at a very high rate due to decreased afforestation and consequently removal of top soil and decreased crop yield.

Bio-gas is a combustible gas evolved from organic matter like animal dung, chicken dropping, animal and farm waste, green grasses, and fallen leaves by fermentation. The main component of Bio-gas(Gober Ga is methane (CH_4) which is about 60-70% the other contents being carbon dioxide (CO_2) alongwith traces of Hydrogen Sulphide(HS_2), Nitrogen (N), Hydrogen (H_2) and Carbon Monoxide (CO). Bio-gas can be used for burning, lighting, poultry hatching and running engines etc.

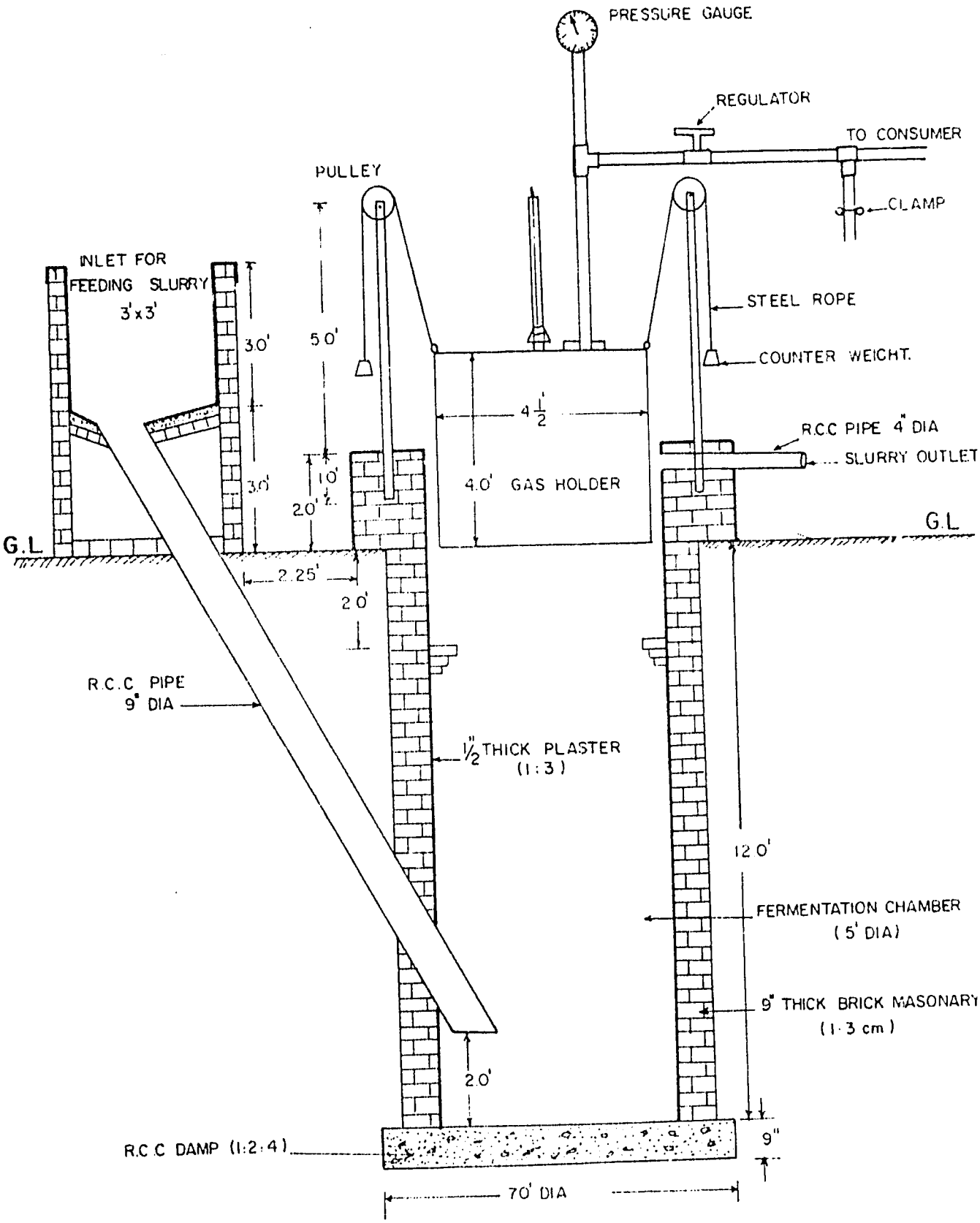
This study will help in saving valuable foreign exchange of the nation which is utilized for the import of oil. During the process of anaerobic digestion or fermentation, the bacteria become more active and the quality of fermented slurry is improved by adding three times the quantity of Nitrogen in the animal dung. Thus, the quality of manure coming through the outlet of the plant is improved three times of ordinary farm yard manure. The Bio-gas plant, if properly maintained remains in good serviceable condition for a long period whereas the recurring expenses on the plant are almost negligible.

It is proposed to construct bio-gas plants with different design parameter in the project area during the year 1982-83. Research activities will be focused to find new materials for providing reliable supply of biogas. Presently the animal waste is being utilized for the production of bio-gas. Some recent developments in this field have indicated that few water plants may be used as a substitute of animal waste for producing sufficient amount of gas for domestic use. The other aspects of this technology which need to be tested in the establishment of fish ponds, fed from slurry produced from the biogas plant. A report on final recommended design alongwith its evaluation will be prepared and distributed for its adoption on larger scale. The drawing of the Bio-gas plant is given in Fig. 3.

FIG _ 3.

TYPE DESIGN OF BIO GAS PLANT

Scale _ 1" = 3'



M Tariq/

WATER, SOIL AND CROP MANAGEMENT

Current levels of agricultural production in the Indus Basin Plain are low as compared to the production potential. This points to the need for the identification of major constraints responsible for the current state of affairs and a programme of continuous research to find their solutions under varying conditions. The approach followed at the project is to identify the constraints in consultation with the farmers so that the solutions sought are applicable under local conditions and are acceptable to the farmers. Improvement of watercourses has given the farmers a positive experience in cooperation with technicians and has given the technicians the essential credibility with the farmers. It is proposed to use this credibility to establish the type of partnership in research between the farmers and the technicians. The purpose of this partnership would be to obtain guidelines for adapting technology to the resources of the farmers and gaining his acceptance and to serve as a prototype of the relationship that can be formed between the technicians and the farmers in other situations where the technicians have gained the confidence of the farmers.

In the light of these guidelines, this programme has been prepared which will cover six studies, five on-going and one new.

Study No.1: Land And Water Use Capability Classification(S&R)

OBJECTIVE

There is a growing need to classify our soils according to their capability to produce more and also to list crop varieties and crop species suitable for different types of land and water. Suitability of a crop in an area depends very much on soil type, irrigation water quality, climate, drainage conditions, salinity/sodicity, insect pests, economic returns etc. Different crops respond differently to these conditions. For example, some crops can flourish better under saline and waterlogged conditions than others.

In order to make the efficient use of land and water resources, it is essential that choice of crops should be made on the basis of land capability and water quality. The objectives of this experiment are:

* To prepare land and water use capability classification scheme and list crop varieties and species suitable for a particular land capability class for sustained irrigated agriculture, to demonstrate suitability of various crops keeping in view the land capability and water quality adaptability.

METHODOLOGY

One farm of 3-4 hectares size have been selected in the Project Area. Farm has been surveyed and land capability classification map is being prepared to determine suitable cropping pattern both for rabi and kharif crop season. Presently, rice and kallar grass is being grown since July, 1980. This will be followed by wheat and alfalfa crops. This is being done to utilize the excess rain water and canal supply for effective application. The farmers are being convinced to grow these crops.

The soil samples from 0-30, 30-60, 60-90 and 90-120cm. depths are being collected for ECe and SAR analysis. Rainfall and crop yield data will also be collected for experiment evaluation.

TREND OF RESULTS

1-Kallar grass was successfully grown where ECe and SAR of soil was 27.0 and 80.5 respectively but rice crop failed under conditions where ECe and SAR of soil were 4.0 and 19.0 respectively.

COMPLETION SCHEDULE

The study started in kharif 1980 and is likely to be completed during 1983-84.

Study No.2: Stand Establishment On Salt Affected Soils(S&R)

OBJECTIVE

Different crops respond differently to soil salinity at various growth stages. In general, the plants are more sensitive to salinity at early growth stages. Soil salinity is one of the limiting factors for poor crop stand and the resultant low yield of crops in

Pakistan. If the salt concentration is minimized at early growth stages either by frequent irrigations or by adoption of various planting practices, the crop yields can be improved considerably.

The objective of the experiment is:

*To evaluate different planting practices on salt affected soils to establish proper crop stand.

PROCEDURE

The experiment is being carried out on moderately saline soil. The soil was first leached with water to bring the ECe of 0-30cm soil between 8 to 16 mmhos/cm. One hectare of medium textured soil was selected for this purpose. The following treatments are being tested.

Planting practices	3	i. Flat sowing ii. Double row bed. iii. Sloping bed.
Crop	1	Cotton
Replications	3	
Total No. of plots	=3x1x3=9	

Planting practices are laid out in the fields with the help of appropriate ridging implements. Soil samples were collected at the beginning of the experiment from 0-30, 30-60, and 60-90cm depths and analysed for ECe, SAR and soil texture. Subsequent soil sampling are done at various growth stages of the crop to observe area of salt accumulation on various beds and the effect of high salt concentration in plant germination, vegetative growth and yield.

TREND OF RESULTS

Cotton growth on slopping beds gave higher yield as compared to other treatments.

COMPLETION SCHEDULE

The experiment is in progress since Kharif 1981 and study will be completed during 1983-84.

Study No. 3: Use Of Saline Groundwater For Reclamation Of Saline Sodic Soils(S&R).

OBJECTIVE

In SCARP areas groundwater is being pumped on a large scale to lower water table and to augment the existing inadequate surface supplies for increasing crop production.

The disposal of saline water pumped in SCARPs poses a serious problem. The saline water needs to be disposed off either into rivers or into natural depressions through a well designed drainage system. This would require heavy investment. There is an other way to utilize saline water, for initial reclamation of medium to highly saline sodic soils because this water can flocculate soil particles, improve soil structure, and thus increase permeability of the soil which is the limiting factor for their reclamation. The purpose of this experiment is to study the possibility of using saline groundwater for the reclamation of saline sodic soil.

PROCEDURE

Two hectare of saline-sodic soil(ECe greater than 8.0 mm/cm and SAR greater than 30 have been selected under the command of the tubewells installed under groundwater management research programme. As a first step, the land was properly levelled and leached with saline groundwater from the experimental tubewell. The leaching is being carried out by applying frequent heavy irrigations. In between irrigations the land is allowed to dry upto field capacity. The leaching with groundwater will continue till the soil reached near equilibrium with the irrigation water i.e. there is no more appreciable reduction in ECe and SAR of the soil.

The following crop rotations are being tried;

1. Simple leaching-kallar grass.
2. Rice-alfalfa.

Two hectare field has been divided into two equal halves. One half of the plot will be under rice and the other half under kallar grass. Initial soil samples were taken from 0-15, 15-30, 30-60 , 60-90 and 90-120cm. depths before the start of the experiment and analysed for

ECe, SAR, soil texture, Subsequent soil sampling will be done after the harvest of each crop.

The evaluation of results will be made on the basis of soil, and crop data by applying different statistical techniques.

TREND OF RESULTS

*Kallar grass flourished well on a saline sodic soil with the application of saline ground-water but rice failed completely.

*As a preliminary, an infiltrometer study was carried out using 0,6,12,18,24,30 and 36 acre inches tubewell water for reclamation purposes. The results obtained are:

The pH of the soil dropped from 8.5 to 8.0, 8.6 to 8.1 and 8.7 to 8.1 at site 1,2 and 3 respectively with 30 acre inches of water applied.

*The ECe of soil decreased significantly with 6 acre inches of water application as compared to control. ECe of soil decreased from 60 to 8, 66 to 6 and 75 to 5 at site 1,2 and 3, respectively.

*SAR of soil decreased significantly with increase in depth of water.

COMPLETION SCHEDULE

The experiment is in progress since kharif 1979 and will be completed during 1982-83.

Study No.4: Methods Of Using Gypsum To Optimize Crop Production From Sodic Irrigation Water(S&R).

OBJECTIVE

Field investigations in Mona Project area have shown that the irrigation water quality remains questionable even after mixing with canal water. Haider et.al.1972 and Bashir et.al.1979 found that high sodium waters can be improved by gypsum application sufficient to bring the sodium levels of tubewell waters within safe limits for Agricultural use, but information on field scale is inadequate to demonstrate and popularise the commercial use of gypsum stone. The objectives of this study are:

* To evaluate the improvement in tubewell water quality by gypsum application and its effect on soil properties and crop yields.
* To work our its cost benefit ratio.

Treatments

a. Gypsum application and water	3	i. Pure tubewell water.
		ii. Tubewell water through gypsum bed.
		iii. Gypsum application to soil on water quality basis.
b. Crop rotation	1	(Wheat-rice)
c. Replications	3	
Total No. of plots	=3x1x3=9	

Tubewell MN-72: Tubewell water with SAR 12 and salinity 800 ppm is being passed through gypsum-stones to reduce SAR to 7.

Note: It is pointed out that in one of the control plots, first grade gypsum @ 100% GR of water was applied to compare it with powdered gypsum for economical reasons.

The soil samples were collected from 0-15, 15-30, 30-60 and 60-90cm depths for ECe, SAR, CEC, ESP and textural analysis. First wheat crop was grown in rabi 1979-80 and Rice during 1981. Pure tubewell water is used for irrigation. Subsequent soil sampling is done after each crop to monitor changes in soil properties. Data on crop yield, soil infiltration is also collected for experiment evaluation.

TREND OF RESULTS

Collected data indicate the decreasing trend in the infiltration rate of soil in control plots as compared with gypsum treated plots. Maximum yield of rice and wheat(grain) was obtained in plots where tubewell water through gypsum bed was applied.

COMPLETION SCHEDULE

1979-80 to 1982-83.

Study No. 5: Weed Control(Agronomy)

OBJECTIVE

Weeds compete with the crop plants for light, space irrigation water and plant nutrients for their growth. This results in reduction of crop yield to a considerable extent. This study will be undertaken to demonstrate various methods of controlling weeds, their impact on crop production and their relative economics.

PLAN OF WORK

The following weed control measures will be tested:

1. Hand weeding.
2. Mechanical weeding.
3. Chemical control by using available weedicides.

Research for controlling weeds by various chemicals will be carried out at Phullarwan Farm. However, demonstrations of the same will be arranged at some improved watercourses.

The implements for controlling the weed and weedicides will be purchased at project cost. Crop yield will be recorded and cost-benefit ratio for each method of controlling weeds will be compared.

TREND OF RESULTS

Weed control either chemically or mechanically gave higher yields over the weedy check. Dicuran for wheat and Gesapax combi for sugarcane were more efficient, gave better weed control and higher yields.

COMPLETION SCHEDULE

The study was started in 1978-79 on maize, wheat, rice and sugarcane. Research on rice and wheat crop has been completed with the previous set of weedicides. Some new chemicals are proposed to be included this year and these will be compared with hand weeding and the pretested weedicides over a period of three years.

Study No. 6: Effect Of Pre-sowing Tillage Practices On Water Application, Fertilizer Use Efficiency And Crop Yields (Agronomy-New)

OBJECTIVE

Generally the farmers confine their tillage practice to the upper 4-6 inch of top soil which serve as the main feeding zone for the crops. With the introduction of tractor operated implements like disc plough deep tiller/chisel plough, deeper layer can be approached and the sub soil can be used better for crop production by increasing the feeding zone of crops. Since plants will make use of the nutrients from a wider range, so the added fertilizer requirements are likely to decrease. Deep tillage will certainly speak for higher water application with special attention to initial irrigation as soil proposity is likely to increase. This study is proposed to see the effect of

presowing tillage practices on fertilizer requirements, water application and their ultimate effect on crop yields.

PLAN OF WORK

The experiment will be conducted at one or two improved watercourses on wheat and sugarcane crops in an area of 0.6 ha. for each crop and the following treatments will be studied.

Treatments

1. Tillage with cultivator.
2. Tillage with disc plough.
3. Tillage with deep tiller.

Fertilizer Levels(Kg NPK/ha.)

Wheat	Sugarcane
i. 0 - 0 - 0	0 - 0 - 0
ii. 50 - 0 - 0	75 - 0 - 0
iii. 50 -50 - 0	75 -50 - 0
iv. 100-50 - 0	150 -50 -50
v. 150-50 - 0	200 -50 -50
vi. 150-75 - 0	200-100 -50

Each treatment will have three repeats in completely randomized block design. All other cultural practices will be common and those recommended for the tract.

The following observations will be recorded.

i. Soil analysis before and after ploughing with the proposed implements.
ii. General plant observations and crop yield.
iii. Water application to each treatment.

EXTENSION OF WATER AND CROP MANAGEMENT

Research in the field of water management is in progress for the last few years with a view to develop procedures for most efficient utilization of irrigation water. Some procedures have already been developed while efforts to refine them and to develop new procedures are in hand. The project approach is noval in the sense that research is being done in partnership with the farmers. The main objective of the research proposed herein is to maintain continuity in efforts to develop methods for motivating farmers to accept the improved water and crop management practices. With this objective in view the following programme has been prepared.

Study No. 1: Motivating And Organizing Farmers For Improvement Of Their Watercourses And Water Management Practices.

OBJECTIVE

* Programme already launched would continue to develop methods for motivating farmers to accept improved water and crop management procedures and to evaluate these methods to determine their cost and degree to which they are effective.

* Research in partnership with the farmers to introduce the "Farmer Factor" into the system and adopt the technology to the farmers resources and social system and to determine the best technologies for use in the area.

* Implementation of the most promising of these technologies and extension techniques into Extension Programme.

PLAN OF WORK

Watercourse improvement in collaboration with farmers and sowing of cotton on broad beds appears to be adequately tested and ready for use. The programme of watercourse improvement will be continued and efforts will be made to build up associations for watercourse improvement and subsequent maintenance. It is also planned to demonstrate cotton sowing on broad beds. One plot at each improved watercourse is proposed to be planted. Half the plot will be sown with the help of tractor drawn bed shaper-cum-seeder

and other half by the farmer in basin. Yield comparison between two methods of planting will be made at harvest. Similarly irrigation in order to compare utilization of irrigation water under the two sowing methods.

COMPLETION SCHEDULE

The study started in the year 1978-79 and will be completed by June, 1983.

Study No.2: Watercourse Cleaning And Maintenance

OBJECTIVE

Studies conducted at the project show that although watercourse conveyance losses often reach 50 percent of the inflow, these losses can be significantly reduced through anearthen improvement programme. This consists of redesigning and rebuilding of cross section, banks and slopes according to new design criteria, installation of concrete and brick turn-outs and check structures, etc.

Unfortunately, resources are insufficient both in terms of money and engineering assistance to improve all 89,000 watercourses in Pakistan within the next few years. An alternative water savings programme was needed which can be implemented more immediately and requires minimal financial and professional engineering investment. Organized watercourse cleaning and maintenance could satisfy these requirements.

Most farmers are aware of the benefits in cleaning weeds and sediments from their watercourse channels. From experience they know that more water enters the field during their allotted irrigation time if the channels are clean. Unfortunately, most watercourses have not developed an association to provide for regular, timely and organized cleaning. There is seemingly little concern for the benefits of watercourse maintenance or preventive maintenance nor is there a tendency to organize for periodic maintenance aside from occasional cleanings. In order to organise regular cleaning and maintenance of watercourses a study was designed and recently completed at the project

The findings of this study show that organized cleaning and maintenance can substantially reduce watercourse conveyance losses.

Organized cleaning and maintenance has been taken up as a general extension activity throughout the Mona Project area. The area's 200 watercourses represent a sufficiently large sample to evaluate the programme potential for water saving, farmer acceptance and implementation.

PROCEDURE

The Project is presently serviced by an extension section consisting of a Senior Research Officer, five Junior Agricultural Officers and 20 Field Assistants all of whom have knowledge and training in surveying, water loss measurement, watercourse improvement and watercourse cleaning and maintenance. Because of their technical knowledge and experience and their close association with the farmers, the extension staff initiated this programme which will be continued during the year.

EXTENSION APPROACH

Each field assistant is assigned a geographical area which contains varying number of watercourses. Based on his knowledge of watercourse physical and social constraints, the Field Assistants should rank each watercourse according to its supposed position to programme organization. Starting with the easiest and progressing to the most difficult he will attempt to organise on each tubewell a cleaning and maintenance programme. After vieweing their neighbours improved water situation it is believed that reluctant water users will more readily participate in the programme. The exact approach to individual watercourse shall be left to the Agricultural Officer or Field Assistant's discretion. However, he might first consider organizing a general meeting on each of his watercourse to explain the programme. After approach each watercourse in a general meeting, he would then concentrate on organizing the most cooperative watercourse association.

WATERCOURSE COMMITTEE

Timely watercourse cleaning and maintenance will require some formal organization or watercourse committee. The manner in which the committee is organized should be one which best meets the needs an individual watercourse. Presumeably,a committee requires a chairman whose duty is to set the time for cleaning and maintenance. Further,each branch should have one representative whose duty should be together the required labour,assign and supervise their work.Where possible,each watercourse should have a Khal Chowkidar whose duty is to patrol "Sarkari Khal" to repair banks,leaks,clean, weeds etc. He should report daily to the committee chairman about the watercourse condition so that a general maintenance can be initiated as soon as required.

The activities of thiscommittee is probably the best indication of the success of the programme on a watercourse. Do they meet periodically? Do they function without continual pressure from the extension staff? Do they serve the needs of entire watercourse rather than the needs of a few? Is the committee effectively functioning several methods after the initial organization? Such questions are probably more meaningful indicators of success than simply the number of cleaning.

Hopefully,organized cleaning and maintenance committee would evolve into water users association who would be concerned with all problems of distribution and utilization of water on the watercourse.

The minimum requirements for cleaning and maintenance will include the following:

1. Removal of sediments and grasses from the "Sarkari Khal" channels when they impede the flow of water and substantially increase the full supply level.

2. Rebuild all bank sections that contain less than 6 inches free board and whose top is less than 18 inches.

3. Plug and compact all leak,seep zone,rat holes,leaky nakkas etc.

4. Rebuild all degraded major junctions and cross sections.
5. Store excess soil for checking at all major "Borrow Paints".

Where farmers have sufficient time and resources the following additional maintenance and improvement shall be undertaken.

1. Removal of all tree from the "Sarkari Khal" banks.
2. Build paths alongwith the top of each bank. This not only helps compact the banks but also allows easier inspection and maintenance of the watercourse.
3. Install turnout and check structures at all major junctions and authorised naccas. These structures will be offered as subsidy to induce the farmers to organize and to remove trees etc.

Structures will be subsidied only at authorised naccas and junctions. Because of engineering requirements and restrictions, No check structures will be permitted except at major junctions. Where check structures create head loss problems a double pannel will be installed to minimize the head loss.

One of the purposes in the cleaning and maintenance programme is to diminish the dependance on professional engineering assistance. Yet, it is possible that particular problem on particular watercourse may require technical competence beyond that of the extension staff. In such case, assistance will be sought from the engineering staff of the project.

EVALUATION AND MONITORING

Prior to and after organized cleaning and maintenance, loss measurement will be made on selected watercourse from the mogha to the field of each branch. Record will be maintained also on the mandays spent in cleaning and maintenance, the particular maintenance conduct, water saving due to cleaning and maintenance etc. This data will be periodically analysed and will provide a basis for further programme recommendations.

The extension Field Assistant will also maintain contacts with each watercourse committee to ensure the committee is operational and activity promoting watercourse cleaning and maintenance. He would

periodically meet with these committees in order to keep them informed of the latest findings in cleaning, maintenance structures, improvement techniques etc.

The above discussion appears primarily oriented towards unimproved watercourses. In reality, cleaning and maintenance is just as essential to the improved and equal emphasis will be placed on organizing all watercourses.

COMPLETION SCHEDULE

The study started in the year 1978-79 and is scheduled to be completed by June, 1983.

Study No. 3: Water Users Associations

IMPORTANCE

Since ancient time, communities have had to combine their efforts to obtain water and protect themselves against harmful effects of droughts and floods. Technological progress in the development, control and use of water in agriculture has led to the creation of more or less formally organised irrigation water user's associations.

In the recent past, the separation of engineering and agricultural aspects of irrigation has resulted into a tendency to over-look the important role which water users associations can play in making irrigation a success. However, in view of the present trend of the engineering, agricultural and socio-economic aspects of irrigation, the pivotal role of irrigation association has been realised and revived. The changed technologies and the growing importance of socio-economic parameters of irrigation indicate that these associations will have a broader field of activities and require a different organizational form than those of the past.

The package of irrigation water management requires a group interaction among the farmers at a watercourse command where collective communal decisions are needed to select a plan, agree with government authorities for a cooperative efforts, provide labour through all farmers, accumulate funds, hire person for maintenance and

many other reasons. Under these circumstances, the water users associations should be quite feasible in irrigated areas of Pakistan, particularly because such an association can focus on specific set of issues for which rewards to cooperative action are considerable. A requirement for farmers on a watercourse to participate in the on-farm irrigation water management programme, is that they organize formally or informally to request help and to carry out the work. However, till present, there exists no formal organization of farmers for better management of water at farm level in Pakistan. Only the informal associations have been tried successfully to a certain limit for implementing the watercourse construction work. Whereas, after the improvement work, there is even greater need for these associations to remain active for keeping the watercourse cleaned as well as maintained, the achievements of such organizations at post development stage remained much less than desired.

To monitor the effectiveness of such informal water users association, investigations have been carried out by experts to know the socio-economic parameters which are causing problems. Such a study conducted by I.H.Mirza and D.G.Murry has presented some tentative conclusions which further need substantial research efforts to confirm their findings and to investigate the possible optimum socio-economic parameters for an effective and active role of water users associations. The research was directed to ascertain the degree of the success of some informal water users associations organized in Mona Project and Faisalabad for achieving the objective of construction and proper maintenance of watercourse improvement.

The next logical step would be to organize some formal organizations to compare the working of both types of arrangements in the context of better management of irrigation water. Moreover, as the recent research remained confined to the informal organizations on earthen improved watercourses, it would be much desireable if the scope of the research is also extended to include watercourses where the main branch/branches are completely or partially lined. So far as the formal

water users organization are concerned, two types can be considered; one registered under cooperative act and the second under social welfare regulations. Although the previous experience of all such formal arrangements has not been very encouraging, yet their role in the new field which if undertaken seriously, is quite rewarding to each member equally and the benefits will flow to the community at the cost of no one else. Hence the idea of formal organization is worth trying and their comparison with the existing arrangement in this field is much desireable.

OBJECTIVES

The study is aimed to concentrate on the following objectives:

* To identify the factors in the farming community which can either inhibit or promote the cause of water user's organization.
* To compare the degree of success of formal or informal organization, on lined or earthen improved watercourses.

PLAN OF WORK

To achieve the said objectives, four watercourses have already been selected under the command of MN-62, 76, 74 and 82. Formal type of water users associations have been got registered under cooperative societies act at MN-74 and 82. MN-62 and 76 have been kept as informal association. The data concerning the condition of each watercourse, number of cleanings done, conveyance loss measurements and attitude of formal and informal associations towards maintenance of watercourses will be recorded.

On all such watercourses the responsibility of research will be shared by three sections of the project. The Hydrology and Water Management Section will contribute its part of making available the required physical inputs and engineering aspect of the programme whereas the economics section will conduct the socio-economic surveys.

The extension section will have the most important responsibilities related to the motivation of the respective farming communities for watercourse improvement and organizing the farmers under two different alternatives being considered for formal and informal water user's association. At the end, each section will write a report about its respective contribution towards the research programme. However, at a later stage these three reports will ultimately be made a part of the final report.

COMPLETION SCHEDULE

This study started in July, 1981 and is scheduled to be completed by June, 1983.

ECONOMICS OF WATER AND CROP MANAGEMENT

Optimal use of scarce resources like water, soil and crops as to get maximum benefits is the major objective of the research plan proposed by Agri. Economics Section. This section also conduct Bench Mark Surveys and Evaluate Different Development Programmes. The following 3 studies are proposed for the plan period.

Study No. 1: Developing Cropping Intensity Coordinated To Actual Water Supplies.

OBJECTIVES

* To determine the optimal cropping pattern and intensity matching to actual water supplies.
* To analyse the effects of water on cropping pattern and intensity.
* To find the maximum net revenue at the expenses of available input resources.

BACKGROUND

The subject of cropping system in Pakistan is complex. Interaction between physical, biological, economic and social systems are involved. The factors limiting the choice of cropping systems are highly varied and often difficult to discern. However, an attempt is being made to determine optimal cropping pattern as to maximize net revenue at the expenses of available input resources.

PLAN OF WORK

This research study will be continued for the second year. Some work has been completed i.e. net revenue per unit for each crop being grown in the area has already been worked out. Water requirements for each crop has been gathered from experiments conducted at Mona. Actual water supplies has been measured in different commands of the project area. Matrix of linear programming model has been developed. Analysis work has been done on computor.

COMPLETION SCHEDULE

Report will be completed during 1982-83.

Study No.2: Evaluation Of The Command Area Selected For Application Of Soil, Water And Crop Management Technology Package.

OBJECTIVES

* Measurement of the changes brought about in different agricultural aspects viz; cropping patterns, intensities level and use of farm inputs, farm costs, gross and net revenue.

* Computation of annual cost of new technology package applied and benefits accured.

BACKGROUND

Tubewell MN-93 watercourse command area has been developed with the purpose to see the impact of application of new technology package. Bench mark survey of the area has already been conducted. For the sake of assessment of changes and their economic evaluation in the overall economy on account of application of farm innovations viz; watercourse improvement management of irrigation supply, introduction of soil reclamation techniques, better cultural practices and standard input use under problematic soil and water conditions will be carried out.

PLAN OF WORK

100 percent farmers will be interviewed and their responsis will be recorded on - pre-planned and field tested interviewing schedule.

COMPLETION SCHEDULE

Report is proposed to be issued during 1982-83.

Study No.3: Bench Mark Survey Of Watercourse Command Areas Selected For Development.

OBJECTIVE

* To establish a base line for measuring overall impact of a development programme.

BACKGROUND

Many developmental as well as experimental programmes are expected during the plan period 1982-83. These sub-projects aim to formulate new concepts for obtaining maximum crop yields, furnish clue to minimize cost and maximize return in the years to come. For achieving the positive results of such sub-projects, bench mark surveys are conducted and repeated subsequently to determine the pace of progress. Moreover, these help in measuring changes by providing data base and thus the collection and analysis of bench mark data is an essential and pre-requisite for calculating benefits cost ratio for various alternatives, devising techniques condusive to economic gains and discarding measures which fail to produce desired results.

PLAN OF WORK

A comprehensive work plan will be prepared to conduct bench mark survey about important experiments and developmental programmes Questionnaires will be developed and data will be collected from command areas proposed for development.

COMPLETION SCHEDULE

It is a continuous type of study. Separate report will be prepared on each activity taken up during the year.

GROUND WATER MANAGEMENT

OBJECTIVE

To develop safe, economical and practical methods for lowering the fresh saline water interface and the water table to reduce water logging and salinization and to provide a "fresh water reservoir" in the aquifer which can accept monsoon rains and provide water for the peak season irrigation and analyse their cost-benefit ratio.

BACKGROUND

The SCARP programme of providing tubewells to lower the water table and increase irrigation supplies has been effective in increasing crop production and halting salinization of soil in those areas where the layer of fresh water(overlying the saline water) in the aquifer is at least 500 ft. thick. However, where SCARP tubewells have been installed in areas with fresh water layer of 200 ft. to 500 ft. thick the pumped water is becoming more saline because the pumping is bringing more saline water into the vicinity of the pumping well. As such, many of the deep public tubewells are being closed at farmers requests.

In these areas (fresh water layer 200 ft. to 500 ft. thick) the use of properly designed shallow skimming wells will be able for a limited time, to extract good quality irrigation water. In fact, with appropriate well design and limited pumping rates it is possible to obtain good quality water from fresh water layers as thin as 50 ft. However, pumping causes a reduction in hydraulic pressure in these areas and unless there is a co-ordinated reduction in hydraulic pressure in adjacent areas where the saline water comes even closer to the surface, the saline water will rise and even the best designed skimming wells will not continue to provide good quality water.

In areas where there is not exploitable fresh water in the aquifer on top of the saline water the SCARP programme has not been initiated because the water is not considered useable and consequently no one has been willing to pay the cost of well construction and

pumping. These areas, which are generally in the middle of Doabs(between the rivers) constitute about 25% of the irrigated lands of Pakistan.

PLAN OF WORK

To carry out this study, three tubewells sites were proposed. The area between two villages namely Sher Muhammad Wala and sakesar was selected, where the saline ground water is near the surface and there is no overlying fresh water layer, or it is too thin for irrigation use.

Site No. 1

Under GWMRP was installed during the year 1978-79, which includes one deep well of 237 ft. with 100 ft. strainer and three shallow wells. Each shallow well had 10 ft. blind pipe and 35 ft. strainer, connected with one motor and pump. Ten observation wells were also installed to depth of 180 ft. for water sampling.

Site No. 2:

Under GWMRP was installed during the year 1979-80. This site consisted of two deep wells, each 62 ft. from ground level with 35 ft. strainer, and one shallow tubewell with well points, each 21 ft. deep, connected with a 10 H.P. motor. For water samples 10 observation wells were also installed.

The installation of site No. 3 will be initiated when the results from above sites are available. The proposed infrastructure for site No. 3 will include 48 acres of land with 3 dug wells and 3 shallow tubewells. Pumping from these wells will be done by a 3 H.P. portable kerosine powered pump which can be moved from one well to another. The intensity and shallow nature of the wells and ability of pumps are designed to provide an efficient skimming capability for retrieving the fresh water from above the saline water. The land will be levelled prior to reclamation.

This study will be continued during the current year. The anticipated results have not been obtained from Site No.1 and 2 and as such practically no lowering of water table has taken place and hence the creation of fresh water reservoir in the saline aquifer. The changes and modification in existing infrastructure of the experiment will be made after the consultation with the experts in the respective field.

TUBEWELL OPERATION, MAINTENANCE AND MANAGEMENT

The tubewells constructed in the SCARPs are being operated and maintained to meet the defined objectives. However, experience shows that many problems have emerged as a result of operation of SCARP tubewells; therefore, the set objectives could not be fully achieved. The main problems faced include motor and pump problems, chokin-g of strainer, closure of many tubewells on the demands of water users because pumped water in such cases was saline and decline in pumping rates. In the Mona Unit of SCARP-II, where 138 tubewells were constructed in 1965, 18 tubewells are permanently closed on account of brackish water. Because of their closure it is not possible to lower the water table in the affected areas. There is generally a shallow layer of fresh water in these areas, which according to recent skimming well studies could be used to obtain water of reasonably good quality if carefully designed shallow skimming wells were used at low pumping rates. This should help to bring the water table down to levels which would favour increased crop production.

The specific capacity of tubewells decrease with passage of time because of incrustation and corrosion problems. These problems require solution in order to bring back the discharge capacity of tubewells to acceptable level. No satisfactory procedures are known at present to remove incrustation and corrosion problems. Research is required to test various materials and procedures to find out the most efficient procedure to solve these problems.

Installation of tubewells require follow-up maintenance is to be a lasting solution to the salinity and waterlogging problem. Various motor and pump components are rendered useless because of wear and tear. In many cases if this can be detected early minor repairs can forest-major repair or complete replacement of tubewells. In order to prolong the life of various tubewell components a study is required to develop the most suitable and economical operation and maintenance schedule of the tubewells. To solve some of these problems the following studies have been planned for execution.

Study No.1: Preventive Maintenance And Rehabilitation Of Tubewells

Mechanical and electrical break-downs often take tubewells out of operation during seasons when the water is critically needed and therefore, these break downs are costly to farmers. Hence a regular maintenance programme is needed to ensure efficient operation of tubewells.

The study is based on a pumping plant testing programme. The result of test would show numerically, how the pumping plant performed relative to an accepted standard. The chosen standard would be what is recognized and known throughout the world.

The logic in trying the tubewell maintenance programme to a testing programme is that the need for tubewell maintenance and possible redesign will not often be reflected by low or marginal performance. Generally, visual inspection will be too late to prevent tubewell break down and the high cost associated with it. At the other extreme, the tubewell that is operating at high efficiency does not require an inspection by pulling the pump from the well. The good pumping plants should be simply monitored for efficiency and maintained as they operate. Also visual inspection of the pump will not indicate any well problems. The possibility also exists that some pumps or motors may not match the task they are assigned.

In this case, a performance test will indicate the mismatch and proper remedies can be made. Also, performance testing is an excellent method to find out if a new or built pump is performing according to the standards prescribed by the manufacturer. Motor problems of this type may also be detected.

The test programme en-tails following:

i. All the pumping plants in the O&M scheme would be tested for performance. The performance would be stated as a percent efficiency.

ii. The pumping plant test information would be used as bench mark data for that well. The data would include static water level, draw-down and well discharge. The test would also include inspection remarks as to pump vibration, motor temperature, packing, leakage, adjustments made, motor emergence, voltage and motor protection.

Using this approach most of the tubewells in Mona Unit and Shahpur Unit have been tested during the year 1979-81. The pumps with efficiency less than 40% were pulled out and re-installed after essential repair and maintenance. The efficiency was increased on the average by 20% on all these tubewells where preventive maintenance was carried out. This helped in providing the dependable water supplies to the farmers. This will be continued during the current year and the programme will be evaluated keeping in view its usefulness.

Study No.2: Modifying And Re-boring Of Closed Tubewells To Obtain Water Of Acceptable Quality

OBJECTIVE

To test plugging and reboring techniques on closed tubewells which would provide water of acceptable quality.

PLAN OF WORK

The tubewells which have been closed due to high salinity, will be plugged or re-drilled to about 2/3 depth of the fresh water layer and pumped at reduced discharge. Pumping schedules, rates of discharge and water salinity levels will be monitored. This study was initiated during the year 1980-81 and will continue during the current year. Three Nos. of tubewells have been successfully rebored and modified under this study during the year 1980-81. All the remaining closed tubewells in the project area will be rebored and modified to get water of acceptable quality using the already developed technology during the previous year under this study.

CHAPTER-IV

RESEARCH IN COLLABORATION WITH PARC

In order to strengthen research capability of different research institutions in the country, PARC is providing financialand technical assistance. In line with that policy, PARC is collaborating with this project for the last six years on two research projects. Annual research programme for these cooperative research projects is prepar in consultation with the concerned co-ordinators in PARC. Physical, financial and other periodical reports prepared for each project are sent to the co-ordinator concerned for compilation and further transmission to cooperating scientists nominated by US-DA and concern technical committees in PARC. Two research programmes under execution at the project are discussed as under:

1. COOPERATIVE RESEARCH PROGRAMME ON MAIZE, SORGHUM AND MILLET

This is an on-going project which aims at development and testing of agronomic practices for optimum production of these crops under varying project conditions. The research programme also cover testing of new promising varieties in combination with recommended varieties for evaluation of their yield potential under the project conditions. The current year research programme covers 6 studies; 3 on-going and 3 new, as shown below:

i) Evaluation of water requirements of maize under different water table depths.

ii) Salinity in relation to growth and development of sorghum strains(pot study).

iii) National cooperative yield trial on maize, sorghum and millet.

iv) Demonstration of improved sowing methods for maize(New).

v) Plant population vs fertilizer trial on maize (New).

vi) Salinity in relation to growth and development of maize varieties (pot study-New).

2. WATER USE CROP PRODUCTION TECHNOLOGY AND CONSUMPTIVE USE OF WATER IN NORTHERN PUNJAB ZONE OF PAKISTAN

PC-I for this programme is approved for 3 years (May 1981 to June 1984). Research work will be continued for the second year of the PC-I to work out consumptive use requirement and crop co-efficients under different moisture stress and fertilizer treatments for 3 crops whereas the fourth crop will be taken up during the year. The crops on which research will be conducted include the following:

i. Berseem, (ii) Sorghum (iii) Citrus garden (iv) Potato(Autumn crop-New).

COOPERATIVE RESEARCH PROGRAMME ON MAIZE, SORGHUM AND MILLET.

The primary objective of research proposed herein is to develop recommendations for raising yields of maize, jowar and bajra under varying soil and ground water conditions. With this objective in view, research is proposed to be conducted on the following six studies.

Study No. 1: Evaluation Of Water Requirements Of Maize Under Different Water Table Depths.

OBJECTIVE

It has been observed that the maize crop is adversely affected by both, execessive and low moisture contents in the soil. The purpose of this study is to evaluate optimum water requirements under different water table depths for improvement of maize yield.

PLAN OF WORK

Two water table depths will be tested in combination with two moisture stress levels in three replications to evaluate the effect of water table depth on water requirements of spring maize as detailed below:

Treatments		Description
Moisture levels	=2	Irrigation will be applied on 25% and 50% deplition of available moisture in 0-15cm soil depth for first irrigation and 0-30cm depth for 2nd and subsequent irrigations (M_1 and M_2) respectively.
Water table depths	=2	(D_1) 0-1 metre (D_2) 1-2 metre
Fertilizer dose	=1	NPK 134- 56-0 kg/ha.
Replications	=3	
No. of plots	=2x2x1x3=12	

This study will be continued on non-saline, non-sodic soils already selected in the command of tubewell MN-66. Pure tubewell water of good quality will be used for irrigation. Soil samplings will be done for assessing the need for irrigation.

TREND OF RESULTS

1. Water requirements were reduced by two irrigations(15cm) without significant reduction in yield when irrigated at 25% soil moisture deplition at 0-1 metre water table depth when compared with 1-2 metre depth.

2. Number of irrigations were reduced from 4 to 3 when irrigated at 50% soil moisture deplition at water table depth 0-1 metre when compared with 1-2 metre beside significant increase in yield.

COMPLETION SCHEDULE

This is on-going study and will be completed in the year 1982-83.

Study No.2: Salinity In Relation To Growth And Development Of Sorghum Strains (Pot Study).

OBJECTIVE

Plant response to different growth limiting factors varies among the varieties and species. These mainly include soil type, salinity/sodicity, soil fertility, fertilizer dose, quantity and quality of available irrigation water, soil moisture condition, water table depth, rainfall pattern and plant protection measures etc. Among these soil salinity/sodicity is of primary importance. A large part of the area in Pakistan is saline and waterlogged. Therefore, this study is planned to be continued with the objective to test various sorghum varieties under different salinity levels and to select most suitable varieties for saline soil.

PLAN OF WORK

The varieties for which seed is provided by Coordinator, Maize, will be initially screened for salinity tolerance in pots and those found better tolerants will be further tested in field.

Treatment		Description
Soil salinity levels-4(Ec)		4,8,12 and 16 mmhos/cm designated as S_1, S_2, S_3 and S_4, respectively.
Sorghum varieties	17	Sorghum varieties designated as V_1 to V_{17}
Fertilizer dose	1	NPK @ 112-56-0 kg/ha
Replications	2	
Total No. of pots	=4x17x1x2=136	

Soil Analysis

Pre and post harvest salinity analysis of the soil will be carried out, plant material will be analysed for NPK up-take. The data will be analysed statistically to evaluate the effect of salinity on the performance of different varieties.

TREND OF RESULTS

All varieties survived upto 16 ECe. However, the yield was affected by high salinity i.e. 12 and 16. Giza-3 and D.C.75 gave good yield at 4 and 8 ECe.

COMPLETION SCHEDULE

This study will be completed in year 1982-83.

Study No. 3: National Cooperative Yield Trial On Maize Sorghum And Millet

OBJECTIVE

Among plant growth limiting factors the environmental and ecological conditions are of primary importance for successful crop husbandry. Therefore, it is imperative to evaluate suitable varieties of maize under project conditions. With this objective this study is proposed to be continued. Two sets (full and short season varieties) of maize and one set each of sorghum and millet varieties will be tested on a normal soil.

PLAN OF WORK

An area of 0.2, 0.2 and 0.1 hectare respectively will be selected for maize, sorghum and millet having normal soil and other field conditions.

The treatments for this experiment will be randomised in a completely randomised block design in four replications (subject to revision according to the instructions received from Coordinator (Maize) PARC, Islamabad. Cultural practices and fertilizer dose will be uniform for all varieties.

TREND OF RESULT (during 1981)

Among full season varieties Composite-15, Sultan and Sarhad White gave better results than other varieties under test.

From short season Afrat, Sunehri and Zia proved better than rest of the varieties under trial.

Study No.4: Demonstration Of Improved Sowing Methods For Maize (Egyptian Ridge Planting Technique-New)

OBJECTIVE

To demonstrate new planting technique in order to popularise their use at farmers field and with a view to enhance maize production in Pakistan.

PROCEDURE

i. Site Selection.

The demonstration plots would be laid out according to the instructions sent by the PARC, Cooperating farmers who agree to plant 4-10 acres of maize blocks, are proposed to be selected where demonstration plots will be laid out.

ii. Methods of Sowing

Two sowing methods i.e. normal sowing method (traditional planting method) and Egyptian ridge planting method will be practised at farmer's field.

Field Area

Ten plots measuring half acre each will be laid out in the project area where seed, fertilizer and plant protection measures will be provided under this scheme. These plots will be selected within a block of 4-10 acres of maize.

Study No.5: Plant Population Vs Fertilizer Trial On Maize(New)

OBJECTIVE

To determine appropriate plant population and fertilizer level for the promising varieties of maize under Mona conditions.

PLAN OF WORK

In order to obtain maximum grain yield it is important to know about the optimum number of plants per unit area, and optimum dose of fertilizer for the promising varieties of maize before these are released to the farmers for general cultivation.

Variety composite-15 and Sultan will be subjected to the following different doses of fertilizer.

1. 0-0-0 NPK kg/ha
2. 50-50-0 -do-
3. 100-50-0 -do-
4. 150-100-0 -do-

The plant population for both the varieties will be as under:

1. 40,000 plants per hectare
2. 60,000 -do-
3. 80,000 -do-
4. 100,000 -do-

The trial will be conducted in a Split-split-plot design with four replications and a plot size of 5mx3m.

Data to be recorded:

i. Days to 50% flowering
ii. Plant height
iii. Ear height
iv. Insect pests and diseases if any
v. Lodging percentage
vi. No. of plants harvested
vii. No. of ears harvested
viii. Fresh weight of ears per plot
ix. Moisture percentage
x. Grain yield per hectare
xi. Stalk yield per hectare

COMPLETION SCHEDULE

This is a new study to be undertaken in 1982-83 and will be completed during 1984-85.

Study No. 6: Salinity In Relation To Growth And Development Of Maize Varieties (Pot Study)

OBJECTIVE

To test the performance of promising maize varieties for salinity tolerance.

PLAN OF WORK

The available varieties will be initially tested in pots and those which gave better performance under high salinity will be further tested in the field.

Treatments		Description
Soil salinity levels=4 (ECe)		2,6,10 and 14 mmhos/cm designated as S_1,S_2,S_3 and S_4,respectively.
Maize varieties		Available promising varieties.
Fertilizer level	1	NPK 134-56-0 kg/ha.
Replications	2	

Soil Analysis

Complete pre and post harvest salinity analysis of soil will be carried out. Plant material will be analysed for NPK up-take, the data will be analysed statistically to evaluate the effect of salinity on performance of different varieties.

COMPLETION SCHEDULE

Screening in pots is proposed to be completed during 1982-83 Field testing will depend upon results of initial screening in pots.

CONSUMPTIVE USE PROJECT

OBJECTIVE

Over or under irrigation results in waterlogging and salinity problems- a major constraint in raising agriculture production besides loss of precious water. In order to efficiently utilise irrigation supplies for raising agriculture production, knowledge of consumptive use requirements of crops is very essential. This study has been designed to determine consumptive use requirements of crops in order to ensure efficient use of water.

PLAN OF WORK

Research will be continued on berseem, sorghum and citrus. Potato being an important vegetable is also proposed to be taken up in September next.

Consumptive use requirement of crops will be worked out in field by two methods, firstly by gravimetric measurement of soil moisture depletion, wherein depletion in moisture contents will be measured by soil sampling. Secondly consumptive use estimation will be made by adding total amount of irrigation applied, plus rainfall plus difference at sowing and harvest. Moisture and fertilizer treatments in varying degrees will be tested.

First moisture sampling will be done at the time of sowing the crop and subsequent sampling will be done before and after each irrigation. Moisture samples will also be taken after each rain exceeding 1.00 cm. Last sampling will be carried out at the time of harvest.

Field capacity and wilting point will be determined to select the irrigation treatments which will be based on depletion percentage of available moisture. The depth of each irrigation to be applied at each plot will be determined by pre-irrigation soil sampling. Each irrigation will restore the soil moisture level down to 150cm depth to field capacity. A cut-throat flume will be used to measure the depth of each irrigation applied to each plot. Pure tubewell water of good quality will be used for irrigation.

1. Estimation Of Consumptive Use Of Water For Berseem Under Optimum Management Conditions.

Berseem is an important fodder crop of this area, therefore, it was included in consumptive use programme during 1980-81. The work on this crop was scheduled to be completed in 1982-83. But with the change of treatments is now proposed to be completed in Rabi 1983-84. The revised treatments under test are:

Moisture levels	4	Irrigations will be applied on 50,65,80 and 95% depletion of available moisture in the upper, 15cm. soil depth.
Fertilizer dose	2	F_1 25-50-30 kg/ha F_2 50-100-30kg/ha
Replications	3	

Total No. of plots= 4x2x3=24

COMPLETION SCHEDULE

This study is proposed to be completed by the end of Rabi 1983-84.

TREND OF RESULTS

Tentative conclusions drawn on the basis of one year data are:

* The consumptive use of berseem(synthetic 1/79) was worked out to be 659, 586 and 505 mm when irrigations were provided on 1,3 and 5 bar stress, respectively.

* Green fodder yield of 104,100 and 84 tons/hec. was recorded under 1,3 and 5 bar stress level, respectively.

2. Estimation Of Consumptive Use Requirements Of Water For Sorghum Under Optimum Management Conditions.

This crop was taken up in Kharif, 1981. Treatments are being revised in this case also from the coming crop which will be as under:

Moisture levels	4	Irrigation will be applied on depletion of 50,65,80 and 95% available moisture in the upper 15cm soil depth.
Fertilizer dose	2	F_1 30-20-0 kg/ha F_2 60-40-0 kg/ha
Replications	3	

Total No. of plots = 4x2x3=24

COMPLETION SCHEDULE

Kharif,1984.

TREND OF RESULTS

* The consumptive use for sorghum 1981 was determined as 379, 365,346 and 319 mm when irrigations were applied at 1,3,6 and 9 bar tension,respectively.

* Sorghum yield (green fodder) of 42,40,39,39.6 and 37.7 tons/hec. was recorded for 1,3,6 and 9 bar stress levels,respectively.

3. Estimation Of Consumptive Use Requirement Of Citrus Garden Under Optimum Management Conditions.

Citrus is an important crop of the project. Consumptive use research on this crop was started during November 1981 and it is proposed to be continued for three years. The experimental field is divided into ten equal plots each having nine plants in three rows. Irrigations are being applied to total plot area in each case. Treatment details are as under:

Moisture stress	4	Irrigation on depletion of 40,55,70 and 85% available moisture in the upper 45cm soil depth.
Fertilizer dose	1	1.0 - 0.30 - 0.25 NPK - kg/plant
Replications	2	

Total No. of plots= 4x1x2= 8

Two plots have been reserved for maximum depletion.

COMPLETION SCHEDULE

1983-84.

4. Estimation Of Consumptive Use Requirement Of Potato Under Optimum Management Conditions.

Autumn crop of potato is proposed for planting in September,1982.

Treatments

Soil moisture levels	4	Irrigation will be . depletion of 40,55,' available moisture : 15cm soil depth.
Fertilizer levels	2	F_1= 75-50-50 NPK kg. F_2=150-75-75 NPK kg.
Replications	3	

Total No. of plots = 4x2x3=24

In addition to the chemical fertilizer, farm yard to 30 tons per acre will be applied to all the treatme

COMPLETION SCHEDULE

September, 1982 to December, 1985.

Treatments

Soil moisture levels	4	Irrigation will be applied on depletion of 40,55,70 and 85% available moisture in the upper 15cm soil depth.
Fertilizer levels	2	F_1= 75-50-50 NPK kg/ha F_2=150-75-75 NPK kg/ha
Replications	3	

Total No. of plots = 4x2x3=24

In addition to the chemical fertilizer, farm yard manure @ 20 to 30 tons per acre will be applied to all the treatments.

COMPLETION SCHEDULE

September, 1982 to December, 1985.