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PAKISTAN
WATER AND POWER DEVELOPMENT AUTHORITY

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Annual Report
OF
Mona Reclamation Experimental Project
July 1980—June 1981

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

FEBRUARY, 1982

PAKISTAN
WATER AND POWER DEVELOPMENT AUTHORITY
(MONA RECLAMATION EXPERIMENTAL PROJECT)

Telephone: 56

Mona Colony, Wapda, Bhalwal
District Sargodha.

No. PD/Mona/27-R/337

Dated: 4.2.1982

The Chief Engineer,
Survey and Research Organization,
Planning Division, WAPDA,
39-A, New Muslim Town,
Lahore.

SUBJECT: ANNUAL REPORT OF MONA RECLAMATION EXPERIMENTAL PROJECT FOR THE YEAR 1980-81

Sir,

I have the honour to present herewith the Annual Report for the year 1980-81 covering physical achievements of the project. The report comprises of ten chapters. The first chapter describes the background, objectives, summary of main findings and number of technical reports/research papers published during the year. The remaining chapters cover progress achieved in each major field.

The research findings of the project are published in the form of technical reports which are supplied to the research and planning agencies in the country for dissemination of results. In this connection nine technical reports were prepared and distributed. Research in the field of consumptive use requirements of crops was continued to cover more crops. In the field of watercourse improvement more designs for low cost lining were developed and tested. Better techniques for efficient utilization of water at field level were also developed.

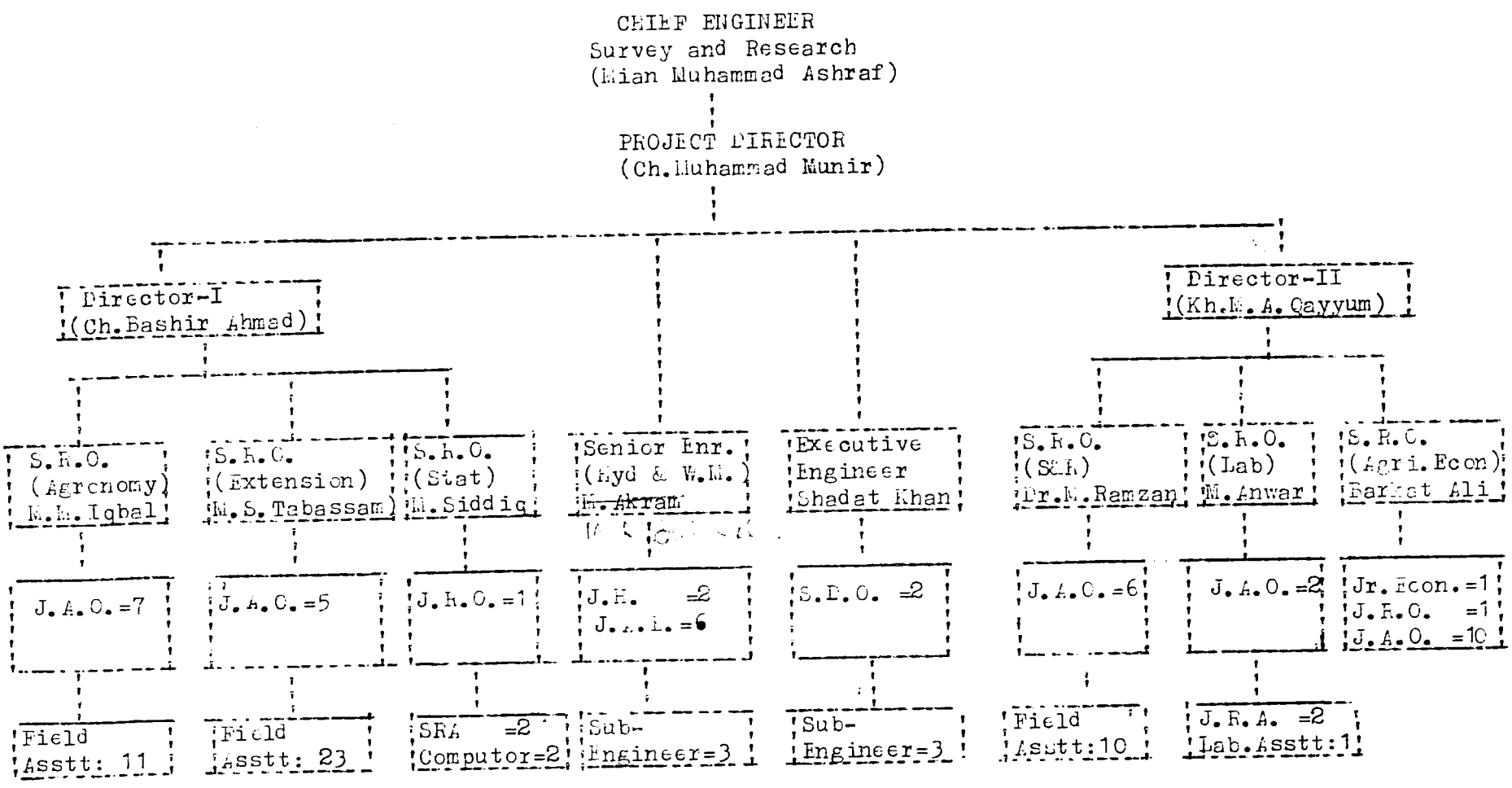
The research findings are also disseminated to the farmers within the project area. As a result of project implementation cropping intensity increased to 132% during the year as compared to 99% in base year. The gross value of crop production which stood at Rs.23 million in 1965-66 increased to Rs.40 million during the year under report.

Yours obediently,

(Muhammad Munir) 4/2
Project Director

MONA RECLAMATION EXPERIMENTAL PROJECT

ORGANIZATION CHART



S.R.O. = Senior Research Officer
J.R.O. = Junior Research Officer
J.H. = Junior Hydrologist
J.A.E. = Junior Agricultural Engineer
J.A.O. = Junior Agricultural Officer
Jr.Econ=Junior Economist
S.R.A. = Senior Research Assistant
Hyd.&W.M. = Hydrology and Water Management
S&R =Soil and Reclamation

SALIENT FEATURES

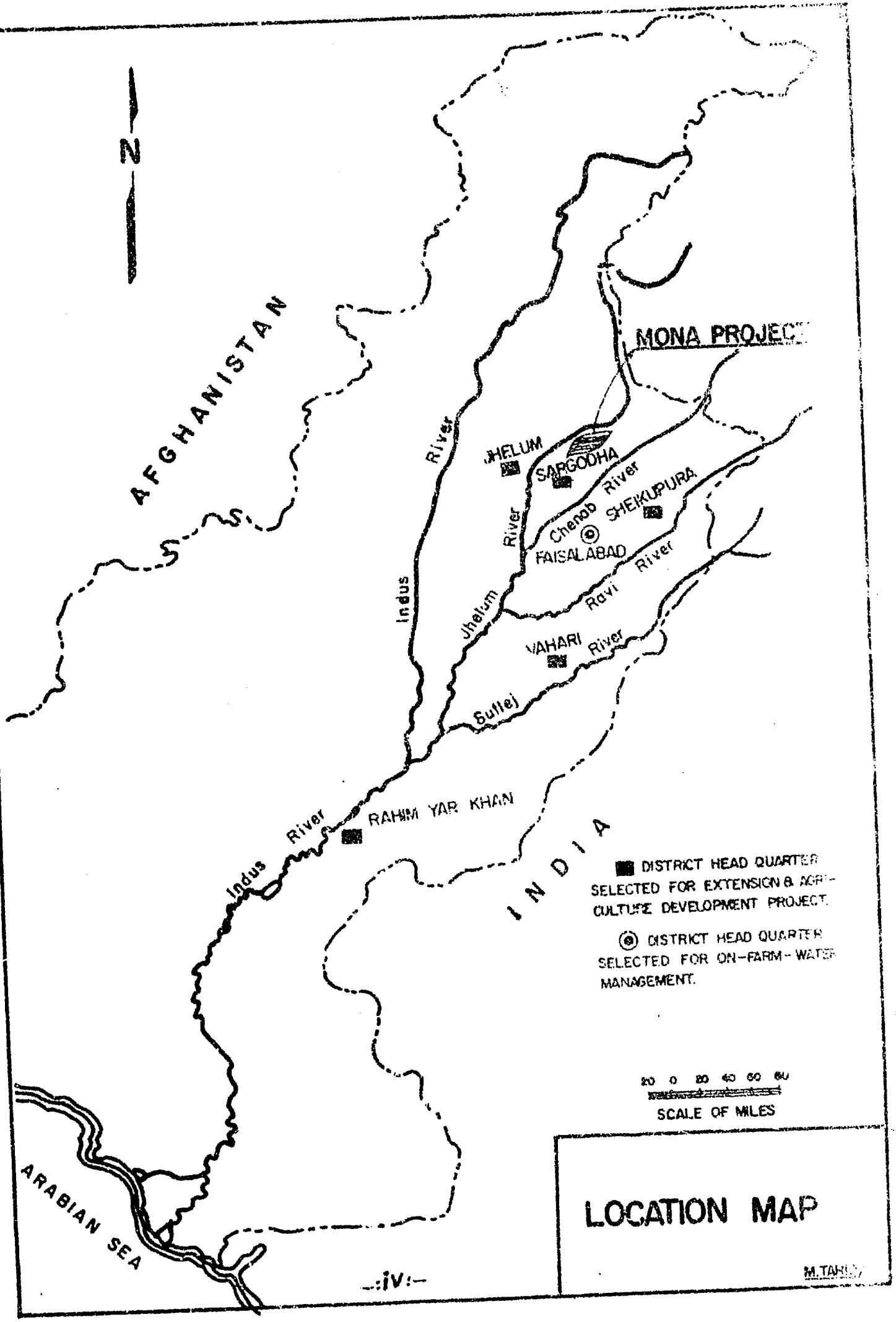
OF

MONA RECLAMATION EXPERIMENTAL PROJECT

	Mona Unit SCARP-II	Shahpur Unit-I(SCARP
TUBEWELLS		
Number of tubewells installed	138	161
Total designed discharge (cusecs)	438	254.5
Individual designed discharge(cusecs)	2 to 4	1 to 3.5
Number of tubewell closed	19	-
Actual pumpage 1980-81 (acre feet)	1,12,108	88,425
Average utilization percentage 1980-81	45.32	45.35
WATER TABLE DEPTH:		
(a) Pre-project/base year (feet)	0-11(1965)	2-10(1977)
(b) Post project(feet)	0-20(1980)	-
AREA:		
Gross Area (acres)	1,10,000	67,275
Culturable Area (acres)	1,02,000	55,113
(a) Perennial (acres)	71,400	-
(b) Non-perennial(acres)	18,150	52,520
(c) Un-commanded (acres)	12,450	2,593
CROP PRODUCTION:		
Cropped area 1980-81(acres)	1,34,793	62,517
Cropping intensity(percentage) 1980-81	132	113
Cropping intensity- base year	99(1965)	108(1977)
Gross value of production of crops; (1980-81) (Rs.million)	39.52	46.73
Gross value of production of crops; based year (Rs.million)	23.14*	42.76**
SALINE ZONE		
Number of tubewells	9	-

* Base year 1965-66

** Base year 1977-78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AFGHANISTAN
MONA PROJECT
JHELUM
SARGODHA
SHEIKUPURA
FAISALABAD
Indus River
Jhelum River
Chenab River
Ravi River
VAHARI
Sutlej River
RAHIM YAR KHAN
Indus River
INDIA
ARABIAN SEA
DISTRICT HEAD QUARTER SELECTED FOR EXTENSION & AGRI-CULTURE DEVELOPMENT PROJECT.
DISTRICT HEAD QUARTER SELECTED FOR ON-FARM-WATER MANAGEMENT.
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SCALE OF MILES
LOCATION MAP
M.TAHIR

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CHAPTER-I

SUMMARY

INTRODUCTION

Agricultural production in the irrigated area of Indus Plain is low as compared to similar areas in other part of the world. This unhappy situation exists despite the fact that the fertile Indus Plain has a potential to increase the production by 3 to 4 times. Many constraints have been recognised for low yields, among which traditional cultivation practices, low level of inputs lack of plant protection measures and waterlogging and salinity are important. The problem of waterlogging and salinity aggravated to such a extent that towards late fifties it was recognised as problem number one facing irrigated agriculture. As a remedial measure, a large number of tubewells are being installed under various SCARPs to restore the productivity of affected land. Irrigation supplies have almost doubled in sweet zone areas with the resultant increase in crop acreage and production. However, the quality of pumped water varies from good to very poor, and the enhanced water supplies used without special management techniques may aggravate the salinity and waterlogging problem rather than contributing towards their solution. It was also noticed that process of reclamation of salt effect land was very slow inspite of additional tubewell supply. It was also observed that supply of water, especially at the tail of watercourses did not increase as anticipated due to high conveyance losses in watercourses. In order to assure the success of huge SCARP programme, it was felt vitally necessary from the very outset to undertake a programme of research and investigation so as to develop criteria for the optimum use of land and water resources and to formulate concepts through research and investigation, for obtaining optimum yield of crops. To meet this requirement, Mona Reclamation Experimental Project was established in 1965. The project is specifically attending the problems of irrigated agriculture to provide guidlines not only for the farming community but also for better planning of future SCARPs. The project covered a gross area of 1,10,000 acres in Mona Unit of SCARP-II upto February, 1979 when 161 tubewells of Shahpur SCARP Unit-I and 9 tubewells of Saline Zone SCARP-II were also transferred to the project to widen the scope of research. The total project area now comprises of 1,77,275 acres served by 308 tubewells. As a consequence of project efforts the cropping intensity in the project area has increased from 99 to 132% and gross value of production from Rs.23.0 million to Rs.40.0 million.

Originally the project PC-I was approved for a five years period of 1965-70 which was subsequently extended upto June,1975 to maintain continuity of research under execution. Second PC-I for the period 1975-80 was successfully implemented. The current PC-I stand approved for a period of three years;July 1980 to June 1983.

The primary objective of the project is to derive such information from operational research which will make it possible to identify and apply the agricultural,pump maintenance and ground-water hydrology techniques most adaptable to the areas being developed under SCARPs. To achieve these objectives,research is being conducted for the last 16 years on the following aspects:

* Develop and evaluate methods of improving irrigation efficiencies through watercourse improvement in terms of costs and benefits.

* Determine costs and benefits of land levelling including changes in irrigation efficiencies,crop stands,nitrogen fertilizer recovery and crop production.

* Develop guidelines and training systems which will allow farmers to achieve optimum production from their water,land and fertilizer resources.

* Develop guidelines of safe use of marginal quality waters and for amendments to economically improve sub-marginal waters.

* Developing methods and procedures for 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.

The scope of the project was originally defined in 1962 by Dr.Milton Fireman,US-AID Advisor. Subsequently it was refined by M/s Harza Engineering Co. Intl. and M/s Tipton and Kalmbach Inc; consultants to WAPDA. Technical Assistance to be furnished by the US-AID could not be secured upto 1973 due to general policy of curtailment of funds. However the first agreement with US-AID for providing technical and financial assistance for "Water Management Research" was signed in April,1973. On termination of this agreement,two new agreements were signed in May 1975, each for two years,between Government of Pakistan and US-AID for carrying out research in these fields at Mona Project.Since the funds provided under these agreements could not be fully utilized upto 30th May,1977 both the agreements were extended upto 30th June,1978. Applied type of research in these fields

was conducted in collaboration with Colorado State University Advisors which received wide recognition and acceptance both within and outside the country. In order to continue the on-going research to take it to a conclusive stage and to initiate research in many new areas, a separate PC-I "On Water Management Research" was approved on 20.12.1978 by EC-CEC. This PC-I provides Rs.12.505 million to be utilized over a five year period of 1977-82 for conducting research in the following fields:

1. Watercourse improvement and management.
2. Water, soil and crop management.
3. Extension of water and crop management.
4. Economics of water and crop management.
5. Ground-water management.
6. Tubewell operation, maintenance and management.

PROJECT ACTIVITIES

These can be divided into two parts namely, "Tubewell Operation and Maintenance" and "Research and Investigations". The research activities can be further divided into two phases.

I-The bench mark studies to make assessment of pre-project conditions prevalent in the project area, thus establishing datum for evaluating the results of the project implementation.

This phase covered:

* Socio economic survey of the project area in partnership with University of Agriculture Faisalabad covering the inventory of land use, cropping pattern, farm input-outputs, land tenure and farming structure etc.

* Hydrologic appraisal of the project area before 1965 with the help of WASID. This includes maps and data on the water-table at different periods of time, the hydrologic regime and water budget analysis for the period 1964-65.

II-Actual research and investigations started after completion of bench mark studies. Physical progress achieved in each major field of research, during the year under report, is presented as under:

SOILS AND RECLAMATION

This section is mainly concerned with the problems associated with the use of poor quality waters, salt salinity fertility and salinity water interactions and salt tolerance of crops.

With these broad objectives in view, it continued field research on seven studies. Tentative conclusions drawn during the year were:

* Wheat yield was significantly increased with the application of fertilizer under saline irrigation conditions.

* Wheat yield was not affected significantly with the application of tubewell water of 2000 ppm TDS.

* Rice and alfalfa yields were significantly increased where 20cm depth per irrigation was applied as compared to 10cm depth.

* The decrease in SAR was significant where 20cm depth per irrigation was applied as compared to 10cm depth per irrigation.

* Increase in rice yield was observed with the application of zinc sulphate.

* Good cotton yield was obtained by sowing the cotton crop on double row beds and sloping beds as compared to flat sowing.

* The pH and EC of the soil decreased significantly with increase in depth of water applied.

* Rice and wheat crops gave higher yields when irrigated with gypsum treated water (SAR 7.0) as compared with pure tubewell water of 14 SAR.

SOIL AND WATER TESTING LABORATORY

The analytical requirements of Soil Salinity and Water Table Survey Project were met in addition to the project requirements. Summary of work done during the year was:

	Soil samples analysed	Water samples analysed
1. Soil salinity and water table survey Directorate.	510	-
2. Mona Project	5609	509

AGRONOMY

This section is responsible to develop methods for the effective use of land and water, optimum cropping impact output relationships and water requirements of crops under different water table depths. With these objectives in view it conducted research on ten studies. Tentative conclusions drawn from one year data are:

* Highest seed cotton yield (B-557, 10.85 q/ha) was obtained from 30cm plant to plant spacing. Yield level decreased to 12.1 q/ha when plant to plant distance was increased to 60cm.

* Seed cotton yield upto 200% higher was obtained with fertilizer dose of 140-45-25 NPK kg/ha and absolute plant protection.

* Highest wheat yield of 41.86 q/ha was obtained with soaking irrigation and through seed bed preparation as against 30.5 q/ha without soaking irrigation and partial tillage.

* 50% higher cane yield was obtained by mechanical weed control. Gesapax combi @ 6 lit/ha fairly substituted hand weeding and gave an increment of 40% over weedy check.

* Highest wheat yield of 44.1 q/ha was obtained when 2 hoeings plans two weedings were done as compared to 26.1 q/ha under control. Lucuran was found the most efficient weedicide for wheat and gave 12 q/ha more yield against no weeding.

* Precision levelling besides saving irrigation water, gave higher wheat yield through efficient utilization of applied inputs.

AGRICULTURAL ECONOMICS

This section deals with the collection and processing of the data on the socio-economic changes brought about as a result of project implementation. In pursuance of these objectives it conducted research on eight studies. Important findings of the work completed during the year are:

* A compaign of heavy cleaning and maintenance of water-courses throughout irrigated areas in Pakistan is recommended. The best time to carry out this programme is each year when the canals are closed in winter for annual maintenance and to provide incentives to the water users, pucca naccas should be provided at subsidized rate.

* Earthen watercourse improvement is considered to be the best investment because it gives highest return. It requires comparatively less capital investment and technical assistance. Earthen watercourse reconstruction is therefore recommended in fresh zone areas.

* For heavy cleaning and maintenance and earthen improvement of watercourses, establishment of viable water-user's association is essential.

* Economic analysis shows that partial lining of watercourse is profitable when the cost of lining is Rs.20/- per linear foot or about Rs. 3.00 per square foot. It is therefore recommended to develop such techniques in which cost should not exceed this limit .

* To achieve higher irrigation efficiency, cleaning of field watercourses, land levelling, ridge sowing, mulching and weed control is also essential.

* Due to shortage of labour, during the harvesting of wheat crop it is recommended that small size harvestors should be introduced to collect grain in time.

STATISTICS

This section assisted in the preparation of experimental designs and layout plans for research studies taken up by various sections. In addition, it carried out statistical analysis of the collected research data for interpretation of results. On the field side, it helped extension section for yield estimation survey of the major crops of the project area.

EXTENSION

The extension section is responsible to organize the farmers to identify and achieve their potential by making efficient use of available land and water resources. Due to scarcity of water priority was given to water management especially watercourse cleaning and maintenance. As a result of extension efforts, two water-users associations were organized to carry out cleaning and maintenance on the selected branches of the Sarkari Khal. The section was also involved in watercourse improvement work at tubewell MN-22, MN-69 and SHP-54 where water users were organized to provide mannual labour for earth work. Besides these actives it employed a number of extension techniques to disseminate the latest research findings to the farmers.

The experience gained in watercourse cleaning and maintenance was useful and encouraging. The results indicate that conveyance losses in the cleaned and maintained sections can be reduced. About 10% additional water can be supplied to fields at a very nominal cost to the Government as entire work is done by the water-users under the supervision of extension staff.

CONSUMPTIVE USE

Research on estimation of consumptive use requirements of cotton was completed and two new crops namely Berseem and Sorghum were taken up for their consumptive use estimation. Final results in case of cotton and one year data for berseem and sorghum is given as under:

Consumptive Use Requirements at Different Bar Tension (cm.)

Crop	1-Bar	3-Bar	5-Bar	6-Bar	9-Bar
Cotton	74.49	-	69.72	-	64.26
Berseem (Fodder)	65.92	58.64	50.50	-	-
Sorghum (Fodder)	37.89	36.47	-	34.59	31.87

HYDROLOGY/WATER MANAGEMENT

The responsibilities of this section include measurement of watercourse conveyance losses, development and testing of watercourse improvement techniques, monitoring of improved watercourses and groundwater management research. To achieve these objectives efforts were continued and progress achieved during the year covered the following:

1. Development and testing of watercourse improvement techniques continued. Emphasis were given to test low cost linings which included:

   i. Cement concrete lining with 3" thick walls and 2" bed.
   ii. Cement concrete lining with 2" thick walls including bed.
   iii. Lining with chicken wire and 3/4" thick cement plaster.
   iv. Brick masonry lining with 4½" thick walls and 3" thick cement concrete bed (1:4:6).
   v. Brick lining with 4½" thick walls and 3" thick cement concrete bed (1:3:6).
   vi. Side lining of watercourse with 2" thick precast concrete slabs.

2. All the improved watercourses were monitored for changes in their delivery efficiencies with the passage of time.

3. Low head jet pumps were installed at tubewells MN-51 and SHP-46 to solve outlet(mogha) submergence problem and to lift water to command higher fields.

4. Precision land levelling was carried out at four sites covering about 19 acres.

5. Ground water management research to lower the water-table and to provide fresh water reservoir in aquifer at site No.2 in Sakesar area was initiated by energising the tubewells.

6. Skimming wells were installed at SHP-26 and MN-116 to skim fresh layers of water overlying saline aquifer.

7. Study to re-bore or modify the closed tubewells due to higher salinity was continued. SHP-25,SHP-24A and MN-94 were modified to improve the quality as well as discharge of these tubewells.

8. Flow measurements with cut-throat flume(12"x3") were compared with the sparling meter and the differences between the two were less than 4%.

TUBEWELL OPERATION AND MAINTENANCE

There are 308 tubewells on the charge of the project.Their running and maintenance costs are financed by Irrigation and Power Department, Government of Punjab.

i)Mona Unit:

Out of 138 tubewells commissioned in October,1965, 119 tubewells are in working order while the remaining 19 have been closed mainly due to brakish water/ no demand. The tubewells in working condition were run during the year according to approved schedule and the average percentage utilization on the basis of 24 hours daily running was 45.32.

ii)Shahpur SCARP Unit-I and Saline Zone SCARP-II

Average percentage utilization of 161 tubewells on the basis of 24 hours daily working for the period from July 1980 to June 1981 was 45.35. Nine tubewells of Saline Zone were energaised during July-August 1980 and their average percentage utilization during the year was 47.30.

TECHNICAL PUBLICATIONS

Technical report is issued on each study on completion of research work. The published reports are supplied to research and planning agencies in the country to keep them informed about the

research results. Following nine reports were finalized during the year:

1. Effect of tubewell waters of different RSC values on soil conditions and plant growth.
2. An investigation into the marketing problems of sugarcane in Mona Project area(Sargodha) 1978-79.
3. Impact of watercourse improvement at tubewell MN-56R on the farm economy.
4. Changes in tubewell water quality in Mona Project Area.
5. Measurement of watercourse losses by ponding method and study of factors which affect watercourse losses.
6. Bench mark survey of watercourse at tubewell MN-22.
7. Determination of suitable dose of gypsum in relation to quality of irrigation waters.
8. Consumptive use requirements of spring maize.
9. Nitrification in fertilizers as a function of salinity and moisture stress.

In addition following research papers were prepared and presented at various national and international forums to project the project findings on completed aspects of the research.

1. Low head jet pump for improved irrigation in SCARPs.
2. Consumptive use requirements of spring maize.

CHAPTER-II

SOIL AND RECLAMATION

This section deals with soil, water and crop problems faced by the cultivators in SCARP Area. In order to find out the solutions of these problems the research on the following studies under Mona Reclamation Experimental Project and Water Management Research was conducted.

1. Salinity-fertility interaction.
2. Cropping patterns on different water quality basis.
3. Interaction of soil depth and chemical amendments on the reclamation of saline-sodic(non-gypsiferous) soils.
4. Determination of reclamation requirement and salt movement pattern for salt affected soils under different water-table depths.
5. Role of zinc application in saline-sodic soils for rice cultivation.
6. Estimation of boron contents in ground-waters and soils.
7. Impact of using high magnesium waters on soils and crops.

The report includes only one year data collected during 1980-81 relating to the above mentioned studies, therefore, only tentative conclusions have been drawn.

STUDY NO.1: SALINITY-FERTILITY INTERACTIONS

OBJECTIVE

Soil salinity/sodicity causes significant reduction in crop yields in the Indus Basin. Considerable 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, sometimes it is not possible to carry out reclamation on all the salt affected soils 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 and under saline irrigation conditions. The application of fertilizers may be beneficial for crop growth on salt-affected soils where saline water is being used for crop growth. The interaction of different fertilizer materials with salts, present in the soil or irrigation water, may improve the uptake of useful nutrients by crop plants for better growth.

Selection of Sites:

Three, 0.4 hectare, fields situated under the command of tubewells SHP-29, MN-138 and MN-25 were selected. These fields were originally non-saline, non-sodic and poor quality irrigation waters were used for irrigational purposes. The quality of waters used was as under:

T/well No.	TDS(ppm)	SAR	RSC(me/l)
MN-25	1344	11.50	2.80
MN-138	1920	3.55	-
SHP-29	1472	8.20	2.60

Treatments:

At SHP-29 and MN-25 the following fertilizer doses were tried.

a) Nitrogen @ 50, 100, 150, 200 lbs N/Acre.
b) Phosphorus @ 50, 100, 150 lbs P_2O_5/Acre.
c) Potassium @ 50 lbs K_2O/Acre.

Where at MN-138 the following treatments were tested.

a) Water salinity having 736, 1056, 1408 and 2000 ppm, TDS.
b) Nitrogen 75, 125, 175 lbs/Acre.

The above-mentioned treatments in all possible combinations were tested with three repeats.

Layout:

Each field was divided into respective plots and plot bunds were constructed. The treatments were randomized. The boundries between treatments were made and each plot was irrigated separately.

Application of fertilizers:

Calculated quantity of fertilizers was evenly broadcast in the plots as per treatment. All the P and K fertilizers and half of nitrogen was applied at the time of sowing whereas the remaining half dose of nitrogen was applied later on.

Crop management:

Wheat-rice crop rotation was followed. The cultural operations carried out at these sites are reported in Table II-1.

Infiltration Rate:

Infiltration rate was measured by "Standard Ring" method. The readings were recorded after 3 and 6 hours on each site. These measurements were made during January-February, as to minimize the loss of water through evaporation. The results are given in Table II-2 and 3.

Crop Yield Estimation:

Crop yield was estimated by crop cutting method. For this purpose an area of 4.5 x 6.1 metre was harvested from each plot and yield was estimated as Kg/ha, but where the crop stand was not uniform, whole plot was harvested for yield estimation. The results are given in Table II-4 and 5.

Soil samples:

Soil samples were taken twice a year from each plot i.e. before sowing and after harvesting the same crop from 0-15, 15-30, 30-60 and 60-90cm soil depths. For each depth soil sample was composited from 12 randomly selected locations in each plot and analysed for ECe and SAR. The results are presented in Table II-6, 7 and 8.

INDICATIONS

1. Soil infiltration rate was not affected by fertilizer application.
2. Wheat yield was significantly increased by the fertilizer application.
3. ECe x 10^3 and SAR of soil at MN-25 and SHP-29 was decreased with the application of tubewell waters but at MN-138 no trend was observed.

4. Fertilizer source and dose did not show any effect on ECe x 10^3 and SAR of soil.

5. Wheat yield was not affected by application of tubewell water having TDS upto 2000 ppm.

STUDY NO.2: CROPPING PATTERNS ON DIFFERENT WATER QUALITY BASIS

OBJECTIVE

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

PROCEDURE

The questionnaire was developed to collect information on water quality, quantity supplied to the area, soil salinity/sodicity status, soil textural class, command area, major crops grown and cropping pattern followed, farm-input used and insect pest measures adopted by the farmers.

Water quality parameters like TDS, SAR and RSC of all the tubewells under this study were monitored and existing cropping pattern being followed by the farmers was recorded. Further data collection is in progress.

STUDY NO.3: 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.

PROCEDURE

Selection of site:

0.8 hectare field was selected near Sahiwal Town, District Sargodha.

Treatments:

i. Gypsum = 3 (0, 50, 100% G.R. of soil).

ii. Depth to which gypsum will be mixed with soil. =3(15, 30 and 45cm).

Replications =3

Total No. of plots=3x3x3=27

Layout:

The field was divided into 27 equal plots and plot bunds were constructed. The treatments were randomized.

Application of Gypsum:

Calculated quantity of powdered gypsum was evenly broadcast in the plots as per treatment prior to the preparation of seed bed. The gypsum was mixed into the soil by repeated ploughings upto the desired depths. Gypsum requirement calculations were made on soil basis.

Crop Management:

Rice-berseem-rice-wheat crop rotation was followed. Canal water was used for irrigation purposes.

Soil Samples:

Soil samples are being taken twice a year from each plot. First sampling was done before transplanting of rice nursery.

Soil samples were taken from 0-15, 15-30, 30-60, 60-90 and 90-120cms soil depths. For each depth the soil sample was composited from 12 locations, randomly selected in each plot. The results of the soil samples are given in Table II-9.

STUDY NO.4: DETERMINATION OF RECLAMATION REQUIREMENT AND SALT MOVEMENT PATTERN FOR SALT AFFECTED SOILS UNDER DIFFERENT WATER-TABLE DEPTHS.

OBJECTIVE

* To monitor the salt movement in a soil profile under different crops and irrigation levels.
* To determine the actual water requirement 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 various water-table depths.

Site Selection

Badly salt affected area of 0.8 hectare was selected under the command of tubewell MN-42. The soil was saline-sodic(gypsiferous) and poor quality tubewell water was used for irrigational purpose. The water table at this site was beyond five feet.

Layout:

The field was precisely levelled before starting the experiment. The field was divided into different plots of uniform size to apply 10cm and 20cm water/irrigation. Plot bunds were constructed such that each plot was irrigated separately.

Crop Management:

Rice-Alfalfa crop rotation was followed. Pure tubewell water was used for irrigation. The quality of applied water was:

TDS =1728 ppm, SAR =8.40 and
RSC =0.00 me/l

The cultural operations carried at this site are given in Table II-10.

Crop yield estimation:

The estimation of crop yield was carried out by "Crop Cutting" method. For this purpose an area of 4.5 x 6.1 metre size was harvested from each plot and yield was estimated as Kg/ha. The results are shown in Table II-11.

Soil Sampling:

Pre and post crop soil sampling was done to observe the treatment effect on soil properties. The results are presented in Table II-12 and 13.

INDICATIONS

1. Rice grain yield and alfalfa green fodder yield was significantly increased where 20cm water per irrigation was applied as compared to where 10cm water per irrigation was applied.
2. ECe of soil was significantly decreased but there was no significant difference between treatment effect.
3. SAR of soil was also decreased significantly. The decrease in SAR was more where 20cm water per irrigation was applied as compared to where 10cm water per irrigation.

STUDY NO.5: ROLE OF ZINC APPLICATION IN SALINE-SODIC SOILS FOR RICE CULTIVATION

OBJECTIVE

* 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.

Selection of Site:

0.4 hectare field under the command of tubewell M -42 was selected to conduct this study. The field was precisely levelled before starting the experiment.

Layout:

The entire field was divided into eight equal plots to observe the effect of four doses of zinc in the form of zinc sulphate @ 0,5,10 and 15 lbs. per acre.

Application of Zinc:

The zinc sulphate was broadcast in the standing water about one week after transplanting of rice nursery.

Crop Management:

Rice crop was grown. Pure tubewell water was used for irrigational purposes. The cultural operations carried out are reported in Table II-14.

Crop Yield:

Crop yield was estimated by "Crop Cutting" method. The results are reported in Table II-15.

Soil sampling:

The soil samples were collected from 0-30, 30-60, 60-90cm depths for chemical analysis. The effects of zinc on chemical properties of soil pre and post cropping is given in Table II-16 and 17.

INDICATIONS

1. Increase in rice grain yield was observed with the application of zinc sulphate.

2. ECe was significantly decreased but there was no treatment effect on ECe of soil.

3. SAR of soil was also significantly decreased but treatment effect was not observed.

STUDY NO. 6: ESTIMATION OF BORON CONTENTS IN GROUNDWATERS AND SOILS

This study could not be started due to non-availability of boron free glass ware in the Kona Soil and Water Testing Laboratory. Arrangements are being made for the purchase of the same. Soil and Water samples collection is in progress.

OBJECTIVE

1. To find out boron levels in soils and water to solve nutrition problems of agricultural crops.

STUDY NO. 7: IMPACT OF USING HIGH MAGNESIUM WATERS ON SOILS AND CROPS

OBJECTIVES

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

Selection of Sites:

Three 0.2 hectare plots situated under the command of tubewells LN-54, LN-132 and SHP-45 were selected. All the fields were non-saline, non-sodic and of medium textured.

Layout:

Each field was properly levelled before the start of the experiment and plot bunds were constructed.

Crop Management:

Rice-wheat crop rotation will be followed. Pure tubewell water having 0.5, 1.0 and 2.0 Ca/Mg ratio were used for irrigational purposes. The water quality of the tubewells under this study is given in Table II-18.

Soil Sampling:

Initial soil sampling was completed at each site after land levelling. Chemical analysis of the soils is reported in Table II-19.

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SOIL,WATER AND CROP MANAGEMENT

STUDY NO.1: LAND AND WATER USE CAPABILITY CLASSIFICATION

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 lands and waters.Suitability of a crop in an area depends very much on soil type,water quality, climate,drainage conditions,salinity/sodicity,insect pests and economic returns.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:

1. To demonstrate suitability of various crops,keeping in view the land capability,water quality,adapt-ability,economic returns etc. and to recommend the most profitable crops for a given set of on farm conditions.
2. To prepare land and water use capability classification scheme,to list crop varieties and species suitable for a particular land capability class for sustained irrigated agriculture.

METHODOLOGY

Three farms of 3-4 hec. size were selected in the Project area. Two out of three farms were surveyed and land capability classification map was prepared to determine suitable cropping pattern both for Rabi and Kharif crops.Rice and Kallar grass were grown on two sites. The rice crop was completely failed due to high salinity,while kallar grass flourished well.This was followed by alfalfa crops which germinated well but completely failed there after.Different crops are being tried for a given set of soil and water conditions.The farmers of the area will be convinced to grow the crops proved successful in the experiments.

Soil and Water Samples:

The soil samples from different depths were collected for the determination of their chemical characteristics.Water samples were also collected to monitor their quality.Soil,water and crop yield data will be used for experiment evaluation.

STUDY NO.2: STAND ESTABLISHMENT ON SALT AFFECTED SOILS

OBJECTIVE

Different crops respond differently to soil salinity/sodicity 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 consequently the low yield of crops in Pakistan. If the salt concentration is minimised at early growth stages, either by frequent irrigations or by adoption of various planting practices, the crop yield can be improved considerably. The objective of this experiment was "To evaluate different planting practices on salt affected soils to establish proper crop stand".

PROCEDURE

The experiment was carried out on moderately saline soil. 0.4 hectare of medium textured soil was selected for this purpose. The soil was first leached with water to bring the ECe of 0-30cm soil between 8 to 16 mmhos/cm.

The following treatments were tested:

1. Planting practices	3	i) Flat sowing. ii) Double row bed. iii) Sloping bed.
2. Crop	1	Cotton
3. Replications	3	

Total No. of plots: 3x1x3=9

Cultural Operations:

Planting practices were laid out in the field with the help of appropriate ridging implements. Detail of the cultural operations is given in Table II-20.

Soil Sampling and yield Estimation:

Initial soil samples were collected from 0-30, 30-60, 60-90 and 90-120cms depths and analysed for ECe, pH and SAR as shown in Table II-21. Subsequent soil samplings were done at various growth stages of the crop to observe area of salt accumulation on various beds and the effect of high salt concentration on plant germination, vegetative growth and yield. The available tubewell water was used for irrigation. The entire field was picked treatment wise and all the pickings were cumulated to calculate the cotton yield as kg/hectare. The data is shown in Table II-22.

INDICATIONS

Good cotton yield was obtained by sowing the cotton crop on double row beds and sloping beds as compared to flat sowing.

STUDY NO. 3: USE OF SALINE GROUNDWATER FOR RECLAMATION OF SALINE SODIC SOILS

OBJECTIVE

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

The disposal of saline water pumped in SCARP areas 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. In Pakistan, approximately 13 million acres of land are salt affected. The saline groundwater can be used for the 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 was to study the possibility of using saline ground-water for the reclamation of saline sodic soils.

PROCEDURE

Two hectares of saline sodic soil(ECe greater than 8.0 and SAR greater than 30) was selected under the command of the tubewell installed under the ground water management research programme.

At first step a preliminary study in infiltro-meters was completed at salt affected soil, where saline ground water of TDS 1856(ppm) was applied for leaching purposes. Seven water treatments ranging from minimum of zero to a maximum of 36 acre inches of water depth were tested with an interval of 6 acre inches between the different irrigation depths. From this preliminary study it was observed that:

1. The pH of the soil decreased significantly with increase in depth of water applied.
2. The ECe of the soil decreased significantly with 6 acre inches of water application as compared with control.

At second step, the land was properly levelled and leached with the saline groundwater of the experimental tubewell. The leaching was carried out by applying frequent heavy irrigations. In between irrigations the land was allowed to dry upto field capacity. The leaching with groundwater continued till the soil reached near equilibrium with the irrigation water.

Following treatments were tried on saline-sodic(gypsiferous) soil.

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

INDICATIONS

Rice and alfalfa crops failed due to high salinity of soil and irrigation water,but kallar grass established well.

STUDY NO.4: METHODS OF USING GYPSUM TO OPTIMIZE CROP PRODUCTION FROM SODIC IRRIGATION WATER

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 found that high sodium waters can be improved by gypsum application,sufficient to bring the sodium levels of tubewell waters within the safe limits for agricultural purposes, but informations on field scale are inadequate to demonstrate and popularize the commercial use of gypsum at farmers field.The objectives of this study were:

i. To evaluate the improvement in tubewell water quality by gypsum application and its effect on soil properties and crop yields.

ii. To work out its cost/benefit ratio.

Selection of Site:

The study was in progress on 0.4 hectare of non-saline, non-sodic soil under the command of tubewell MN-72,where tubewell water with SAR 14 and TDS 800 ppm was passed through gypsum stones laid in the watercourse to lower the SAR to 7.0. The tubewell water quality,before and after passing through gypsum stones is given in Table II-23.

Treatments

The following treatments were tested:

i. Pure tubewell water application.

ii. Irrigation through gypsum bed.

iii. Pure tubewell water application+gypsum application on 100% water quality basis in the soil.

Replications: Three.

Layout:

The field area was divided into 9 equal plots and plot bunds were constructed.The treatments were randomized.

Application of Gypsum:

The calculated quantity of powdered gypsum was evenly broad cast in respective plots prior to preparation of seed bed of each crop.The material was mixed into the soil by repeated ploughings.

Crop Management:

Rice-wheat crop rotation was followed.The rice(Kharif 1980) and wheat (Rabi 1980-81) crops were grown,optimum land and water management practices were followed.The cultural practices followed are given in Table II-24.

Infiltration Rate:

Infiltration rate of the soil was measured by "Standard Ring" method after 3 and 6 hours in each treatment during Feb-March 1981 to determine the treatment effect.The results are presented in Table II-25.

Crop Yield Estimation:

The yield was estimated by harvesting an area of 4.5x6.1 metre from each plot of rice and wheat crops.The grain yield is given in Table II-26.

Soil Sampling;

Soil samples were taken before and after each crop.Soil samples were collected from 0-15,15-30,30-60,and 60-90cms depths. For each depth the soil samples were composited from 12 locations randomly selected in each plot.The samples were analysed for ECe and SAR.The results are given in Table II-27.

INDICATIONS

1. There was an increasing trend in infiltration rate of soil in gypsum treated plots.It increased significantly in plots where powdered gypsum @ 100% of water quality basis was applied as compared with control plots.

2. Rice and wheat crops gave more yields in plots irrigated with water passing through gypsum bed over other treatments.

TABLE:II-1 CULTURAL OPERATIONS CARRIED ON THE EXPERIMENTAL SITES OF SALINITY/FERTILITY INTERACTION STUDY

Cultural operations	Tubewell LN-25 Rabi, 1980-81 Wheat	Tubewell MN-138 Rabi 1980-81 Wheat	Tubewell SHP-29 Rice 1980	Tubewell SHP-29 Wheat 1980-81
Seed bed preparations:				
No. of ploughings	14	6	8	7
No. of plankings	5	4	6	5
Seed Rate(Kg/ha)	93.00	93.00	20.00	93.00
Date of sowing	21.11.1980	20.11.1980	8.7.1980	27.11.1980
Irrigation (cm):				
Tubewell water	48.26	45.72	122.00	45.72
Rainfall	14.10	14.10	43.00	14.10
Total	62.36	59.82	165.00	59.82
Hoeings	1	2	-	2
Weedings	2	2	4	2

TABLE:II-2 EFFECT OF SALINITY/FERTILITY INTERACTION STUDY ON THE INFILTRATION RATE OF SOIL

Treatments	N-P-K Lbs/acre	Tubewell LN-25 Water percolated after 3 hrs. (cm)	Tubewell LN-25 Water percolated after 6 hrs. (cm)	Tubewell SHP-29 water percolated after 3 hrs. (cm)	Tubewell SHP-29 water percolated after 6 hrs. (cm)
T-1	50-50-50	1.60	2.20	2.38	3.17
T-2	100-50-50	1.50	2.30	2.70	4.15
T-3	150-50-50	1.90	2.75	2.02	3.05
T-4	200-50-50	2.05	2.90	1.88	2.95
T-5	50-100-50	1.05	1.90	2.58	3.43
T-6	100-100-50	1.25	1.85	2.93	4.03
T-7	150-100-50	1.70	2.10	2.75	3.93
T-8	200-100-50	2.10	3.20	2.60	3.20
T-9	50-150-50	1.15	1.70	2.25	3.15
T-10	100-150-50	1.50	2.35	2.65	3.50
T-11	150-150-50	1.90	2.90	2.03	3.38
T-12	200-150-50	2.10	3.10	2.75	3.65
Control				2.13	2.98

TABLE:II-3 EFFECT OF SALINITY/FERTILITY INTERACTION ON THE INFILTRATION RATE OF SOIL AT SITE

TUBEWELL MH-138

Treatments			Water percolated after 3 hrs. (cm)	6 hrs. (cm)
T-1	TDS* =736+75 lbs	N/acre	1.20	2.00
T-2	TDS =1056+75	"	1.20	1.80
T-3	TDS =1408+75	"	1.50	2.40
T-4	TDS =2000+75	"	1.20	2.00
T-5	TDS =736+125	"	1.00	1.60
T-6	TDS =1056+125	"	1.10	1.70
T-7	TDS =1408+125	"	1.20	1.90
T-8	TDS =2000+125	"	1.00	1.60
T-9	TDS =736+175	"	1.00	1.60
T-10	TDS =1056+175	"	1.20	1.90
T-11	TDS =1408+175	"	1.00	1.70
T-12	TDS =2000+175	"	1.00	1.50

* TDS= ppm

TABLE:II-4 EFFECT OF SALINITY-FERTILITY INTERACTION ON THE GRAIN YIELD OF WHEAT

Treatments N - P - K lbs/acre	T/Well SHP-29 Kharif 1980 Rice(kg/ha)	T/Well MH-25 Rabi 1980-81 Wheat(kg/ha)	T/Well SHP-29 Rabi 1980-81 Wheat(kg/ha)
T-1 50-50-50	1291.34	1803.55	1672.22
T-2 100-50-50	1825.23	1813.55	2134.80
T-3 150-50-50	1313.03	1771.84	2224.49
T-4 200-50-50	1301.35	1438.16	2646.07
T-5 50-100-50	1553.28	1815.22	2271.13
T-6 100-100-50	1094.47	1875.29	2330.33
T-7 150-100-50	1928.67	2232.32	2107.89
T-8 200-100-50	1823.56	2100.52	3293.69
T-9 50-150-50	1229.67	1283.00	1722.19
T-10 100-150-50	1594.99	1791.86	2474.88
T-11 150-150-50	1374.76	2304.60	2493.58
T-12 200-150-50	1845.20	2137.72	3510.75
Control	1062.77	[illegible]	819.83

TABLE:II-5 EFFECT OF SALINITY/FERTILITY INTERACTION ON GRAIN YIELD OF WHEAT

TUBEWELL MN-138

Rabi 1980-81

Treatments		Wheat (grain yield kg/ha)
T-1	TDS=736(ppm) + 75 lbs N/acre	2331.82
T-2	TDS=1056(ppm)+ 75 "	2547.41
T-3	TDS=1408(")+ 75 "	2816.58
T-4	TDS=2000(")+ 75 "	2864.42
T-5	TDS=736 (")+ 125 "	1991.34
T-6	TDS=1056(")+ 125 "	2212.60
T-7	TDS=1408(")+ 125 "	1776.06
T-8	TDS=2000(")+ 125 "	2075.06
T-9	TDS=736 (")+ 175 "	2786.68
T-10	TDS=1056(")+ 175 "	3100.03
T-11	TDS=1408(")+ 175 "	2750.80
T-12	TDS=2000(")+ 175 "	2541.50

TABLE:II-6 EFFECT OF SALINITY-FERTILITY INTERACTION ON THE EC$_e$ OF SOIL

Treatments	lbs/acre	Depths (cm)	Tubewell Lk-25 S_2^*	Tubewell Lk-25 S_3^{**}	Tubewell SHP-29 S_2^*	Tubewell SHP-29 S_3^{**}
1	N - P - K	2	3	4	5	6
T-1	50-50-50	0-15	1.42	1.30	3.0	1.40
		15-30	1.32	1.25	1.55	1.40
		30-60	1.10	1.05	1.30	0.85
		60-90	1.37	0.90	1.0	0.82
T-2	100-50-50	0-15	1.72	1.10	2.40	0.80
		15-30	1.62	1.60	1.25	0.90
		30-60	1.87	1.20	1.55	0.72
		60-90	2.10	1.20	1.10	1.00
T-3	150-50-50	0-15	1.75	1.30	2.10	0.85
		15-30	1.95	1.50	1.35	0.70
		30-60	1.40	1.00	1.15	0.70
		60-90	1.40	1.00	1.02	0.90
T-4	200-50-50	0-15	1.42	1.52	3.25	0.75
		15-30	1.95	1.62	1.55	0.62
		30-60	1.60	1.52	1.35	0.60
		60-90	1.67	1.37	1.25	0.90
T-5	50-100-50	0-15	1.97	1.10	1.85	0.70
		15-30	2.00	0.97	2.05	0.80
		30-60	1.67	1.07	1.20	0.80
		60-90	2.02	1.27	1.50	0.87
T-6	100-100-50	0-15	1.75	1.45	2.50	0.80
		15-30	2.05	1.20	1.43	0.90
		30-60	2.00	1.05	1.20	0.70
		60-90	2.15	1.15	1.15	0.75
T-7	150-100-50	0-15	2.30	1.35	1.75	1.50
		15-30	1.85	1.40	1.35	0.80
		30-60	1.67	1.55	1.08	0.85
		60-90	1.80	1.65	1.25	0.73
T-8	200-100-50	0-15	2.35	1.77	2.33	1.25
		15-30	2.25	1.87	1.45	1.00
		30-60	1.80	1.47	1.10	0.77
		60-90	1.65	1.42	0.93	0.76

Cont'd....

TABLE:II-6(Cont'd)

1		2	3	4	5	6
T-9	50-150-50	0-15	2.55	1.90	2.35	1.77
		15-30	3.10	1.80	1.65	0.90
		30-60	1.92	1.69	1.40	0.85
		60-90	1.55	1.70	1.13	0.70
T-10	100-150-50	0-15	1.80	1.67	1.85	1.00
		15-30	1.55	1.50	1.40	0.85
		30-60	1.40	1.45	1.10	4.30
		60-90	1.90	1.28	1.17	0.73
T-11	150-150-50	0-15	2.20	1.87	3.40	1.03
		15-30	2.90	1.65	2.63	0.75
		30-60	2.30	1.20	1.10	0.86
		60-90	2.95	1.40	1.40	0.79
T-12	200-150-50	0-15	2.20	1.40	2.0	0.94
		15-30	2.35	1.15	1.70	0.80
		30-60	2.35	0.90	1.10	0.92
		60-90	2.60	1.30	1.55	0.82
Control		-	-	-	2.42	1.20
					1.22	0.80
					1.30	0.95
					1.15	0.80

S_2^*= Pre wheat 1980-81

S_3^{**}= Post wheat 1980-81

TABLE: II-7 EFFECT OF SALINITY-FERTILITY INTERACTION ON THE SAR OF SOIL

Treatments	lbs/acre N-P-K	Depth (cm)	Tubewell LB-25 S^*_2	Tubewell LB-25 S^{**}_3	Tubewell SHP-29 S^*_2	Tubewell SHP-29 S^{**}_3
1		2	3	4	5	6
T-1	50-50-50	0-15	5.37	6.74	5.35	4.45
		15-30	4.53	7.21	4.10	2.33
		30-60	4.36	5.54	3.40	2.89
		60-90	5.83	3.76	2.75	2.24
T-2	100-50-50	0-15	5.80	5.54	4.20	2.96
		15-30	5.93	7.99	3.60	2.60
		30-60	7.24	5.79	2.90	2.51
		60-90	7.08	5.06	3.50	2.83
T-3	150-50-50	0-15	5.52	5.50	5.80	1.95
		15-30	5.13	6.70	4.65	1.55
		30-60	3.91	4.67	4.00	1.50
		60-90	4.61	4.33	4.20	2.85
T-4	200-50-50	0-15	3.49	7.35	5.55	2.45
		15-30	5.94	8.05	4.10	2.95
		30-60	5.05	6.50	4.30	1.55
		60-90	3.74	6.25	4.31	2.88
T-5	50-100-50	0-15	11.18	7.75	3.80	1.39
		15-30	6.04	6.60	5.55	2.00
		30-60	6.10	9.75	4.10	1.30
		60-90	5.27	8.15	5.65	2.55
T-6	100-100-50	0-15	6.80	8.25	5.0	1.45
		15-30	7.00	7.15	3.40	2.50
		30-60	5.25	7.70	4.60	2.00
		60-90	5.70	6.60	4.85	1.95
T-7	150-100-50	0-15	7.20	9.95	3.80	2.45
		15-30	5.20	8.60	3.20	1.45
		30-60	4.40	9.95	3.20	2.55
		60-90	5.50	8.30	3.60	2.40
T-8	200-100-50	0-15	6.15	10.80	3.90	5.72
		15-30	4.50	12.00	3.25	1.00
		30-60	4.80	9.90	3.10	1.40
		60-90	4.00	9.20	3.20	1.65

Cont'd....

TABLE: II-7(Cont'd)

1		2	3	4	5	6
T-9	50-150-50	0-15	9.35	10.85	5.40	6.30
		15-30	6.30	11.85	3.00	1.85
		30-60	4.35	10.80	6.30	0.85
		60-90	3.69	11.05	3.90	1.65
T-10	100-150-50	0-15	4.80	8.70	5.60	3.35
		15-30	3.90	10.00	3.95	1.10
		30-60	3.90	9.00	4.45	1.20
		60-90	5.25	7.00	3.90	1.25
T-11	150-150-50	0-15	6.32	10.65	5.80	2.70
		15-30	7.30	9.30	4.75	1.05
		30-60	6.70	6.90	3.00	1.00
		60-90	4.30	5.95	8.40	0.85
T-12	200-150-50	0-15	5.95	8.10	4.20	2.15
		15-30	3.10	5.36	3.20	2.20
		30-60	5.55	5.00	3.00	1.50
		60-90	6.05	6.59	3.55	1.55
Control		-	-	-	5.85	1.70
					4.80	1.30
					5.20	2.10
					4.10	1.25

S_2^*= Pre Wheat 1980-81

S_3^{**}= Post Wheat 1980-81

TABLE: II-8 EFFECT OF SALINITY-FERTILITY INTERACTION ON THE CHEMICAL CHARACTERISTICS OF THE SOIL

Tubewell LF-130

Treatments	Lbs/acre	Depth (cm)	$EC_e \times 10^3$		SAR	
			S_2^*	S_3^{**}	S_2^*	S_3^{**}
1		2	3	4	5	6
T-1=TDS***	736+75	0-15	2.90	3.13	2.56	2.49
		15-30	3.07	2.75	3.40	6.76
		30-60	3.65	2.70	3.10	3.20
		60-90	4.30	2.90	3.26	2.96
T-2=TDS	1056+75	0-15	2.90	3.16	1.93	2.49
		15-30	2.80	2.53	1.80	3.03
		30-60	3.00	2.90	1.33	3.21
		60-90	3.70	3.36	2.06	2.13
T-3=TDS	1408+75	0-15	1.83	2.15	1.83	2.10
		15-30	2.43	2.20	1.80	6.14
		30-60	2.76	2.46	1.93	2.18
		60-90	2.53	2.26	2.13	2.13
T-4=TDS	2000+75	0-15	2.16	2.16	4.06	2.16
		15-30	2.36	1.98	2.43	2.28
		30-60	3.30	2.43	2.03	2.76
		60-90	3.00	2.60	2.18	1.89
T-5=TDS	736+125	0-15	1.60	2.03	3.03	2.63
		15-30	2.13	1.93	2.88	3.15
		30-60	2.10	2.30	2.45	2.10
		60-90	2.34	3.08	1.11	1.87
T-6=TDS	1056+125	0-15	2.03	3.73	3.64	1.43
		15-30	4.03	2.76	3.13	1.17
		30-60	3.90	2.50	2.22	3.46
		60-90	3.73	3.73	2.14	2.00
T-7=TDS	1408+125	0-15	1.64	2.26	2.24	1.92
		15-30	2.30	1.96	2.98	2.59
		30-60	2.33	2.00	2.86	2.72
		60-90	2.36	2.26	3.09	5.83
T-8=TDS	2000+125	0-15	2.26	1.63	2.67	1.93
		15-30	2.16	1.90	2.47	3.13
		30-60	2.28	1.83	2.28	3.00
		60-90	2.26	2.25	2.55	3.16

Cont'd....

TABLE: II-8(Cont'd)

1	2	3	4	5	6
T-9=TDS 736+175	0-15	2.00	2.08	3.86	2.82
	15-30	2.23	2.16	2.78	2.33
	30-60	2.87	2.23	3.82	3.21
	60-90	2.36	2.35	2.17	2.83
T-10=TDS 1056+175	0-15	1.75	1.93	2.23	3.88
	15-30	2.13	1.70	3.11	2.34
	30-60	2.40	1.95	2.16	4.34
	60-90	2.40	1.85	2.50	2.85
T-11=TDS1408+175	0-15	2.50	2.50	2.07	3.99
	15-30	2.50	2.51	2.80	1.83
	30-60	2.71	2.60	1.82	2.86
	60-90	2.78	2.80	2.20	2.94
T-12=TDS=2000+175	0-15	2.40	2.5	2.60	2.86
	15-30	2.7	2.26	2.40	1.62
	30-60	2.9	2.36	2.80	2.50
	60-90	2.1	3.00	2.07	3.42

S^*_2=Pre-rabi 1980-81

S^{**}_3=Post-rabi 1980-81

*** =TDS= ppm

TABLE:II-9 INITIAL SOIL CHARACTERISTICS OF THE SOIL USED FOR THE STUDY,"INTERACTION OF SOIL DEPTHS AND CHEMICAL AMENDMENTS ON THE RECLAMATION OF SALINE-SODIC NON-GYPSIFEROUS SOIL"

(Pre-Kice-1981)

Treatments	Depth (cm)	Average ECe x 10^3	SAR
1	2	3	4
0% G.R.with 15cm depth.	0-15	12.0	89.02
	15-30	13.7	94.9
	30-60	15.9	83.03
	60-90	12.83	13.83
	90-120	2.3	13.83
0% G.R.with 30cm depth.	0-15	1.80	9.7
	15-30	26.90	65.9
	30-60	6.17	30.97
	60-90	3.18	18.97
	90-120	2.18	13.90
0% G.R.with 45cm depth.	0-15	1.12	6.8
	15-30	14.2	55.8
	30-60	6.9	41.9
	60-90	5.1	30.3
	90-120	3.56	29.5
50% G.R.with 15cm depth.	0-15	21.1	209.7
	15-30	9.8	96.2
	30-60	4.7	44.5
	60-90	2.38	20.8
	90-120	1.5	12.1
50% G.R.with 30cm depth.	0-15	12.0	51.6
	15-30	7.3	48.4
	30-60	4.7	30.7
	60-90	2.42	16.2
	90-120	2.02	16.6
50% G.R.with 45 cm depth.	0-15	18.0	129.07
	15-30	7.33	69.10
	30-60	5.48	44.63
	60-90	4.33	35.80
	90-120	3.63	29.37

Cont'd...

1	2	3	4
100% G.R.with 15 cm depth.	0-15	31.40	247.0
	15-30	7.67	64.27
	30-60	3.57	25.27
	60-90	1.65	9.23
	90-120	1.23	7.70
100% G.R.with 30 cm depth.	0-15	17.30	141.33
	15-30	6.83	50.47
	30-60	4.07	28.50
	60-90	2.50	16.77
	90-120	1.80	12.73
100% G.R.with 45 cm depth.	0-15	12.43	80.36
	15-30	5.93	35.32
	30-60	4.22	26.27
	60-90	2.67	16.80
	90-120	2.63	18.91

TABLE:II-10 DETERMINATION OF RECLAMATION REQUIREMENT AND SALT MOVEMENT PATTERN FOR SALT AFFECTED SOIL UNDER DIFFERENT WATER TABLE DEPTHS

TUBEWELL MN-42

Cultural Operations	Kharif 1980 Rice	Rabi 1980-81 Alfalfa
Seed bed preparations:		
No.of ploughings	4	-
No.of plankings	2	-
(Nursery transplanting)	23.7.1980	-
Seed Rate	20 kg/ha.	17.5 kg/ha
Fertilizer application(Kgs/ha)		
N	84	-
Irrigation(cm):		
Pure tubewell water:		
10cm	200	172.72
20cm	400	345.44
Rainfall	32.45	18.57
Total: 10cm	232.45	191.29
20cm	432.45	364.01

TABLE:II-11 YIELD OF CROPS UNDER THE STUDY "DETERMINATION OF RECLAMATION REQUIREMENTS AND SALT MOVEMENT PATTERN UNDER DIFFERENT WATER TABLE DEPTHS"

Tubewell No.	Treatments (irrigation levels) incms.	Kharif 1980 Rice(grains) kg/ha	Rabi 1980-81 Alfalfa(Fodder) kg/ha
MN-42	10	146.48	17091.15
	20	201.21	19961.28

TABLE:II-12 ECe OF SOIL AS AFFECTED BY THE TREATMENT EFFECTS OF THE STUDY "DETERMINATION OF RECLAMATION REQUIREMENTS AND SALT MOVEMENT PATTERN FOR SALT AFFECTED SOILS UNDER DIFFERENT WATER TABLE DEPTHS"

Treatments	Depth (cm)	Average S_1 Initial soil sampling	S_2 Pre-rice & after one irrigation	S_3 Post rice	S_4 Post Alfalfa
10cm Irrigation	0-30	75.25	39.75	2.97	3.64
	30-60	37.50	23.10	2.85	3.68
	60-90	27.00	15.12	2.85	3.33
20cm Irrigation	0-30	55.00	30.75	3.05	3.64
	30-60	38.25	29.25	2.60	3.63
	60-90	31.60	14.25	2.92	2.93

TABLE:II-13 SAR OF SOIL AS AFFECTED BY THE TREATMENT EFFECTS OF THE STUDY "DETERMINATION OF RECLAMATION REQUIREMENTS AND SALT MOVEMENT PATTERN FOR SALT AFFECTED SOILS UNDER DIFFERENT WATER TABLE DEPTHS"

Treatments	Depth (cm)	Average S_1 Initial soil sampling	S_2 Pre-rice after one irrigation	S_3 Post rice	S_4 Post-Alfalfa
10cm Irrigation	0-30	176.30	94.45	1.95	9.15
	30-60	85.80	54.15	1.80	7.78
	60-90	66.80	36.70	2.50	6.10
20cm Irrigation	0-30	134.60	72.65	0.97	5.38
	30-60	88.07	66.87	1.50	4.63
	60-90	72.93	34.82	1.59	5.53

TABLE:II-14 CULTURAL OPERATIONS CARRIED ON THE STUDY SITE OF "ROLE OF ZINC APPLICATION FOR RICE PRODUCTION"

Tubewell M-42

Cultural Operations	Kharif 1980 Rice
Seed bed preparation:	
No. of ploughings	4
No. of plankings	2
(Nursery transplanting)	23.7.1980
Seed rate	20 Kg/ha.
Variety	Irri-6
Fertiliser Application(kg/ha):	
N	84
Irrigation(cm):	
Pure tubewell water	200
Rainfall	32.45
Total	232.45

TABLE:II-15 EFFECT OF ZINC APPLICATION ON THE RICE YIELD

Treatments	Irrigation level each	Kharif 1980 Rice(grains) Kg/ha
Control (No.zinc sulphate)	10cm	116.79
5 lbs/acre (Zinc sulphate)	-do-	205.77
10 lbs/acre (Zinc sulphate)	-do-	155.72
15 lbs/acre (Zinc sulphate)	-do-	180.08

TABLE:II-16 EFFECT OF ZINC APPLICATION ON THE ECe OF SOIL

Treatments	Depth (cm)	S_1^*	S_2^{**}	S_3^{***}
Control	0-30	60.00	48.00	2.20
	30-60	48.00	31.20	3.00
	60-90	30.00	18.00	3.20
5 lbs/acre Zinc sulphate	0-30	66.00	45.00	3.10
	30-60	36.00	31.20	3.20
	60-90	27.00	15.00	2.80
10 lbs/acre Zinc sulphate	0-30	121.00	51.00	3.60
	30-60	39.00	15.00	2.60
	60-90	27.00	13.50	2.60
15 lbs/acre Zinc sulphate	0-30	54.00	15.00	3.00
	30-60	33.00	15.00	2.60
	60-90	24.00	14.00	2.80

TABLE:II-17 EFFECT OF ZINC APPLICATION ON THE SAR OF SOIL

Treatment	Depth (cm)	S_1^*	S_2^{**}	S_3^{***}
Control (No Zinc sulphate)	0-30	142.00	109.00	4.90
	30-60	94.30	70.70	1.00
	60-90	76.00	45.60	4.70
5 lbs/acre (Zinc sulphate)	0-30	143.70	107.10	1.00
	30-60	81.20	82.10	1.00
	60-90	69.40	39.70	1.00
10 lbs/acre (Zinc sulphate)	0-30	285.40	124.30	1.30
	30-60	89.90	21.20	1.10
	60-90	62.60	.40	1.10
15 lbs/acre (Zinc sulphate)	0-30	134.10	37.40	0.60
	30-60	78.20	32.60	1.10
	60-90	59.20	30.00	3.20

* S_1 = Initial soil sampling 1980

** S_2 = Pre-rice sampling 1980(after one 10 cm irrigation)

*** S_3 = Post rice sampling 1980.

TABLE:II-18 CHEMICAL COMPOSITION OF TUBEWELL WATERS USED AT HIGH Mg-WATERS STUDY SITES

T/Well No.	Ca/Mg ratio	Milli equivalents/litre Ca	Mg	Na	HCO_3	Cl	SO_4	D.S. (ppm)	ECx10^6 at 25°C	pH	RSC me/l	SAR
MN-54	0.5	1.4	3.0	2.2	3.0	2.0	1.0	384	600	7.6	0.00	1.4
MN-132	1.00	2.3	2.4	2.4	3.0	2.0	2.0	448	700	7.8	0.00	1.5
SHP-45	2.00	1.8	1.0	1.2	1.0	2.0	1.0	256	400	7.6	0.00	1.1

TABLE:II-19 IMPACT OF USING HIGH Mg-WATERS ON SOIL CHARACTERISTICS

S_1 = (Initial Soil Sampling)

T/well No.	Treatment Ca/Mg ratio	Depth (cm)	ECe x 10^3	SAR
MN-54	0.5	0-15	0.57	1.15
		15-30	0.50	2.03
		30-60	0.57	2.44
		60-90	0.48	1.54
MN-132	1.0	0-15	1.21	2.85
		15-30	1.58	2.09
		30-60	0.57	2.63
		60-90	0.39	1.75
SHP-45	2.0	0-15	0.55	1.48
		15-30	0.59	1.56
		30-60	0.83	1.51
		60-90	0.50	1.20

TABLE:II-20 CULTURAL OPERATIONS CARRIED ON "STAND ESTABLISHMENT OF SALT AFFECTED SOILS" SITE

Operations	Kharif-1980 Cotton
Seed bed preparation:	
No.of ploughings	5
No.of plankings	3
Sowing time and method of sowing	8.5.80 by Dibbling method.
Seed rate	25 kg/hect.
Variety	B-557
Fertilizer Application(kg/ha):	
N	78
P_2O_5	56
Insecticide:	
Dusting	1 lb.B.H.C./Acre
Spraying	1/2 lb.Navacron/Acre
Hoeings:	2
Irrigations(cm):	
Canal+tubewell water	65
Rainfall	21
Total:	86

TABLE:II-21 INITIAL SOIL ANALYSIS OF THE STUDY "STAND ESTABLISHMENT ON SALT AFFECTED SOILS" SITE
Kharif-1980 (Cotton)

Depth(cms)	pH	ECe	SAR
0-30	9.02	6.28	20.9
30-60	9.32	6.75	24.2
60-90	9.70	5.07	25.8
90-120	10.07	3.4	18.0

TABLE:II-22 EFFECT OF DIFFERENT STAND ESTABLISHMENT PRACTICES ON YIELD OF COTTON ON SALINE SODIC NON-GYPSIFEROUS SOILS
(Site Sahiwal)

Treatments	Yield of cotton(Kharif-1980) (Kg/ha)
Flat sowing	Very low germination and crop failed.
Double row bed	272.29
Sloping bed	202.66

TABLE: II-23 CHEMICAL COMPOSITION OF IRRIGATION WATER BEFORE AND AFTER PASSING THROUGH GYPSUM BED

Irrigation waters	Milli-equivalents per litre					D.S. (ppm)	EC x 10^6	pH	RSC	SAR
	Ca+Mg	Na	HCO_3	Cl	SO_4				me/l	
IR-72 (pure tubewell water)	1.20	11.4	2.00	7.00	2.50	736	1150	7.8	0.8	14.80
IR-72 (tubewell water through gypsum bed)	3.2	9.8	3.00	4.00	5.50	800	1250	7.9	0.00	7.70

TABLE:II-24 CULTURAL OPERATIONS CARRIED ON THE EXPERIMENTAL SITE OF GYPSUM USE STUDY

Tubewell No.-72

Cultural Operations	Kharif 1980 (Rice)	Rabi 1980-81 (Wheat)
i) Seed bed preparation:		
No. of ploughings	6	7
No. of plankings	2	3
Seed rate (kg/ha)	25	92.22
Date of sowing	14.7.1980	1.12.1980
ii) Water application (cm):		
Irrigations	149.86	22.86
Rainfall	41.40	9.65
Total	191.26	32.51
iii) Fertilizer (kg/ha):		
N	112	134
P_2O_5	-	56
iv) Hoeings	-	1-
v) Weedings	1	1
vi) Insecticide applied	-	-

TABLE:II-25 INFILTRATION RATE OF SOIL AS AFFECTED BY DIFFERENT METHODS OF USING GYPSUM TO OPTIMIZE CROP PRODUCTION FROM SODIC IRRIGATION WATERS

Tubewell No.-72

Treatments	Year 1980-81 Water percolated after 3 hrs (cm)	6 hrs (cm)
1. Tubewell water through gypsum bed	1.15	2.05
2. Pure tubewell water.	1.05	1.95
3. Pure tubewell water+gypsum application in the soil on 100% water quality basis.	2.40	3.90

TABLE:II-26 EFFECT OF DIFFERENT METHODS OF USING GYPSUM TO OPTIMIZE CROP PRODUCTION FROM SODIC IRRIGATION WATERS ON CROPS YIELD

Tubewell LL-72 (Yield kg/ha)

Treatments	Kharif 1980(Rice)	Rabi 1980-81(Wheat)
1. Tubewell water through gypsum bed	2650.98	2810.57
2. Pure tubewell water	2105.19	2601.78
3. Pure tubewell water + Gypsum in the soil on 100% water quality basis.	2200.48	2750.77

TABLE:II-27 EFFECT OF DIFFERENT METHODS OF GYPSUM USE ON SOIL CHARACTERISTICS

Tubewell LL-72

Treatments	Depth (cm)	ECe		SAR	
		S_3 Pre-wheat 1980-81	S_4 Post-wheat 1980-81	S_3 Pre-wheat 1980-81	S_4 Post-wheat 1980-81
1. Tubewell water through gypsum bed	0-15	1.13	1.23	5.07	4.80
	15-30	1.45	1.03	3.00	5.21
	30-60	1.40	0.91	2.70	4.61
	60-90	1.33	0.60	2.53	3.32
2. Pure tubewell water	0-15	1.05	0.85	4.35	3.00
	15-30	0.82	0.67	2.25	2.61
	30-60	0.75	0.65	3.60	0.98
	60-90	0.62	0.70	2.52	1.93
3. Pure tubewell water+ gypsum in the soil on 100% water quality basis.	0-15	1.45	1.13	4.47	2.67
	15-30	1.33	1.10	4.13	5.22
	30-60	0.85	0.77	3.70	2.76
	60-90	0.60	0.63	3.40	1.90

CHAPTER-III

SOIL AND WATER TESTING LABORATORY

Soil and water testing laboratory of this project is mainly concerned with the analysis of soil,water and plant samples collected from various research sites located in the project area. Previously the laboratory was equipped with salinity analysis only,now the scope has been expanded to cover detailed fertility analysis and moisture holding capacity determination at different bar tension in view of the compelling need of field research on fertility.In addition to this,facility for boron determination has been provided to study water quality from the view point of boron contamination. Therefore,field experiments are being conducted to study salinity-fertility interaction on different crops and boron toxicity hazard of tubewell water in the project area.

The laboratory also extends facilities to other Government Semi Govt. agencies,different organization of WAPDA e.g. SCARPs and private sector in the field of water and soil analysis. Soil samples received from the Directorate of Soil Salinity and Water Table Survey are also analysed.

Since adequate analytical facilities are available,study on various problems relating to soil,water and crop problems has been initiated. A report on "Nitrification in fertilizers as a function of salinity and moisture stress" is being published shortly. Progress achieved is given hereunder:

I-Analytical work:

1. Soil samples analysed for SP,ECe,pH,Ca+Mg,Na, CO_3,HCO_3,Cl,SO_4,SAR.	6119
2. Water samples analysed for pH,ECw,Ca+Mg,Na, CO_3,HCO_3,Cl,SO_4,RSC,TDS,SAR.	509
3. Mechanical analysis of soil	200
4. Gypsum contents in soil.	220
5. Gypsum requirement of soil.	80
6. Lime determination in soil	5
7. Total nitrogen in soil	85
8. Total phosphorous in soil.	85
9. Available phosphorous in soil.	45
10. Total potassium in soil	85
11. NH_4 in soil	100
12.NO_2 in soil	100
13. NO_3 in soil	100
14. Moisture holding capacity of soil at 1/3,1,3,5,9 and 15 bar tensions.	395

15. Moisture percentage of soil 41
16. Cation exchange capacity. 39
17. Seed germination test. 24

II-Research Work

Study completed:

A "Nitrification in fertilizers as a function of salinity and moisture stress"

OBJECTIVES

The experiment was conducted to investigate the impact of salinity, moisture stress and water-logging on nitrification with a view to develop better techniques for use of nitrogenous fertilizers on such problem soils.

PROCEDURE

The soil used in this experiment was collected from the project area. It was air-dried, ground, screened through 2 mm sieve and finally homoginized. Five hundred grams of soil was taken in each plastic beaker and artificially salinized by quadratic equation method by using salts namely NaCl, Na_2SO_4, $MgSO_4$ and $CaCl_2$. Salinity levels varied with constant SAR i.e. 10; $Cl:SO_4$ and Ca:Mg being 1:1 and 2:1 reppectively. The salt were thoroughly mixed and proper moisture stress was created. Nitrogen in the form of urea, DAP and Nitrophos was added @ 134 kg/ha.

Treatments:

Following treatments were tested:

1. Salinity levels: 3

S_1 = 4 millimhos/cm
S_2 = 8 -do-
S_3 = 12 -do-

2. Fertility levels: 4

F_1 = Control
F_2 = Urea
F_3 = DAP
F_4 = Nitrophos.

3. Moisture levels: 4

M_1 = Control (air dry)
M_2 = 1/2 field capacity
M_3 = Field capacity
M_4 = Saturation.

4. Replications: 2 (R_1 and R_2)

5. Incubation period: 3

I_1 = 14 days
I_2 = 28 days
I_3 = 42 days

Observations recorded:

1. Total nitrogen.
2. Ammonium contents.
3. Nitrite contents.
4. Nitrate contents.

Trend of results:

1. It was observed that total nitrogen increased significantly with the increase in salt contents in soil whereas increasing moisture upto field capacity also increased the total nitrogen contents of soil which finally decreased at saturation level.

It was further observed that application of nitrophosphatic fertilizer especially -A- proved to be more beneficial. Nitrogen losses increased with increasing incubation period.

2. Ammonium contents increased with increasing salinity. Increasing moisture upto field capacity decreased ammonium contents, whereas nitrification was stopped altogether at saturation.

3. Nitrite contents were directly proportional to salinity. Moisture did not show significant effect on $I.O_2$ of soil at all intervals. Application of fertilizer increased nitrite contents. Increasing incubation decreased the nitrite contents significantly.

4. Salinity imposed a negative effect on nitrate contents. Moisture upto field capacity showed a favourable effect on nitrification whereas saturation exerted negative effect. Nitrate contents were directly proportional to fertilizer application, however, -A- -treated soils revealed to be more favourable for nitrate formation. Increasing incubation period increased nitrate formation.

CHAPTER-IV

AGRONOMY

Agronomic research at the project aims at improving the crop production technology by making best use of soil and water resources in combination with other agricultural inputs. Water is considered to be key input for raising crop yields, hence in most of the studies its use is planned in different ways to make most efficient use of this scarce resource.

In all, eight studies were included in the annual research programme for the year under report. List of studies is given below and the detailed progress for each study follows the list.

1. Effect of plant population on yield and yield components of cotton.

2. Optimum management studies on major crops.

3. The relation between plant population, water application, pest management and nitrogen fertility on cotton production.

4. Evaluation of water requirements for sugarcane grown on soils of different water table depths.

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

6. Water distribution and saving as affected by different shapes of field.

7. Paddy yield and plant population as affected by salinity.

8. Carry-over of water in rice fields for wheat production.

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STUDY No.I: EFFECT OF PLANT POPULATION ON YIELD AND YIELD COMPONENTSOF COTTON.

OBJECTIVE

Appropriate plant stand is the primary requirement of any crop to produce optimum yield. Cotton stand in the farmer's field is generally less than 50% of the required plant population. This study was planned to find out optimum plant population for cotton variety B-557 which could ensure maximum yield under normal soil conditions.

Plan of Work:

The study was conducted at Thullarvan Farm in an area of 0.2 ha. The following plant spacings were tried in randomised block design in three replications and a net plot size of 18x9m. plant to plant spacings:

i. 30 cm.
ii. 45 cm.
iii. 60 cm.

The distance between lines was 75cm. Recommended dose of fertilizer @ 90-45-25 kg NPK/ha was applied. Entire dose of phosphorus, Potassium and half of N was applied at sowing while remaining N at pre-flowering stage. All other cultural practices were common and those recommended for the tract.

Observations recorded:

i. Plant stand.
ii. Number of bolls per plant.
iii. Number of opened and unopened bolls/plant
iv. Plant height.
v. Seed cotton yield

Trend of Results:

Perusal of the results given in Table-IV-1 indicate that the highest yield of 16.85 q/ha was obtained with 30cm plant to plant distance. Yield showed inversly proportional trend to the intera-row spacing and reduced to 12.1 q/ha when plant to plant distance was increased upto 60cm.

STUDY NO.2: OPTIMUM MANAGEMENT RESEARCH ON SUGARCANE

OBJECTIVE

Although majority of Pakistan's population is engaged in agriculture yet the production has not reached the level of consumption. 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 was proposed to test and develop higher production technology for sugarcane.

Plan of Work:

The study was laid out at tubewell MN-78 during the spring 1981 in an area of 1 ha. Land was well levelled, well drained, salt free and had good quality water supply for irrigation.

The following treatments were tested in randomized block design in three replications.

i. Low fertility-traditional irrigation - No plant protection.

ii. Low fertility, irrigation at 3 bar moisture tension, No plant protection.

iii. Low fertility, irrigation at 3 bar moisture tension, optimum plant protection.

iv. Recommended fertilizer dose, irrigation at 3 bar moisture tension, no plant protection.

v. Recommended fertilizer dose, irrigation at 3 bar moisture tension, optimum plant protection.

Fertility Treatments:

Low fertility represented the average rate of fertilizer application to this crop in the project area which was 50 kg N/ha. Whereas recommended dose 200-90-45 kg NPK/ha.

Irrigation Treatments:

Traditional irrigation means irrigation according to farmer practice and irrigation at 3 bar moisture tension denotes application on development of this stress in the top 30cm. soil depth.

Optimum Plant Protection:

Administration of suitable insecticides in required amount and at required time to provide full protection against insect damage.

Observations recorded:

i. Number of plants/unit area.
ii. Number of tillers/plant.
iii. Cane height

Note:- The crop has not been harvested yet hence yield results could not be reported.

STUDY NO. 3: THE RELATION BETWEEN PLANT POPULATION, WATER APPLICATION, PEST MANAGEMENT AND NITROGEN FERTILITY ON COTTON PRODUCTION.

OBJECTIVE

Good yield is almost unimaginative without optimum number of plants, proper safety against the insect pests and proper fertilizer dose. High plant density and fertilizer inputs offer favourable habitat for insects flourishment which in turn reduce the potential return to the farmers. Commonly, these yield factors are taken independently hence nothing certain concluded. In view of a perfect crop management, these three major factors were taken to influence crop yield in a group.

Plan of Work:

Three fields each having 0.4 ha area were selected one each in the command of tubewells MN-15,56 and at Phullarwan Farm. Lowest population was proposed at MN-56, medium at Phullarwan Farm and the highest at MN-15. Comparable soils were selected at three sites to avoid site differences. The following variables were tested in split plot design in three repeats.

Treatments:

	Locations		
	T.W.56	Phullar-wan Farm	T.W.15
Plant population level	Low	Medium	High
Pest management	Low	Low	Low
	Medium	Medium	Medium
	High	High	High
Nitrogen fertility	Low	Low	Low
	Medium	Medium	Medium
	High	High	High

Plant Population:- Low,medium and high plant population corresponded to 25000,37000 and 50000 plants per hectare.

Pest Management :- Low pest management represented farmer's practice,medium-recommended and high absolute pest control.

Nitrogen Fertility:-Low fertility- Zero N,Medium-70 kg/N and high 140 kg N/ha.

Note:- The highest plant population (50,000 plants/ha) could not be achieved due to crust formation. Although resowing and gap filling was done to come up with the required number of plants but no success was achieved.

Observations recorded:

i. Actual number of plants under each treatment.

ii. Number of flowers and bolls/plant.

iii. Productive and unproductive bolls/plant.

iv. Seed cotton yield.

v. Number of sprays and total cost incurred for each pest management practice.

Trend of Results:

Results shown in Table IV-2 indicate proportionate yield response to the increasing levels of N and pest management. Plant population did not make significant difference on seed cotton yield.

STUDY NO.4: EVALUATION OF WATER REQUIREMENTS FOR SUGARCANE GROWN ON SOILS OF DIFFERENT WATER TABLE DEPTHS

OBJECTIVE

In most cases farmers apply total delta of water recommended for a particular crop, irrespective of water-table depth and other factors regulating water requirements,although at high water table crop water requirements are met from ground-water. With a view to prepare guidelines for efficient use of irrigation water.This study is being conducted on sugarcane crop.

Plan of Work:

. Treatments:

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

The experiment was laid out at four different locations having an approximate water table depth of 0-1, 1-2, 2-3 and 3-4 m from the surface. There were three replications. Fertilizer dose was kept 200-90-56 kg NPK/ha. Entire dose of P_2O_5, K_2O and ½ of N was applied at soving while remaining ½ N at closing in. Irrigation to 3 bar moisture tension treatment was provided on development of this stress in upper 30cm soil depth. For 0-1 m water table depth, the deficit was made good by bringing the soil moisture contents back to field capacity. This deficit was worked out for the upper soil layer overlying the saturated soil. For other water-table depths, the deficit for the upper 1m soil depth was replenished. Siphons were used to apply measured amount of water to each treatment. Traditional irrigation was applied according to farmer's practice. Contribution of water at each water table depth was recorded alongwith effect of each water-table depth on crop yield.

Observations 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. Stripped cane yield.
v. Total delta applied for each water-table depth.

Trend of Results:

Results presented in Table-IV-3 indicate that higher cane yields were obtained with irrigation application at 3 bar moisture tension at all the water table depths. However yield differences were more prominent at water table depths in the range of 1-2 and 3-4m.

STUDY NO.5: 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. Thus crops grown on saline soils need more frequent irrigations to provide favourable conditions for growth, compared with normal soil. The amplification effect of salinity on moisture stress has been widely recognized but very little research has been conducted designed to quantitatively evaluate the amplification effect of salinity on moisture stress and crop production.

Plan of Work:

The study was laid out in an area of 0.2 ha at tubewell LR-66 representing a field having salinity in the range of 8 mmhos/cm. wheat variety yecora was sown in the last week of Nov. and the following irrigation treatments were tried.

i. Irrigation application on the depletion of 20% available moisture.

ii. Irrigation application on the depletion of 30% available moisture.

iii. Irrigation application on the depletion of 40% available moisture.

Soil moisture deficit was replenished in the top 15cm soil for the first irrigation and 30cm for the subsequent irrigations.

Observations recorded:

i. Number of plants/unit area.
ii. Number of tillers per unit area.
iii. Number of spike bearing tillers.
iv. Grain yield.
v. Salinity status before and after irrigation.

Constraint:- The crop received only two irrigations according to proposed plan of work. Soon after the crop received second irrigation, winter rains started and did not permit the operation of scheduled treatments. Since soil was fairly rich in sodium salts hence had poor porosity and allowed prolonged stay of water. This Phenomenon besides disturbing the proposed irrigation pattern, resulted in fair percentage of grainless ears.

STUDY NO. 6: WATER DISTRIBUTION AND SAVING AS AFFECTED BY DIFFERENT SHAPES OF FIELD

OBJECTIVE

Generally the field size is 67.07 x 60.35m 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 the field. However no data on water saving, its distribution and impact of these factors on crop production is available under local conditions. This study was initiated with a view to compare the yield response and the water saving as affected by differently shaped fields.

Plan of Work:

A field measuring an approximate area of one hectare was taken in the command of tubewell LN-94. After precision levelling it was reshaped with the following measurements, each having two replications.

i. 60.4 x 33.5m (½ acre)
ii. 134.1 x 15.1m (½ acre)

Wheat variety Pari-73 was sown in the last week of November. Recommended dose of fertilizer @ 140-5[illegible]-28 kg NPK/ha was applied.

The following observations were recorded.

i. Amount of water applied to each plot for irrigation.
ii. Number of tillers and plants per unit area.
iii. Grain yield.

Trend of Results:

The crop received only one irrigation during initial stages of growth. Later, frequent rain showers did not allow the soil to receive irrigation. Data of one irrigation indicate slightly higher water application to field dimension, 134.1 x 15.1m and proportionately higher yield over 60.4 x 33.5m field (Table IV-4).

STUDY NO. 7: PADDY YIELD AND PLANT POPULATION AS AFFECTED BY SALINITY

OBJECTIVE

Plant to plant spacing of 23cm is generally recommended for rice production on normal soil. Since plant growth may be affected due to 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 was taken up.

Plan of Work:

Site Selection:

A number of fields were sampled to have selection according to experimental specifications but uniform salinity could not be encountered on a single field and variation was quite large. Salinity patches were very irregularly scattered in different shapes and size.

Most of the sampled fields, if had desired ECe range, were high in SAR. The finally selected field had almost 70% samples with ECe upto 8 mmhos/cm and 30% above 8 mmhos/cm.

First year rice crop is in the field and yield data will be reported after crop harvest.

STUDY NO. 8: CARRY-OVER OF WATER IN RICE FIELDS FOR WHEAT PRODUCTION

OBJECTIVE

Wheat follows rice in a considerable acreage. Rice crop generally vacates the land some-where 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 in possession of a fair amount of sub-soil moisture. Commonly these soils are ploughed to restore normal soil structure and soaking irrigation is provided for planting wheat. Due to this, sometimes wheat sowing is delayed considerably which, in turn, affects the yield. This study was proposed to test the concept of minimum tillage and utilization of stored soil moisture to ensure timely sowing of wheat and its effect on yield level.

Plan of Work:

One acre field re-presenting normal soil was selected at Phullarvan Farm. After harvesting rice it was divided into four equal parts to test the following treatments.

i. Thorough preparation of seed bed for wheat planting without soaking irrigation.

ii. Partial tillage for wheat planting without soaking irrigation.

iii. Soaking irrigation and thorough seed bed preparation for wheat sowing.

iv. Soaking irrigation and partial tillage for wheat planting.

Rice field was vacated on 6.11.1981. After two ploughings and two plankings the treatment under partial tillage without soaking irrigation was sown on 9.11.1981. For complete preparation it took an additional period of 3 days for 4 ploughings with even number of plankings. Soaking irrigation was applied on 7.11.1981 and the treatments having partial and thorough tillage were sown on 19.11.81 and 22.11.1981, respectively. Wheat variety Pari-73 was planted and normal fertilizer dose of 140-56-28 kg NPK/ha was applied.

The following observations were recorded:

i. Number of plants/square metre.
ii. Number of tillers/square metre.
iii. Number of spikelets and grains/ear.
iv. Grain yield.

Trend of Results:

The results given in Table IV-5 indicate that the highest wheat yield was obtained in thoroughly prepared seed bed after soaking irrigation. The lowest yield was achieved without soaking irrigation in partially prepared field.

WATER, SOIL AND CROP MANAGEMENT (WSR)

STUDY NO. 1: WEED CONTROL

OBJECTIVE

Weed growth in the field crops especially during Kharif is a problem of deep concern. Weeds compete with the planted crop for moisture, light, nutrients and space besides offering a poor quality produce at harvest. Part of the inputs applied for the crop production is utilized by the inter growing weeds. To check this loss, some of the suitable chemicals, available with the firms operating in Pakistan were tested alongwith manual weeding to compare their cost, effectiveness in terms of weed control and crop yield. Research work was taken up on wheat, sugarcane and rice crops and progress concerning each crop is discussed as under:

Sugarcane:

The experiment was laid out at tubewell LB-76 in an area of 0.4 ha, in randomized block design in three repeats. Crop was planted in the first half of March and fertilizer dose was 200-90-50 kg NPK/ha Irrigation was applied on crop demand basis and appropriate insecticides were administered to control insect pests. Following treatments were tested:

i. No weed control
ii. Best weed control.
iii. Gramaxone 2 lit/ha pre-emergence
iv. -do- 3 -do-
v. -do- 2 post-emergence
vi. -do- 3 -do-
vii. Gesapax combi 6 lit/ha post emergence
viii. -do- 9 -do-

Observations Recorded:

i. Number of plants and tillers/unit area.
ii. Millable and non-millable tillers/unit area.
iii. Cane height and cane weight.
iv. Cane yield/plot.
v. Labour requirement of each treatment.

Trend of Results:

Results given in Table IV-6 indicate that upto 50% increase in cane yield can be obtained through complete weed control. Amongst the two weedicides tried gesapax combi @ 6 lit/ha gave better control of weeds and higher cane yield.

Wheat:

The experiment was conducted at Phullervan Farm in randomized block design in three replications. Wheat variety yecora was planted in the middle of November. Recommended fertilizer dose @ 140-56-28 kg NPK/ha was applied according to recommended practice. The crop received two irrigations during the season. Following treatments were tried.

i. No weed control
ii. Normal weed control.
iii. Best weed control.
iv. Dicuran 2.5 kg/ha post emergence application.
v. Dicuran 3.0 -do-
vi. Afalon 1.0 Pre-emergence
vii. Afalon 1.5 -do-
viii. Afalon 1.0 Post-emergence
ix. Afalon 1.5 -do-
x. Banvel 0.28 lit/ha -do-
xi. Banvel 0.42 -do-

Following observations were recorded:

i. Number of plants and tillers/unit area.
ii. Number of spikelets and grains/spike.
iii. Grain yield.
iv. Labour requirements of each treatment.

Trend of Results:

The results given in Table IV-7 show that the highest grain yield of 44.07 q/ha was obtained through best hand weeding followed by dicuran @ 3 kg/ha post emergence application. No weeding gave the lowest (26.13 q/ha) yield.

Rice:

The experiment was laid out at tubewell LH-78 in an area of 0.4 ha in randomized block design in three replications. Fine variety, B-370 was planted in the middle of July in lines spaced 30cm. Recommended fertilizer dose i.e. 120-60-30 kg NPK/ha was applied during the crop season. All P and K and 1/3 N was applied at sowing while remaining 2/3 at tillering and panicle initiation in equal instalments. The following treatments were tried:

i. No weed control
ii. Normal weed control(farmer's practice)
iii. Complete weed control.
iv. Aviroson @ 23 kg/ha 10 days after transplanting.
v. -do- 29 -do-
vi. -do- 35 -do-
vii. Treflan @ 4 lit/ha 5 days after transplanting.
viii. -do- 6 -do-
ix. -do- 8 -do-

Observations Recorded:

i. Number of plants/square metre.
ii. Number of productive and unproductive tillers/sq.m.
iii. Weed count under each treatment.
iv. Cost of weed control.
v. Paddy yield.

Trend of Results:

The results given in table IV-8 indicate that higher paddy yield was obtained by controlling weeds mechanically and with treflan at the application rates of 6 and 8 lit/ha yet cannot be relied upon since the crop had sporadic root infection during initial growth stages which caused complete failure of the affected plants. The attack was more severe in the centre and less at the sides. Moreover it was not specific to any chemical but was observed in all treatments including control. Inspite of the application of granular insecticides the infection could not be controlled.

STUDY NO.2: LAND LEVELLING AND LAND FARMING

OBJECTIVE

Levelling of land is beneficial as it improves irrigation and fertilizer use efficiency which ultimately results in increased production. Reshaping of fields by increasing the length and reducing the width also helps in water saving. Although this has been proved under experimental conditions but the farmer's response has so far been conservative. In order to demonstrate the benefits of levelling in terms of high crop yields four to six acre plots are being established at improved watercourses.

Plan of Work

One hectare area was selected with a farmer having mostly unlevelled fields in the command of tubewell SHP-20. It was precision levelled and reshaped into 0.2 ha units for irrigation. Wheat variety pavon was sown in December. Recommended dose of fertilizer @ 140-56-28 kg NPK/ha was applied. Following irrigation levels were tested.

i. One irrigation during the growth period.
ii. Two irrigations during the growth period.
iii. Three irrigations during the growth period.

Farmer's irrigation practice on a traditional levelled, adjacent plot, similarly fertilized were observed for comparison purposes. Farmer applied three irrigations during the crop growing season and looked even ambitious to apply more irrigation if he had some more water at his disposal.

Following observations were recorded:

i. Number of plants and tillers/square metre.
ii. Grain yield of levelled and unlevelled farmer's field.
iii. Number of irrigations applied and depth of irrigation delta to both the fields.
iv. Distribution of irrigation water in the wheat plots.

Trend of Results:

As reported in Table IV-9 wheat yield was significantly higher on levelled field even with one irrigation as compared with traditionally levelled plot. Yield increased with increase in number of irrigations on precision levelled plots.

TABLE:IV-1 SEED COTTON YIELD AS AFFECTED BY DIFFERENT SPACINGS

Plant spacing	Yield (q/ha)
30cm	16.85
45cm	15.81
60cm	12.10

TABLE:IV-2 SEED COTTON YIELD AS INFLUENCED BY PLANT POPULATION PEST MANAGEMENT AND NITROGEN FERTILITY

(Yield q/ha)

Nitrogen(kg/ha)	Treatments: Pest Management	Plant population/ha: 25000	37000
Nil	Poor	5.62	5.85
	Medium	7.13	6.81
	Best	7.57	7.66
70	Poor	9.81	9.82
	Medium	12.18	12.53
	Best	12.60	13.30
140	Poor	11.21	11.83
	Medium	13.60	13.90
	Best	14.60	14.83

TABLE:IV-3 CANE YIELD AS AFFECTED BY IRRIGATION PRACTICE AT DIFFERENT WATER-TABLE DEPTHS.

(Yield ton/ha)

Treatments	Water Table Depths(m) 0-1	1-2	2-3	3-4
Traditional irrigation(Farmer's practice)	49.15	64.35	52.16	74.28
Irrigation at 3 bar moisture tension.	54.73	78.28	56.61	84.24

TABLE: IV-4 IRRIGATION DELTA AS AFFECTED BY DIFFERENT FIELD DIMENSIONS

Field Dimension	Depth of irrigation (cm)	Wheat Yield(q/ha)
134.1 x 15.1m	10.14	24.22
60.4 x 33.5m	8.84	22.53

TABLE:IV-5 WHEAT YIELD AS AFFECTED BY PRE-PLANTING IRRIGATION AND TILLAGE

Treatment	Yield(q/ha)
Partial tillage and sowing without soaking irrigation.	30.50
Thorough preparation and sowing without soaking irrigation.	36.28
Partial tillage and sowing with soaking irrigation.	35.88
Thorough preparation and sowing with soaking irrigation.	41.86

TABLE:IV-6 CANE YIELD AS AFFECTED BY DIFFERENT WEED CONTROL METHODS

Treatments	Cane yield (ton/ha)
No weed control	55.980
Best weed control	83.501
Gramaxone 2 lit/ha pre-emergence	55.743
-do- 3 -do-	64.037
-do- 2 post-emergence	60.968
-do- 3 -do-	64.746
Gesapax Combi 6 lit -do- 500 FW	77.059
-do- 9 lit -do-	62.462

TABLE:IV-7 WHEAT YIELD AS AFFECTED BY DIFFERENT WEED CONTROL METHODS

Treatments	Yield(q/ha)
No weeding	26.13
Normal weeding	32.47
Best weeding	44.07
Ticuron @ 2.5 kg/ha post emergence	36.89
-do- 3.0 -do-	38.09
Afalon 0 pre-emergence	35.88
-do- -do-	35.46
-do- 1.0 post-emergence	34.26
-do- 1.5 -do-	37.25
Banvel 0.28 lit/ha -do-	33.66
-do- 0.42 lit/ha -do-	34.80

TABLE:IV-8 PADDY YIELD AS AFFECTED BY WEED CONTROL TREATMENTS

Treatments	Yield (q/ha)
No weeding	26.92
Normal weeding(farmer's practice)	33.23
Best weeding	31.78
Avirosan @ 23 kg/ha	27.68
-do- 29 -do-	27.55
-do- 35 -do-	27.32
Treflan @ 4 lit/ha	27.95
-do- 6 -do-	29.57
-do- 8 -do-	29.78

TABLE:IV-9 WHEAT YIELD UNDER DIFFERENT IRRIGATION LEVELS ON LEVELLED AND UNLEVELLED FIELDS

Treatments	Wheat yield(q/ha)
One irrigation on precision levelled land.	29.12
Two irrigationson precision levelled land.	33.25
Three irrigations on precision levelled land.	35.88
Three irrigations on traditional levelled land.	24.22

CHAPTER-V

AGRICULTURAL ECONOMICS

Agricultural Economics Section is responsible to conduct Bench Mark Surveys, prepare feasibility reports and evaluate new techniques and methods of land reclamation and various irrigation development programmes carried out at Mona Project. A future line of action is determined on the basis of recommendations made by this section. In addition, the Section is also conducting research in the field of Farm Management, Crop production and optimal allocation of input resources as to maximize benefits. During the year under report following 8 studies (5 in respect of Mona Reclamation Experimental Project and 3 in respect of Water Management Research) were started whose status is given below:

Title	Status
1. Overtime resource adjustment patterns on farm using brakish and sweet waters.	Questionnaire was prepared, tested in the field and finalized. Survey work completed. Summary tables were prepared and write up of report in hand.
2. Bench Mark Survey of the area selected for integrated development of watercourse command area.	Survey work completed. Data analysis and draft report will be finalized shortly.
3. An economic comparison of private versus public tubewells in the Mona.	Data sheets were prepared. Tubewells data and farmers interviews were recorded. About 50% editing of interviewing schedule has been completed.
4. An evaluation of the socio-economic Impact of Mona Reclamation Experimental Project.	Questionnaire tested in the field and finalized.
5. Socio-economic analysis of Shahpur (SCARP Unit-I).	Completed.
WATER MANAGEMENT RESEARCH	
1. Socio-economic factors that constraint water management efficiency.	Survey work completed and data analysed. Draft report prepared. Final draft will be finalized shortly.
2. Evaluation of cropping intensity coordinated to actual water supply.	Sanctioned discharge of canal and public tubewells collected. The actual water supplies are being measured with flumes. Matrix of L.P. model has been prepared.
3. Bench Mark Survey of Tubewell SHP-19 Watercourse No. 46000-L.	Final draft completed.

STUDY NO.I: OVERTIME RESOURCE ADJUSTMENT PATTERNS ON FARMS USING BRAKISH AND SWEET WATER

IMPORTANCE

Underground water reserves,if exploited,can play an important role to fulfill water requirement in Agriculture sector.In fact,these resources are an integral part of irrigation system in Pakistan. About one third of the total water supplies to farms comes from underground water reservoirs, Total underground water reserves have been estimated to about 40 million acre feet.If we exploit these resources properly we can expect a tremendous increase in water supplies to fullfil water requirements of crops in future.

Generally speaking the quality of underground water is not as good as surface(canal) water.The analysis of underground water resources exploited upto date has shown that these are high in TDS, SAR and RSC as compared to canal water. Percentage of injurious salts present in underground water varies from place to place. Broadly speaking,underground waters can be classified as under with respect to their quality.

	TDS	SAR	RSC
1. Hazardous water	More than 1500 ppm	More than 15	More than 5 m.e/lit.
2. Marginal water	1000-15000 (ppm)	10-15	2.5 - 5 me./lit.
3. Useable water	below 1000 ppm	below 10	below 2.5 m.e./lit.

In Mona Project area about 32,8 and 60 percent tubewells are pumping hazardous,marginal and s useable water respectively.If we look at Mona statistics,about 40 percent tubewells pump poor quality water,which have negative effects on crops and soils and ultimately on economic prosperity of the area.

Mona Project started operating in 1964-65. Since then underground water is being used on large scale for irrigation purpose.Sooner or later during operational period,bad quality water started creating problems.Upto date figures shown that about 18 tubewells have been closed in Mona Project due to pumping brakish water.It was a mere wastage of valuable public funds besides other harmful effect of brakish water on land and crops. It is important to study the ill effects and resources adjustment patterns due to brakish water used for irrigation purposes over a period of time.

OBJECTIVES

* Comparison of cultural practices, use of inputs and income of farms receiving waters of different quality.
* Evaluation of the effect of different quality waters on crop yields and farm income.

METHODOLOGY

Tubewells of perennial area were stratified into two groups. Those pumping water with 1204 TDS, 16.05 SAR and 3.13 RSC were named as brakish and others pump water with 426.67 TDS, 1.9 SAR and Zero RSC were classified as sweet. Three tubewells each from brakish and sweet water were randomly selected. Nine farmers were randomly selected on each tubewell, thus 27 farmers each from brakish and using sweet irrigation water were interviewed. Information about cropping patterns, inputs, costs and returns, etc. were recorded on preplanned and tested questionnaires.

TENTATIVE RESULTS

1. According to survey it has been found that eighteen tubewells have been closed in Mona Project due to poor quality of water. These tubewells were deteriorating soil and have bad effect on plant germination and crop yields.
2. Farmers on brakish water tubewells are using higher seed rate per hectare for the following crops; Kharif Rabi Fodder, Wheat, Cotton, Sugarcane and Rice.
3. Farmers on brakish water tubewells are applying more irrigation water/crop compared to farmers on sweet water tubewells.
4. Farmers on sweet water tubewells have shown higher cropping intensity.
5. Farmers on brakish water tubewells are using higher dose of FYM especially for citrus orchards and fodder crops.
6. Farmers are unaware of scientific methods of land reclamation and adoption of more salt resistant crops.

STUDY NO.2: BENCH MARK SURVEY OF THE AREAS SELECTED FOR INTEGRATED DEVELOPMENT OF WAT-E-COURSE COMMAND AREA

Efforts are being made to apply full package of new technology developed at Mona on a watercourse command area. For this purpose tubewell MN-93 has been selected. Before application of farm land, water and crop management technology, bench mark survey of the area as to measure the state of economy is recommended. For this purpose Agri. Economics Section carried out a survey in which pre-conditions of the area has been marked.

OBJECTIVES

* Analysis of existing agricultural economy of the areas selected for application of farm land, water and crop management technology.

* Assessment of the changes and their economic evaluation in overall agricultural economy on account of application of farm innovations viz, management of irrigation supply, introduction/* techniques use of marginal quality water, better cultural practices and standard use under problematic and water condition.

/*of soil reclamation

Complete analysis of the survey is still awaited but some tentative results have been derived and summary is given as under:

1. Gross area of the command is 157.09 hectares, cultivated area being 148.58 hectares and un-cultivated area is 8.5 hectares.

2. Generally, the type of soil is clay loam, 4.86 hectare of land was affected by water-logging, 2.83 hectares area affected a by salinity and about 7.29 hectare is un-levelled and require proper levelling.

3. Total supplies of water from canal and tubewell per month are 145.79 acre feet, of which 61.88 acre feet from canal and 83.90 feet water is supplied from public tubewell. There is no private tubewell in the command of tubewell No-93. Main watercourse as well as farmers branches are in poor conditions. Heavy water losses occure during conveyance and field application. Magnitude of losses are higher than 50 percent of the total supplies at head.

4. Major crops sown in the area are citrus fruit, wheat, fodder, rice, cotton and sugarcane etc. besides crops animal rearing such as cows, buffaloes goats and sheep are also common with farmers.

5. In the watercourse commanded area cropping pattern constitute 42% food crops, 33% cash crops and 27% fodders.

6. Cropping intensity during Kharif 1979 was 50.34 and during Rabi 1980-81 was 73.19. Annual cropping intensity is 123.53.

7. Per hectare yields of different crops are, cotton 370 kg, sugarcane 31.36 metric tons, rice 1.81 metric tons, Wheat 1.53 metric tons, Garden Rs. 6058.38, Rabi fodder Rs. 3918.97 and Kharif fodder Rs. 1062.42.

8. 30 pair of bullocks and one tractor providing draft power for cultivation. Among improved implements 15 mould board ploughs, one bar harrow, one ridger and one thresher is available in the command area.

9. Live stock strength is 342 animals of which draft animals are 132,milch-68, Y.stock-19,Donkey and horses 6. Goats and sheeps are 54. Animal and land ratio comes 2.31 per hectare.

10. Total number of families depending on land directly are 30 in number,at least two family members are whole time employee on farm.Average family size comprises 7 members. The total population of the area is about 210 persons. Land man ratio comes 1.5 per hectare.

11. Three tenure classes exists i.e.owner operators,owner cum tenants and tenants being 60%,10% and 30% respectively.

12. Three kind of farm labour i.e.family,permanent hired and casual hired labour is generally employed.Average cost of total mannual labour employed/cropped hectare is Rs.168.27.

13. Farmers are mostly un-educated but have learned farming techniques from their parents. Out of 30 farmers 27 are un-educated.

14. Gross income/cropped hectare is Rs.4485.95 while total cost of inputs/hectare is Rs.2149.8. Thus net income per cropped hectare is Rs.2276.15.

STUDY: SOCIO-ECONOMIC BENCH MARK SURVEY OF SHAHPUR SCARP UNIT-I

The scarp Shahpur unit one is a part of SCARP-II falling in the north central part of Chaj Doab Between Shahpur branch of lower Jhelum canal and the river jhelum. The project area covers 27530.30 hectares of which 25506.07 hectares are culturable.The date has 64 villages,of these 43 are non-perennial and 21 are un-commanded. 161 tubewells have started working during 1977.Bench mark survey with the objectives to provide basis of various socio-economics conditions of the area has been completed.Survey reports explain pre-conditions of Shahpur SCARP Unit-I.

SUMMARY OF RESULTS

1. Shahpur SCARP Unit-I has two modes of irrigation. (a) Non-perennial (b) Un-commanded. Out of 64 villages about 43 villages are served by Non-perennial canal system and the rest are un-commanded.

2. Average size of holding was 4.44 , 4.62 and 4.49 hectares in respect of non-perennial,un-commanded and overall project conditions. On over all project basis 60 percent holdings were fragmented which comprise 55 percent non-perennial, and 73 percent from un-commanded area.Main reasons of fragmentation were inheritance,purchase,rentings and other which influenced to the extent of 85,10,8 and 3 percent respectively.

3. About 90 percent of gross area was cultivated and 10.3 percent was un-cultivated of which 3.4, 5.6 and 1.3 percent was banjar jadeed, banjar qadeem and not available for cultivation.

4. Major farming activities include raising of crops like sugarcane, rice, cotton, Kh. fodder, Rabi fodder, wheat and Lehndi. Besides, crops animal rearing is also common which include buffaloe, cow, goat, sheep and donkey etc.

5. Cropping intensity on an average worked out to be 122 for non-perennial area, 99.8 for uncommanded area and 108.4 for overall project basis. In the non-perennial area about 60% areas were occupied by food crops, 13% by cash crops and 36% by fodder. In the un-commanded area corresponding figures were 56, 12 and 27.

6. Use of inputs was highly substandard, mostly seed used was home produced, average dose of FYM varied between 2.5 to 3.5 metric ton per hectare against requirement of 15.0 metric tons. About 17 to 40 percent of farmers were using fertilizer to 20-40 percent of area under main crops. Rate of application per cropped hectare worked out to 16.8 =30.25 kg. of nitrogen and 1.12 ÷ 3.38 kg. of phosphorus. Plant protection coverage was very low.

7. Crop yields were also very low i.e. 21466.5, 223.5, 1452.6, 651.8, 1080.18 and 264.46 kg. per hectare for sugarcane, cotton, rice, maize, wheat and oilseeds for overall project.

8. Marketable surplus for sugarcane, cotton, rice, maize and wheat worked out to be 53, 43, 57, 45 and 19 percent.

9. Input costs worked out to be Rs. 16004, 14167 and 15430 per holding for non-perennial, un-commanded and overall project area.

10. Gross farm income were Rs. 14608 per holding in non-perennial area of which 62% derived from crops, 37% from livestock and 1 percent from misc. sources. Simmilarly it was Rs. 11752 per holding in uncommanded area of which about 60, 39 and 1% derived from crops, livestock and misc. sources. On overall project basis gross income per holding was Rs. 13724, of which 62, 37 and 1 percent was accrued from crops, livestock and misc. sources respectively.

11. An overall whelming majority of the farmers are illitrate. There are about 9 caste groups. Janglies dominate refugees and settlers. As far as adoption behaviour is concerned majority of farmers are laggards.

12. Nuclear type families are more common being 65 percent of which 32 percent are of extended type and rest of 3 percent are un-married. Family system is parti-local and parti-archeal. Average size of family is 6 person per house hold However, the stregth of 2,3-4,5-6,7,8 and above 9 numbers families are 3,18,32,13,12 and 22 percent respectively.

13. Endogamous marriages are more common. On overall project, basis almost 80 percent marriages are of endogamous nature, and 20 percent are of exogamous nature.Polygamy(for men only) accounted for 10 percent farmers.Generally people marry in the age group of 17-21 years and 22-26 years age. For both son and daughter the most common expenditure range is Rs.4001 to 10,000. "Sharai haq Mehar" is more common.

14. Educational aspirations are relatively much favoured for made children.About 8,2,9,51.24 and 6 percent farmers aspired for no education or islamic education,primary, middle,matric above matric and un-decided level.Whereas for female children 83% aspired for no or islamic education. About 53 percent respordents like that their children should serve various Government departments.

15. Generally the housing conditions are poor as about 60% respondents have to live under these.Another 25% were having satisfactory housing conditions and rest 15% have enjoyed good housing conditions.About 88 percent respondents have hand pumps for water supply right in their houses.

16. Value indicators regarding family,religion,bussiness, rationalism and the science(knowledge) were studied, analysis regarding these indicates that farmers are generally bussiness minded and rationalistic.However,most of them are still family oriented and traditional in beliefs. Status of women was though to the inferior to men.These appear due to some un-consistency in their orientation in general which is an indicator of transitory trend of society.

17. Marketing facilities and intelligence are scanty in nature. Both transportation and communication were also of unsatisfactory level.Still the primary and secondary unregulated markets are main bargaining centres for most farmers.

18. Services of beneficient departments were inadequate both from coverage and quantity points of view,only one Agri. Officer,two vetinary doctors are available among professional Agri.staff quantum of seed and fertilizer supply was also meagure.Agri.credit flow is extremely poor.

19. There is one sugarmill,one milk plant around the project area.A small wheat milling plant and a rice husking plant was found. There were two large and four small plants for processing of "Mehndi".

STUDY: ECONOMICS OF CROPS PRODUCTION

IMPORTANCE

Various farm production activities are going on in Mona project area. The most common activities are raising of citrus culture, sugarcane, rice, cotton, fodder, wheat and hena crop. Besides crops animal raising is also very common which includes rearing of cows, buffaloes, sheep and goats. Some basic components of to-days farming are tractors, tubewells and wheat thresher. Unit-wise economic evaluation of all these activities will provide useful information to planners and policy makers. Results of this report will also be helpful to farmers in deciding what to grow to maximize net revenue.

METHODOLOGY

Information about cost and revenue was collected for the period 1979-80 for major crops sown in Mona Project area. Random sampling technique was used and 5 percent sample was drawn. Data was recorded on interviewing schedule. Benefit cost ratio was arrived using present worth benefits and cost formulae. This report is scheduled on 1981-82, but as we have completed the work on major crops therefore, summary of results are being furnished for annual reports.

SUMMARY OF RESULTS

CITRUS FRUIT:

Rapid economic growth, resulting increased per capital income has pushed up demand for palatable food. Citrus provide nutritious food rich in vitamin c and calories. Citrus is an important fruit crop of Sargodha area and yields higher income per hectare compared to other agricultural crops. Fruit industry in Pakistan is at its initial stage but has a lot of scope for future to meet the need for domestic consumption as well as for export.

Citrus plants can be grown on medium textured soils. where underground water table depth is below 12 to 15 feet. Citrus growing areas of Pakistan are Sargodha, Multan, Lahore, Peshawar, Rawalpindi, Bahalwalpur Divisions,. It is also grown in hilly tracts of Punjab. Citrus plants are sown in March, September, October, and November. About 200 to 250 plants are generally grown per hectare. Citrus trees last for about 15 years. Wheat, Berseem, Cotton and some vegetables are generally intercropped at early stage.

Weekly irrigation in summer and fortnightly irrigation in winter except rainy season is required. Interculture, weeding and fertilizing is essential for proper norishment of plants. Sufficient pronning is recommended at oldage. Spraying is done to keep plants healthy conditions, usually farmers sell this crop while standing in the fields. Picking, packing and transportation charges are paid by contractor. This crop bear fruit after 3 years and continues fruiting for 15 years.

Sugarcane:

Sugarcane is a cash crop and produces sugar.It is a crop of tropical and sub-tropical areas,therefore its cultivation is going on successfully all over the country.It requires fertile well drained soil with abundant water supply.The crop requires thoroughly prepared seed bed.Four to six ploughings and the same number of planking should be given for preparing the seed bed.It requires enough manure and fertilizer.Generally sown in March and harvested in October,November, December,January,February and March.

Rice:

Rice is the most important cereal and can be grown in tropical and sub-tropical areas.It is grown all over the country,but very common crop is SCARP areas.It thrives well on heavy clay loam soil,with plenty of water and rain fall.It is successfully grown on water logged areas,where other crops seldom survive.Rice crop requires 2 to 4 ploughings in standing water with almost the same number of plankings.This crop is sown from April to July and harvested from September to November.Nursery is prepared for this crop and then transplanted into the fields.It requires 50 to 60 inches water to mature.

Kharif Fodder:

Kharif fodder includes Maize,Jowar,Bajra,Guara,Moong,Mash,etc; but Jowar is one of the most important Kharif fodder with high feed value.It is generally mixed with guara,moong and mash etc.

It can be grown on variety of soils,but medium to heavy loam soil is considered better for its growth. 3 to 4 ploughings are enough to prepare the seed bed.Its sowing starts from March and goes upto September.The crop is ready for cutting in about 2 months time. 59 to 74 kg. seed is enough for fodder/ha.

Cotton:

Cotton is grown in tropical and sub-tropical areas and hence is being grown successfully all over the country except mountaneous and sub-mountaineous tracts. The crop can be grown on all types of soils except waterlogged areas and sandy soils.The best crop can be had on rich loamy soil.Scarp areas are not very suitable places therefore a falling trend can be observed in waterlogged areas.

Cotton is used in Textile Industry at home and is being exported to other countries for exchange earnings.It is a cash crop for growers. Its sticks are used as fuel cooking in villages.

Three to four ploughings and three plankings are required for this crop.Cotton is generally sown in June and picking begins from October and continues upto the end of January.It requires 5 to 7 irrigations. Watering at flowering and boll formation should be given with more care and attention.Remedial measures for insect and pest attacks are essential to fetch good yield.

Mehndi:

The cultivation of mehndi is restricted to south western parts of Punjab only. It is widely grown in Tehsil Bhalwal of District Sargodha and has become a particular crop of the area.It grows in all types of soil ranging from light loam to clay loam with deep water table.It does not grow on waterlogged and saline soils.The seed is first got sprouted and then sown.Three kilograms of seed is spread over a nursery seed bed and covered with a fine layer of manure in March-April.Then remain irrigating till nursery is ready for transplanting in July.The distance from plant to plant and row to tow should be one foot.Four to five irrigations are enough during a year.Occaional hoeing and weeding should be done.

The crop is harvested twice a year,once in October and then in May.Farmers sell this crop to contractors on area basis.Mehndi crop gives low yield for first 2 to 3 years and then goes on increasing. It is a perennial plant and losts for many year.It is used to prepare dyes which are used in Textile industries etc.It is also used by women folks as cosmetics.

Wheat:

Wheat is the most widely world's cultivated plant.It is the leading cash and grain crop in many parts of the world.It is used as staple food in one form or the other.The main products are bread, biscuits,cakes,double rotti,pasteris,cream rools and Dalia. Besides this it is also consumed in roasted and cooked form.It is also used as feed to animals in whole or ground form. Its straw; green or dry serves as fodder.The dry straw is turned into wheat bhoosa and fed to animals,either mixed with green fodder or concentrates.

It is culi-vated throughout the country on all types of soils, except water logged and alkaline soils.The best suited soil is medium loam.For raising successful crop, 6 to 7 ploughings and 4 plankings are essential.Its sowing starts from October and continues upto December but the optimum sowing time is the month of November.

Rabi Fodder:

Rabi fodder includes barseem,shaftal,senji,metha,sarsoon, turnips and oats. Most promising and popular fodder is barseem.It is used as green fodder.It gives 4 to 6 successive cuttings from November onward upto June.It requires heavy loam to medium loam soil. It is sown from middle of September to middle of November.Eight to 10 seers of seed is enough for sowing one acre of land.First cutting gives poor yield.Due to tender growth.barley,oats, sarsoon are generally mixed as to get good yield for first cutting.It requires watering after every 10-15 days,till the crop is over.

BENEFIT COST ANALYSIS

Crops	Present worth benefits (Rs)	Present worth costs (Rs)	Benefit cost ratio
Citrus	53931.42	22644.37	2.38
Sugarcane	8118.00	5420.64	1.50
Rice	3756.80	2193.46	1.71
Kharif fodder	1581.44	1198.60	1.32
Cotton	2592.00	1950.00	1.32
Mehndi	26754.04	18961.38	1.41
Wheat	3118.68	2376.78	1.39
Rabi fodder	3954.00	2626.35	1.50

Above table reveals that among different production alternatives citriculture is the most profitable as it gives highest benefit cost ratio. Second best is rice production and third is sugarcane and Rabi fodder. Over all farming bussiness is not very attractive especially for those new entrants who want to adopt this profession.

ECONOMICS OF WATER AND CROP MANAGEMENT

STUDY: SOCIO-ECONOMICS FACTORS THAT CONSTRAINTING WATER MANAGEMENT EFFICIENCY IN MONA PROJECT AREA.

IMPORTANCE

Irrigation water is the most limiting factor of Agriculture production on account of deficit water supplies. However in SCARP area with installation of public tubewells, the available water supplies was increased from about 1 cusec/350 acres to about 1 cusec/150 acres. Yet the cropping intensity increased from about 100 percent to 127 percent only. In addition during seventies the idea of reducing watercourse conveyance losses conductive to about 30 to 50 percent increase in water supplies was developed and tested in the project. As a consequence many watercourses have been improved using various techniques viz; different lining earthen improvement, cleaning and maintenance. All these lead to an increase of water supplies more than 100 percent compared to 1964-65. This increase in water supplies registered very low response in increasing cropped area as cropping intensity as present is around 128-130 compared to 100 during 1964-65, which should have principally touched the figure of near 200. In fact on some watercourses cropping intensity has reached 180 to 200. Farmers are smart and well organized on these watercourses and they have used irrigation water most efficiently. But majority of farmers and their watercourses are still low in cropping intensity in SCARP area. In other words, water, a scarce factor of production is not being used efficiently, certainly there must be some bottle-necks/ constraints in the way of attaining desired level of water use efficiency(WUE).

OBJECTIVES

* To identify socio-economic factors that constraint water measurement efficiency.
* How various constraints effect WUE.
* To suggest remedial measures as to improve water use efficiency(WUE) in SCARP areas.

METHODOLOGY

Universe(Mona Reclamation Experimental Project Area) was stratified into two major groups i.e. efficient water users and inefficient water users. Improved watercourses where water delivery efficiency (DE) was about 75 percent and have water users associations were called efficient water users. Three watercourses from efficient and the same number of in-efficient were selected. As three mode of irrigation system exist in Mona Project area i.e. perennial, non-perennial and uncommanded.

Two watercourses from each command, one efficient and second in-efficient was randomly selected. Data was collected by interview method and recorded on preplanned and tested questionnaire.

SUMMARY OF RESULTS

Three types of constraints were identified, physical, social and economic. Among these physical constraints were deposited silt in watercourse near moghe, watercourse designed capacity and level broken and zig-zag watercourse banks, deteriorated sections of watercourse adjoining to fuccas, grass, shrubs and trees on watercourse banks, animals and rat holes. Social constraints were non-existing water users Associations, unhealthy and greedy leadership in rural communities, factionalism among brotheries and lack of experience in cooperative work. Economic constraints include uneven distribution of benefits of water management programme and equal contribution of labour, un-consolidated and unviable farm size, sub-standard cultural practices, un-levelled field, non adoption of water saving practices, low rate of return due to high cost of agricultural inputs uncertainly and natural hazards are some of the constraints in the system of efficient water use.

1. It has been found that some constraints, even on improved watercourses(Efficient water users) exists, when considering application efficiency. Intensive extension services can help to remove these hurdles by teaching farmers how to use water more efficiently. As for example making smaller plots for irrigation, precision land levelling, ridge sowing, multch formation and weeding etc.

2. Active water users associations can remove many constraints especially to increase delivery efficiency through mobilizing their fellow farmers and by desilting and regular cleaning of watercourses. Removing vegetation, keeping animals away, killing rats, reconstructing broken watercourse banks etc.

3. Earthen improvement which provide proper design specifications, replacing permeable side banks with fresh compacted soil and installing concrete outlets. This type of improvement use relatively little capital and can utilize labour that is available during slack periods of the year. Earthen improvement bring highest return and is considered best investment. This programme can be most successful if government provide incentives to both parties i.e. farmers and supervisory staff. Further it has been found that gifting upto Rs.500/- per improved watercourse to supervisory staff and providing free pucca nuccas to farmers can activate and mobilize rural communities to do the job properly.

BENCH MARK SURVEY OF WATERCOURSE NO.46000-L TUBEWELL SHP-19

Tubewell SHP-19 watercourse channel is under consideration for improvement with brick lining.To evaluate development programme in future necessitate bench mark survey which explain pre-improvement conditions of the watercourse command area. Bench mark survey reports help to measure changes in social,economic and agronomic variables as they provide base line for a development programme. Agricultural Economics Section has conducted a bench mark survey during April 1980. Summary of results is as follows:

SUMMARY OF RESULTS

1. Gross area of watercourse No.46000-L at tubewell SHP-19 is 132 hectares of which 104.86 hectare is cultivated-culturable area and 27.13 hectares uculturable.
2. Type of soil is generally clay loam.
3. Area is served by non-perennial canal with 1.11 cusecs discharge of moghe and have a public tubewell with 1.5 cusecs discharge.Total supplies of irrigation water in kharif are 38.77 acre feet/week while 17.36 acre feet/week in winter.There is one private tubewell which supplies 50 acre feet water annually.
4. Farming activities include growing of wheat,fodder, sugarcane,rice,cotton and Lehndi while animal rearing is also common with farmers,such as cows,buffaloes,sheep, goat etc.
5. Live stock strength consist 159 draft animals,153 buffaloes 102 cows,180 young stock,24 donkeys and 6 horses,total 465 animals making 3.5 animals in one hectare land.
6. Majority holds 0-5 hectare of land.
7. Cropping intensity for kharif 1979 was 50.48 and for habi 1979-80 was 67.17. Thus making annual cropping intensity about 117.65.
8. Per acre yields of different crops is very low such as sugarcane 13.66 m.tons,rice 1.21 m.tons,wheat 1.65 m.tons, and cotton 451.44 kg. per hectare.
9. Time to irrigate per hectare is about 6.18,8.03,11.12 hours on head,middle and tail farms.

10. Distribution of irrigation water on this watercourse is not fair, canal water is being used by farmers of one village. While tubewell water is used by farmers of an other village Farmers are not following warabandi system because of physical barrier i.e. land elevations etc. Therefore, proper mixing of tubewell and canal water is not taking place. Even farmers of the same village lack proper distribution of water among themselves. Stronger use more irrigation water than the weaker.

11. Water ways are not properly maintained hence causing water losses during conveyance and application. Magnitudes of losses are higher than 50 percent.

12. Farmers are un-aware of techniques of using irrigation water more efficiently.

13. Farm labour comes from family members and during peak period mutual help by neighbour and relative farmers is also practiced.

14. The watercourse had 60% local farmers and 40% settlers.

15. Most of the cultivators (77 percent) were primarily educated. Only 7 farmers were literate of which one got education upto primary level, two upto metric three upto middle and one received education upto F.A. levels.

CHAPTER-VI

STATISTICS SECTION

This section is responsible to prepare plans and design for various studies being conducted by different disciplines on Soil, Water and crops. Different sampling techniques are used to draw samples for the various surveys conducted in the project area. The section plays an important role in drawing meaningful results from research data. The data is statistically analysed, interpretted and presented in the form of graphs and diagrams to make the comparison more comprehensive and to look the result at a glance.

Programming is also an important assignment of this section. The research programme conducted at project ganerates quite a lot of data. Its computor analysis necessitates programming. To shoulder these responsibilities, the section codes the data and then frames the programmes for computor analysis. In addition, mathematical, models are also proposed to show input-output relationship of the data. An other important assignment of the section is crop putting survey. The crop cutting survey reveals the true picture of the crops yields and other agri. activities in the project area. The survey is carried out in collaboration with the Extension Section to determine the level of factors management followed by the farmers. The master charts are also prepared from the results of these surveys.

ACHIEVEMENTS

This section successfully rendered its services and provided all kinds of statistical guidence to the various formations at every step. This section developed input and output relationship of the major agricultural crops in the project area. Mathematical models were prepared to evaluate the true pictures of various studies conducted at Mona. The section also collected statistics on the area under all crop by outlets and tubewells. These were consolidated by command of perennial and non-perennial canals and barani areas at project level. This data proved very useful for future research programme in the project.

CROP CUTTING SURVEY

The crop cutting survey were conducted in collaboration with Extension Section. This survey was carried out regularly each season to monitor trends of major crop yields.

Multi-stage stratified random sampling procedure were adopted for the selection of sample fields. The project area has permanent feature of being divided into three distenct irrigation regions i.e. perennial, non-perennial and un-commanded. This division serves as stratification. From each region, outlet or tubewells were selected on the basis of probability proportionate to the area under crop in the previous seasons. From each selected tubewell or watercourse, square and then field was selected at random. The sample size was determined on the basis of minimum variance.

CROP PRODUCTION AND GROSS VALUE OF PRODUCTION

On the basis of crop yields obtained from crop cutting survey of major crops, agricultural production of the project was worked out for each year. Gross value of production based on the base year prices was worked out each year for the annual reports.

The section was associated with soil and reclamation section to carry out special survey of areas commanded by tubewells of high salt contents to evaluate the effect of such waters on soils and crops in order to prepare cropping patterns more appropriate under various conditions.

MASTER CHARTS

Crop cutting survey on major crops were conducted to determined the yield trends of major crops in the project. All possible agricultural activities; adopted during the crop period were noted to find out input output relationship of crops grown in the project area.

LAYOUTS

Layouts of the studies of various disciplines in the project area were prepared. Suitable designs and techniques were suggested for different experiments conducted during the year.

STATISTICAL ANALYSIS OF THE STUDIES

All the studies conducted in various formations were statistically analysed. Sectionwise position of the research studies for different crops analysed were eleven for Agronomy, twenty for Soil and Reclamation, four for Consumptive Use, Two for Pakistan Agricultural Research Council and nine for Water Management Research.

AGRONOMY SECTION

Sugarcane:

Study No.1: Evaluation of water requirements for sugarcane grown on soil of different watertable depths.

Study No.2: Optimum management study on sugarcane.

Cotton:

Study No.1: Effect of plant population on yield and yield components of cotton.

Study No.2: Optimum management study on cotton.

Study No.3: The relation between plant population, water applications, pest management and nitrogen fertility on cotton production.

Wheat:

Study No.1: Carry over of water in Rice field for wheat production.

Study No.2: Optimum management study on wheat.

Study No.3: Amplification effect of salinity on moisture stress and crop production.

Study No.4: Water distribution and sucking as affected by different size and shape of fields.

Rice:

Study No.1: Optimum management study on Rice.

Study No.2: Paddy yield and plant population as affected by salinity.

Wheat factors involved in the analysis were plant/unit area, tillers unit area, plant height, number of spikes, grains/spike and yield.

The statistical analysis for the cotton crop in favour of stand of plant/plot, number of flowers, number of bolls, opened bolls, unopened bolls, height of the plant and yield were carried out.

Sugarcane factors like tillers, height/stock, nodes/stock, weight/stock, stripped cane yield and un-stripped cane yield were analysed. Yield factor for all the studies pertaining to different crops were handled. In all, 24 tables were analysed to evaluate TDS(ppm), SAR and RSC.

SOIL AND RECLAMATION SECTION

Wheat:

Study No.1: Salinity-fertility interactions.

Study No.2: Cropping pattern on different water quality basis.

Study No.3: Interaction of soil depth and chemical ammendments on the reclamation of saline sodic(non-gypsiferous) soils.

Study No.4: Determination of reclamation requirements and salt movement pattern for salt affected soils under different water table depths.

Study No.5: Estimation of boron contents in ground water and soils.

Study No.6: Impact of using high magnesium waters on soils and crops.

Rice:

Study No.1: Salinity-fertility interactions.

Study No.2: Cropping pattern on different water quality basis.

Study No.3: Interaction of soil depth and chemical ammendments on the reclamation of saline-sodic (non-gypsiferous) soils.

Study No.4: Determination of reclamation requirement and salt movement pattern for salt affected soils under different water-table depths.

Study No.5: Role of Zinc application in saline-sodic soils for rice cultivation.

Study No.6: Estimation boron contents in ground water and soils.

Study No.7: Impact of using high magnesium waters on soils and crops.

Cotton:

Study No.1: Cropping pattern on different water quality basis.

Study No.2: Estimation of boron contents in ground water and soils.

Study No.3: Impact of using high magnesium waters on soils and crops.

Sugarcane:

Study No.1: Cropping pattern on different water quality basis.

Study No.2: Impact of using high magnesium waters on soils and crops.

Berseem:

Study No.1: Interaction of soil depth and chemical ammendments on the reclamation of saline-sodic(non-gypsiferous) soils.

Study No.2: Determination of reclamation and salt movement pattern for salt affected soils under different water-table depth.

Yield factor for all the studies pertaining to different crops were handled.In all,24 tables were analysed. to evaluate TDS(ppm), SAR and RSC.

RESEARCH IN COLLABORATION WITH PARC

Consumptive Use Project.

Wheat:

Study No.1: Estimation of consumptive requirements of wheat crop.

Rice:

Study No.1: Estimation of consumptive requirements of rice crop.

Sugarcane:

Study No.1: Estimation of consumptive requirements of sugarcane crop.

Cotton:

Study No.1: Estimation of consumptive requirements of cotton crops.

Cooperative Research Programme of Maize,Jowar & Bajra:

Study No.1: Evaluation of water requirement of maize under different water table depth.

Study No.2: Salinity in relation to ground and development of sorghum strains(P&T study).

Five factors namely yield,weight of 100 bolls(gm), No.of bolls/ plant population/sq.metre and height in favour of cotton crop,four factors yield,plant height,plant population/sq.metre and tillers/unit area in respect of sugarcane,six factors like grain yield,weight of 1000 grains(gm), No.of grains/cob, hoeing of the plant,plant population/sq.metre and size of cob(cm) for the maize crop and yield factor for the wheat,rice and sorghum was analysed like wise sixty tables were analysed.

EATER MANAGEMENT RESEARCH

Wheat:

Study No.1: Land and water use capability classification(S&R)

Study No.2: Methods of using gypsum and optimize crop production from sodic irrigation water(S&R)

Study No.3: Weed control(Agronomy)

Study No.4: Determination of optimum sowing method for wheat crop(Agronomy)

Rice:

Study No.1: Land and water use capability classification(S&R).

Study No.2: Use of saline ground water for reclamation of saline sodic soils(S&R).

Study No.3: Methods using gypsum to optimize crop production from sodic irrigation water(S&R).

Cotton:

Study No.1: Stand establishment on salt affected soils(S&R)

Study No.2: Determination of optimum sowing method for cotton crop(Agronomy).

Yield and yield components like totle tillers,millable tillers,non millable,height/stock,nodes/stock,weight/stock, stripped cane yield and un-stripped cane yield for sugarcane crop,stand of plant/plot,number of flowers number of bolls, opened bolls,un-opened bolls,height of the plant for cotton and yield factor for rice crop were analysed statistically.Thus thirty tables were processed for these studies.

MISCELLANEOUS

In addition to above,all the formations assisted in collection tabulation and compilation of the research data.The section also assisted in preparing the proposals and PC-1 of the various schemes.Graphical representation of all the research studies were managed by this section.

CHAPTER-VII

EXTENSION AND PLANT PROTECTION

A. EXTENSION

In SCARP projects where the main objective is to achieve rapid agricultural development the existance of an efficient Extension Service is all the more essential. The basic aim of agricultural extension is to help the cultivators to increase agricultural production by making most efficient use of enhanced irrigation supplies combined with other inputs. In Mona Project area routine extension approaches being practiced in other parts of the country and effective and modern techniques most suited to the requirements of SCARP Area are being implemented. Some of these approaches and progress achieved there-under are briefly discussed below:

1. Agricultural Schools:

Agricultural schools are functioning as an informal educational system aiming at teaching farmers through gatherings at places and time convenient to them by using simple audio-visual aids. An extension officer delivers lecture on modern agriculture to the farmers gatherings once each month in each Field Assistant's halqa. The lecture covers all important aspects of agriculture for that period. Twenty such schools have been established in the chaks/villages of the project area.

2. Seed distribution scheme:

Under this scheme, seed of improved varieties purchased from various agencies and is supplied to the project farmers free of cost at the time of sowing and the cost recovered with 10% interest at harvest.

During the current year 240 kg of cotton seed (B-557) 300 kg of rice (B-370) and 3600 kg of wheat (Sandal, Blue Silver and some like) was supplied to the farmers.

3. Farm Libraries:

Twenty farm libraries already established at 20 different centrally located sites in the project area were furnished with literature in the form of leaflets, brouchures, periodicals received from various agencies. These libraries not only help the farmers but also the Extension workers to remain in touch with the latest findings and trend in Agricultural Research.

One copy of each issue of following periodicals was regularly added to these libraries.

1. Zarai Digest.
2. Fehi Hezakar.
3. Zaraat Nama.
4. Shaoor-i-Nau.

4. Agah-i-Nau:

To keep the farmers and Extension Staff in touch with latest research findings and to educate them properly, publishing of a monthly circular namely "Agah-i-Nau" was continued. This circular written in simple language embodies the informative out- line that the farmer needs during the month. One copy of each issue was also placed in farm libraries.

5. Demonstration Plots:

In view of its established impact over the years this approach was continued. The number of demonstration plots established and maintained during the year is given in Table VII-1. A comparison of project yield with those of demonstration plots is given in Table VII-1.

6. Contact Scheme:

Under this scheme each field assistant contacted 25 selected cultivators of his Halqa once a fortnight. The idea is to intensify efforts to introduce improved farming to the selected farmers from whom the neighbouring farmers can learn.

B-PLANT PROTECTION

The plant protection service had to tackle the following main problems:

* Insect pests and disease of cotton crop.
* Low yield of citrus due to insect pests and diseases.
* Pyrilla in case of sugarcane and borer attack of sugarcane, rice and maize.
* Jassid attack in case of oilseed and tobacco.
* Rodents.
* Sparrows.
* Wild Boars

The following plant protection measures were adopted to control the above mentioned problems.

1. Chemical control:

Chemical control measures as given in Table VII-3 were carried out to control insect pests and diseases of cotton, sugarcane, rice, vegetable and citrus. To control rodents, pills prepared from zinc phosphide were distributed among the farmers. The sparrow problem was tackled by placing sparrow cages at different sites in the area.

2. Cultural Measures:

Main emphasis had been laid to educate the farmers to carry out measures which can effectively control many of the insect pests and diseases by merely carrying out cultivation operations in particular manner and at a particular time. This approach is useful not because it does not involve any cost but because it makes the farmers self sufficient in controlling some of the pests and diseases.

For this purpose many centres were set up where the up-rooting of cotton sticks 2" below the soil surface and removal of sugarcane and rice stubbles and other infested portions of plants were undertaken.

C-IMPACT OF EXTENSION ACTIVITIES

1. Cropped Area:

Year-wise hectarage under various crops since the establishment of Project(1965-66) is reported in Table VII-4. Area matured during Kharif 1980 was 23897.2 hectares and that matured during Rabi 1980-81 was 30652.8 hectares. This shows an increase of 4406.7 hectares in Kharif and 8106.6 hectares in Rabi as compared with base year 1965-66. Cropping intensity went up from 99% during 1965-66 to 132.0 during the year under report.

There is an increase in area under Rabi because irrigation water supplies were increased which enabled the cultivators to grow high delta crops. Wheat hectarage also increased and similar trend was observed for sugarcane, fodder, citrus gardens and vegetables(Table VII-5 and 6).

2. Crop Yield:

Year-wise yield/hectare of major crops since 1965-66 are reported in Table VII-7. Perusal of table indicates that the yield per hectare in case of sugarcane increased due to

favourable climatic conditions whereas rice, cotton and wheat yields have shown some decline.

3. Gross value of production:

The production and gross value of major crops during the pre-operation period (1965-66) and the year under report is given in Table VII-8. It has been calculated on constant factor price for all the crops at the base year prices i.e. 1965-66. The gross value of production of major crops increased from Rs.23.1 million (1965-66) to over Rs.39.52 million during the year 1980-81.

EXTENSION OF WATER AND CROP MANAGEMENT

The extension section primarily attended to the following four studies:

1. Watercourse cleaning and maintenance.
2. Watercourse improvement.
3. Convincing farmer to adopt the recommended soil reclamation practices.
4. Testing the use of herbicides in cleaning of watercourses.

1. WATERCOURSE CLEANING AND MAINTENANCE

The farmers of tubewell MN-29,30,31,32,33,34,36,37,44,53,74,75, 76,77,82,83,92,113,123 and 132 were motivated for heavy cleaning and maintenance of these watercourses. These watercourses were cleaned and maintained by the farmers under the supervision of extension staff.Except for the water users own labour,no other expenditure was involved in this programme.Only pucca structures were provided at the project cost at tubewell MN-75,76,77 and 83.

2. WATERCOURSE IMPROVEMENT

Improvement work was completed at three watercourses at tubewell MN-69,22 and SHP-54 as per detail given below:

1. Tubewell MN-69:

Pucca improvement of this watercourse has been completed. The water users provided labour for all the earth work carried out during improvement. Farmer's branches were cleaned with the help of farmer labour. Structureswere provided at the project cost.Total length of pucca khal improved was about 7750 ft.

2. Tubewell MN-22:

This watercourse has been improved upto a length of 5200ft. Farmer's branches were cleaned and maintained by farmer's labour. All earth work was carried out by the farmer's labour under the supervision of Extension staff.

3. Tubewell SHP-54:

Two branches of this watercourse were improved having a total length of 5000'. The whole earth work was done by the farmers under the supervision of extension staff.Farmers branches were also cleaned and maintained by the farmers.

3. CONVINCING FARMERS TO ADOPT THE RECOMMENDED SOIL RECLAMATION PRACTICES:

IMPORTANCE

Waterlogging, salinity and alkalinity are very common calamities for the soils of Pakistan. Although the Government is leaving no stone unturned to bring these soils back to cultivation, the rate of success can considerably be enhanced if the resources of private sector are also manipulated towards the same end. Since many of the recommendations of agricultural research workers, which were once difficult to be adopted, are now under the common practice of the farmers, it seems necessary that they should also be encouraged to adopt the practices concerning reclamation of soils similar to those of fertilizer, improved implements, plant protection measures etc.

WORK DONE

As a result of extension efforts, 15 plots were selected where the farmers were advised to sow salt resistant crops like rice, jantar, barley and kallar grass. In addition a demonstration block of 12.5 acres has also been developed where reclamation is being carried out by the farmer through simple leaching and growing of high delta crops. Eight more plots have been selected were kallar grass is proposed to be planted. Levelling of land and seed bed preparation is in progress.

4. TESTING THE USE OF HERBICIDES IN CLEANING & MAINTENANCE OF WATERCOURSES

IMPORTANCE

Earthen improved watercourses require frequent cleaning of grass, weeds etc. from the cross section and banks for maintaining conveyance efficiencies within the designed limits. Grass and weeds are generally cleaned with the help of spades which results in removal of soil as well. Thus each cleaning results in sufficiently enlarged section with possible increase in conveyance losses. This has been observed at earthen improved watercourses at tubewells 56 and 51. In order to maintain designed cross section and to eliminate the use of spade for cleaning and maintenance, herbicides were tested.

WORK DONE

A section of 900 metres on each of the two earthen improved watercourses at tubewell No-56 and 94 was selected. Water losses were measured for both selected sections. 900 metres length was equally divided into three portions. At one portion cleaning was carried out with the help of manual labour and on the other, five herbicides i.e. gramaxone, trefolon, metaven, folen and dicuran were applied in low and high dose. Weed count was carried out after 10 days, thirty days and ninty days after the application of herbicides to observe the treatments effect. Second application of herbicides, weed count and waterloss measurement have been completed.

TABLE:VII-1 COMPARATIVE YIELD OF DEMONSTRATION PLOTS AND PROJECT AREA ESTIMATE THROUGH CROP CUTTING SURVEY 1980-81

Crop	Demonstration plots(Nos)	Yield (Q/ha) D.plots	Project area	Difference
Sugarcane	50	550.82	392.36	158.46
Cotton	50	8.82	6.10	2.72
Rice	50	31.55	23.28	8.27
Wheat	80	36.88	25.31	11.57

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TABLE:VII-2 SUMMARY OF EXTENSION WORK PROGRESS

Education and training	Unit of measurement	During 1980-81	Progress since 9/67
1.Lectures delivered in Agri.schools	Nos.	106	2334
2.Farmers who consulted farm libraries	Nos.	15113	111924
3.Farmer's gathering held	Nos.	485	8043
4.Asan-i-Nau distributed	Nos.	250	19225
5.Seed bank members enrolled	Nos.	99	2148
6.Staff refresher courses held	Nos.	24	332
Field Demonstration:			
Eradication of weeds	Ha.	3590	44198
Removal of stubbles:			
1.Sugarcane		980	19910
2.Rice		273	10692
3.Cotton		483	12458
Cotton sown on ridges and beds	Ha.	40	
Sowing of wheat by drill	"	514	

TABLE:VII-3 CHEMICAL CONTROL MEASUREMENT 1980-81

Crop	Hectare treated	Pest & diseases	Pesticide/fungicide treatment
Citrus	115.50	Citrus canker citrus wither Tip, Jassid Fruit fly.	Dimecron 100 Dithen M-45 Supracide and Bordeu Mixture.
Sugarcane	20.5	Top borer, stem borer and Termite	Nuvacron, Basodin "Gr." B.H.C., Furodon.
Cotton	12	Jassid, leaf roller Pink boll worm, white fly, termite and spotted boll worm.	D.D.T., B.H.C. Nuvacron.
Rice	23	Stem borer	Basudine "Gr" Furodon "Gr"
Vegetable	31	Jassid, fruit fly bugs.	Nogos, B.H.C.

TABLE:VII-4 YEAR-WISE CROPPED AREA AND CROPPING INTENSITY
(1965-66 TO 1980-81)

(Hectares)

Kharif	1965-66	1966-67	1967-68	1968-69	1969-70	1970-71	1971-72	1972-73	1973-74
Sugarcane	1509.92	1949.82	1915.82	2321.33	3819.10	3326.50	2171.99	1897.21	2568.59
Cotton	6263.05	5915.01	6303.52	4924.92	4824.73	4312.02	5668.15	5516.79	5713.07
Rice	1181.11	1461.76	1792.80	3227.44	2404.69	1947.79	1594.90	1372.32	1293.00
Maize	1261.03	1776.20	1741.80	1945.37	2007.69	2040.57	1841.76	1653.58	1288.55
Fodder	7150.55	6871.31	7316.07	6569.00	6815.46	7384.05	7976.12	8450.02	8337.11
Garden/vegetables	2063.54	2541.48	2697.29	2632.94	2819.91	2315.66	2530.15	2492.11	2494.54
Misc.	99.55	886.28	1052.21	1308.38	880.61	1176.04	1247.67	707.81	721.57
Total Kharif	19490.49	21328.21	22819.51	22890.33	23267.50	22502.63	23030.76	22089.84	24416.43
Increase over 1965-66	-	1800.89	3292.19	3363.01	3740.19	2971.67	3499.80	2558.88	2925.94
Percentage increase.	-	9.42	17.08	17.44	19.38	15.45	18.16	13.34	15.01
Cropping intensity.	45.9%	50.1%	53.7%	73.0%	51.8%	53.0%	54.2%	63.5%	54.3%

Cont'd....

TABLE:VII-4(Cont'd)

Kharif	1974-75	1975-76	1976-77	1977-78	1978-79	1979-80	1980-81
Sugarcane	2726.83	2462.16	3272.76	3265.48	2831.65	2143.66	2371.9
Cotton	6002.83	5439.09	4558.86	3641.84	3992.55	3528.12	2829.2
Rice	1632.13	1618.37	2629.30	3257.39	3575.88	4576.68	3983.0
Maize	4550.79	1244.03	1181.30	1241.60	1172.00	975.71	994.7
Fodder	4477.54	4846.62	7426.95	4993.12	5364.63	6322.54	5815.5
Garden/vegetable	2696.07	2777.01	3596.92	3586.40	3804.53	4038.85	4930.8
Misc.	1253.34	4353.30	1286.12	4047.33	3550.38	3214.89	2972.1
Total kharif	23339.54	23072.44	23948.60	24033.59	23691.62	23800.55	23897.2
Increase over 1965-66	3449.05	3581.95	4458.11	4543.10	4201.14	4309.96	4406.7
Percentage increase	19.75	18.38	22.87	23.31	21.56	22.11	22.61
Cropping intensity	56.5%	55.8%	57.9%	57.96%	57.38%	75.64%	57.8%

Cont'd.....

TABLE: VII-4(Cont'd)

Rabi crop	1965-66	1966-67	1967-68	1968-69	1969-70	1970-71	1971-72	1972-73
Wheat	9959.93	132299.47	13973.67	15452.04	13809.39	14990.29	15454.47	14772.56
Barley/oats	1470.25	1029.14	772.97	927.56	2828.81	1880.21	1357.34	1329.83
Oilseeds	601.38	983.81	896.40	463.37	493.32	634.96	950.63	684.34
Pulses(grams)	494.13	629.70	473.90	412.79	240.39	252.12	210.44	189.80
Fodder	6213.27	6602.18	6878.19	6357.75	6633.75	6993.12	7464.59	7648.32
Sugarcane	1509.92	1948.82	1915.82	2317.28	3819.10	3326.50	2171.99	1897.21
Garden/vegetable.	2290.17	2646.30	2598.54	2484.42	2235.13	2319.71	2489.68	2467.83
Misc.	12.14	297.05	297.05	318.49	369.89	399.43	355.73	385.67
Rabi total	22551.19	27449.62	27806.56	28733.71	30146.50	30877.78	30455.69	29375.56
Increase over 1965-66	-	4898.42	5255.37	6182.52	7595.31	8326.59	7904.49	6824.36
Percentage increase.	-	21.17	2.33	27.4	33.6	42.6	35.1	30.0
Cropping intensity	53.1%	64.6%	63.5%	67.6%	70.9%	42.6%	71.7%	71.1%
Total rabi and kharif.	42082.15	48777.82	50623.23	51624.04	53414.00	53380.41	53486.44	51465.40
Increase over 1965-66	-	6695.67	8541.08	9541.89	11331.85	11298.26	11404.29	9283.25
Percentage utilization	-	15.9	20.3	22.7	27.2	28.8	27.1	22.3
Cropping intensity	99.0%	114.8%	119.1%	121.5%	125.5%	125.6%	125.9%	124.6%

Cont'd.....

TABLE:VII-4(Cont'd)

(Hectares)

Rabi crop	1973-74	1974-75	1975-76	1976-77	1977-78	1978-79	1979-80	19780-81
Wheat	13814.24	13474.30	13254.55	13956.70	13908.54	13272.70	14619.18	14773.4
Barley/oats	1600.57	1931.61	2004.45	631.73	611.09	-	582.36	586.4
Oilseeds	680.29	620.80	598.54	566.17	643.06	1049.37	970.07	844.2
Pulses(grams)	263.86	146.90	191.02	184.54	191.84	258.31	240.79	210.0
Fodders	6922.30	6648.73	6907.32	6980.57	6994.54	6151.36	5772.97	5826.4
Sugarcane	2568.59	2723.19	2785.92	3269.19	3265.48	2931.65	2143.66	2371.9
Garden/vegetable	2623.63	2660.38	3101.27	3494.53	3854.71	4026.31	4993.79	5310.4
Misc.	388.91	373.94	386.48	386.48	412.38	410.36	444.35	730.1
Rabi total	28862.00	28783.49	29233.51	29469.85	29881.83	30027.11	29772.15	30652.8
Increase over 1965-66	6310.81	6232.29	6682.31	6910.66	7330.64	7475.92	7220.96	8106.6
Percentage increase	28.0	27.0	27.0	20.0	32.50	33.15	32.02	35.9
Cropping intensity	69.9%	69.7%	70.8%	70.4%	72.36%	72.72%	72.10%	74.2%
Total Rabi and Kharif	51276.41	52123.03	52305.95	53418.45	53935.70	53718.74	53572.60	54550.0
Increase over 1965-66	9194.25	10040.88	10223.80	11336.30	22853.55	11636.59	11490.45	12467.9
Percentage increase	21.8	23.8	24.3	27.2	28.11	27.65	[illegible].30	29.6
Cropping intensity	124.2%	126.2%	126.7%	129.4%	130.32%	130.0%	[illegible].74%	132.0%

TABLE:VII-5 PERCENTAGE OF CROPPED TO CULTURED AREA 1965-66 TO 1980-81

Crop	1965-66	1966-67	1967-68	1968-69	1969-70	1970-71	1971-72	1972-73
KHARIF								
Sugarcane	3.6	4.6	4.5	5.5	8.9	7.8	5.1	4.4
Cotton	14.7	13.9	14.8	11.5	11.6	10.2	13.3	13.0
Rice	2.8	3.4	4.2	7.6	5.7	4.6	3.8	3.2
Maize	3.8	4.2	4.1	4.6	4.7	4.8	4.3	3.9
Fodder	16.6	16.0	17.2	15.4	16.1	17.4	18.8	19.9
Garden/Vegetable	4.9	6.0	6.4	6.2	5.7	5.5	5.9	5.9
Misc.	0.2	2.1	2.5	3.1	2.1	2.8	2.9	1.7
Kharif Intensity	4.59	50.2	53.7	53.9	54.7	53.0	54.2	53.5
RABI								
Wheat	23.4	31.3	32.29	36.3	32.6	35.5	36.4	34.8
Barley/oats	3.5	2.7	1.8	2.1	5.5	4.6	3.2	3.1
Pulses	1.2	1.5	1.1	1.0	0.6	0.6	0.5	0.4
Oilseeds	1.4	2.3	2.1	0.1	1.1	1.5	2.2	1.6
Fodders	14.6	15.5	16.2	15.0	16.0	16.5	17.6	18.0
Sugarcane	3.6	4.6	4.5	5.5	8.9	7.8	5.1	4.5
Garden/vegetables	5.4	0.7	6.1	5.8	5.3	5.5	5.9	5.9
Misc.	-	0.7	0.7	0.8	0.9	0.9	0.8	0.9
Rabi Intensity	53.1	46.6	65.4	76.6	71.0	72.7	71.1	71.1

Cont'd...

TABLE:VII-5(Cont'd)

Crop	1973-74	1974-75	1975-76	1976-77	1977-78	1978-79	1979-80	1980-81
KHARIF								
Sugarcane	6.0	6.6	6.7	7.9	7.9	6.9	5.1	5.7
Cotton	13.4	14.5	13.1	11.0	8.8	8.2	8.5	6.9
Rice	3.0	4.0	3.9	6.4	7.8	8.7	11.0	9.6
Maize	3.0	11.0	3.0	2.9	3.0	2.8	2.3	2.4
Fodders	19.6	10.8	11.7	17.9	12.0	12.0	12.8	14.1
Garden/vegetables	5.8	6.6	6.7	7.7	8.6	9.2	9.7	11.9
Misc.	1.7	3.0	10.5	3.1	8.6	8.6	7.7	7.2
Kharif Intensity	54.3	56.5	55.8	57.9	57.96	57.38	57.64	57.8
RABI								
Wheat	32.5	32.5	32.1	33.8	33.6	33.7	35.4	35.8
Barley/oats	3.7	4.7	4.8	1.5	1.4	-	1.4	1.4
Pulses	0.4	0.6	0.4	0.3	0.4	0.6	0.5	0.5
Oilseeds	1.6	1.5	1.4	1.5	1.5	2.5	2.3	2.0
Fodders	16.2	16.1	16.9	16.9	16.9	14.7	13.9	14.1
Sugarcane	6.0	6.6	6.7	7.9	7.9	6.9	5.1	5.7
Garden/vegetables	6.0	7.9	7.5	9.3	0.3	9.7	12.1	12.9
Misc.	0.9	0.9	0.9	0.9	0.9	0.9	1.0	1.8
Rabi Intensity	69.9	69.7	70.8	71.4	72.72	72.72	72.10	74.2
Annual cropping intensity	124.2	126.2	126.7	129.3	130.32	130.10	129.70	132.00

TABLE:VII-6 CROPPING INTENSITIES FOR VARIOUS COMMAND AREA

Year	28907.32 Hec Perennial Area		7345.20 Hec Non-perennial area		5038.45 Hec Un-commanded area	
	Cropped Area	Intensity %	Cropped Area	Intensity %	Cropped Area	Intensity %
1965-66	34199.11	114.19	7879.40	103.92		
1966-67	36726.43	122.63	8753.14	115.39	3302.31	66.48
1967-68	37293.81	124.52	7853.54	115.45	4578.71	92.17
1968-69	37472.00	125.12	8995.14	118.64	5156.21	103.80
1969-70	37812.22	126.26	9408.34	124.09	6192.63	124.66
1970-71	37589.64	126.21	8970.50	130.18	5923.11	119.23
1971-72	36912.99	123.25	10009.61	132.02	6563.74	132.12
1972-73	36836.10	122.99	8220.56	108.43	6412.79	129.01
1973-74	36688.38	126.9	8202.75	111.7	6385.27	126.7
1974-75	37008.50	128.00	8318.90	133.3	6794.63	134.9
1975-76	37102.39	127.1	7551.11	105.5	6139.62	121.8
1976-77	39163.09	136.8	8330.23	113.4	5292.59	105.0
1977-78	39335.90	135.07	9517.20	129.57	7249.70	143.80
1978-79	36486.85	126.22	7758.40	105.63	8040.47	159.59
1979-80	37359.36	129.23	7894.77	107.48	6579.52	130.58
1980-81	39090.2	135.2	8613.5	117.3	6846.3	135.8

TABLE:VII-7 PROJECT YIELD ESTIMATION THROUGH CROP CUTTING SURVEY(1980-81)

(Kg/Ha)

Crop		1966-67	1967-68	1968-69	1969-70	1970-71	1971-72	1972-73	1973-74
Sugar-cane	P	52361.22	51466.71	46745.16	38159.69	39957.91	40428.25	40852.45	39312.41
	NP	28366.17	32193.21	41341.20	36057.13	38104.36	39515.29	38547.01	42945.79
	UC	33797.79	35614.48	37846.15	38205.80	42558.48	37753.93	37661.72	9249.44
	PT	44033.96	42576.92	43167.11	38159.69	37818.48	39533.74	39487.63	36616.73
Cotton	P	876.07	737.74	756.18	599.42	866.85	855.29	940.62	783.85
	NP	608.64	774.63	719.30	544.08	624.31	673.19	922.18	746.96
	UC	746.96	700.85	774.63	654.75	627.08	885.29	702.89	719.30
	PT	774.63	737.74	746.96	608.64	746.96	829.96	894.51	765.41
Rice	P	1853.58	S.N.C.	1973.45	2038.01	1844.35	2065.68	2028.79	2545.21
	NP	1113.07	-	2148.67	2462.20	1346.38	1346.38	1945.79	2425.33
	UC	-	-	1512.37	1798.25	1798.25	1779.80	2093.34	2001.12
	PT	1576.92	-	1881.24	1881.24	1706.03	1881.24	2019.57	2388.44
Maize	P	-	-	2609.76	2877.19	S.N.C.	3375.17	-	-
	NP	-	-	1798.24	1254.18	-	1816.69	-	-
	UC	-	-	1429.37	2471.43	-	1918.13	-	-
	PT	-	-	2194.78	2655.87	-	2757.31	-	-
Wheat	P	2084.12	1890.46	2231.67	-	2304.00	2775.75	313.54	2738.87
	NP	1337.16	1742.91	1955.02	1344.35	1844.35	2600.54	2333.11	2333.11
	UC	977.80	1779.80	1724.47	1372.02	1696.81	2591.32	2646.65	2692.76
	PT	1650.70	1825.91	2028.79	2130.23	1982.68	2572.87	2646.65	2628.21

Cont'd....

TABLE:VII-7(Cont'd)

Crop		1974-75	1975-76	1976-77	1977-78	1978-79	1979-80	1980-81
Sugar-cane	P	31925.77	34797.43	32550.09	35797.07	29945.86	36817.11	43988.00
	NP	41802.29	40288.08	26377.03	37338.97	28733.20	27357.10	30303.00
	UC	36140.12	31869.52	35843.18	39850.97	31648.20	37209.89	39523.00
	PT	35300.94	26367.81	34075.37	37023.57	29986.44	34520.08	39236.00
Cotton	P	507.20	740.51	521.03	683.33	680.57	708.80	695.00
	NP	820.74	686.10	428.81	474.92	519.19	531.47	451.00
	UC	774.63	549.62	595.73	460.17	511.40	610.40	608.00
	PT	654.75	679.64	523.80	590.19	623.39	644.92	610.00
Rice	P	2259.33	2388.44	2147.76	2767.45	2713.97	2547.92	2488.00
	NP	2388.44	2254.72	2256.57	2323.89	2601.89	2524.90	2374.00
	UC	1982.68	2056.45	1947.38	2055.53	2692.77	2000.54	1946.00
	PT	2268.56	2268.56	2133.00	2433.00	2680.77	2420.34	2328.00
Maize	P	-	-	-	-	-	-	-
	NP	-	-	-	-	-	-	-
	UC	-	-	-	-	-	-	-
	PT	-	-	-	-	-	-	-
Wheat	P	2701.98	2446.65	2089.65	2537.83	2746.24	3008.49	2496.00
	NP	2508.32	2335.87	2142.22	2465.90	2885.49	2700.15	2677.00
	UC	2600.54	2432.70	2335.87	2239.97	2312.82	2673.05	2457.00
	PT	2628.21	2518. 47	2164.35	2444.69	2678.92	2849.53	2531.00

P = Perennial
NP = Non-perennial
UC = Un-commanded
PT = Project
S.N.C = Survey not carried out

TABLE: VII-8 GROSS VALUE OF PRODUCTION OF MAJOR CROPS
1965-66 TO 1980-81

Season	Crop	Area in Ha.	Yield kg/Ha.	Production kg.	Value (Rs. Million)
			1965-66		
KHARIF	Sugarcane	1510	37102.61	56062045.00	3.36
	Cotton	6263	387.16	24259445.00	2.35
	Fodder & Maize	8511	-	-	3.13
	Rice	1182	1290.53	1526691.17	0.57
RABI	Wheat	9964	1438.53	14328373.00	5.73
	Fodder & Misc.	6905	-	-	4.26
	Barley & Oats.	1470	-	-	0.30
	Pulses	496	460.90	227684.60	0.15
	Oilseeds	601	553.08	332402.52	0.31
	Garden+Vegetable	2291	-	-	2.91
				Total:	23.07
			1980-81		
KHARIF	Sugarcane	2371.9	43908.00	104145385.2	6.25
	Cotton	2829.2	695.00	1966294.00	0.92
	Rice	3983.0	2488.00	9909704.00	3.67
	Fodder & maize	6810.2	-	36874406.4	2.51
RABI	Wheat	14773.4	2496.00	-	14.75
	Barley oats	586.4	-	-	0.12
	Fodder	5826.4	-	-	4.00
	Pulses	210.0	-	-	0.06
	Oilseed	844.2	-	-	0.44
	Garden + Vegetable	5310.4	-	-	6.80
				Total:	39.52

TABLE:VII-9

RAINFALL 1980-81 (mm)

Name of Station	July 80	Aug. 80	Sept. 80	Oct. 80	Nov. 80	Dec. 80	Jan. 81	Feb. 81	Mar. 81	Apr. 81	May. 81	June 81	Total	Average
Beriwala	250.17	70.00	70.25	70.20	-	-	-	-	-	109.27	0.35	-	582.24	48.52
T/well No. MN-66.	133.53	96.03	39.25	-	-	-	35.56	24.38	17.78	46.62	13.97	2.54	409.66	34.13
Chak Qazi	150.00	13.95	100.86	-	0.08	-	36.56	-	-	29.46	-	-	330.91	27.57
T/well MN-141	202.67	164.31	58.17	11.43	5.33	5.33	34.54	46.09	25.37	74.41	-	-	627.67	52.30
Mieni	324.10	113.53	30.49	6.35	5.58	-	43.18	23.13	25.34	75.14	22.86	17.20	682.45	56.87
Phullerwan	111.65	-	48.09	3.81	2.54	6.85	30.01	23.13	24.12	24.13	14.70	4.46	33.62	27.80
Head fagirian	290.83	-	55.89	4.56	1.77	5.84	29.01	44.96	17.78	40.42	12.95	-	520.01	43.34
T/well 102	-	144.77	67.57	7.11	-	3.14	34.54	61.54	34.38	76.49	27.68	3.0	460.49	38.37
Total:	1462.95	602.59	476.57	109.46	15.30	21.16	243.57	260.86	144.82	494.24	92.51	23.00		
Average:	182.86	75.32	59.57	13.68	1.91	2.64	30.44	32.60	18.10	61.78	11.56	2.87		

CHAPTER-VIII

PARC FINANCED CO-OPERATIVE RESEARCH

CONSUMPTIVE USE

STUDY: ESTIMATION OF CONSUMPTIVE USE OF WATER OF MAJOR CROPS UNDER OPTIMUM MANAGEMENT CONDITIONS FOR THE YEAR 1980-81.

OBJECTIVE

Estimation of consumptive use of various major crops under best conditions of management, mineral nutrition and water supply upon demand indicated by soil moisture tension. The informations on consumptive use requirements of crops will help the farmers to make efficient use of irrigation water. These informations will also guide the irrigation planners in irrigation scheduling to fix more realistic targets of crop acreage and crop production under same ecological conditions in different parts of the country.

Four major crops of the project namely, cotton, sugarcane, wheat and spring maize were included in consumptive use programme. On the completion of research work on these crops berseem and sorghum were taken up for their consumptive use requirements.

PLAN OF WORK

Berseem:

Berseem variety synthetic 1/79 was sown on 8th October, 1980 by chata method using seed @ 22 kg per hectare in standing water. The crop harvesting was completed on 5th May, 1981. In all five cuttings were taken during the growth period. The soil selected for the experiment was medium textured non-saline, non-sodic. The ground water table was more than 4.5 metre having no chance for the crop to utilize sub soil water. The moisture and fertilizer treatments were applied in a factorial design as per details given below:

Treatment	Level	Description
Moisture	3	Irrigations were applied on the development of moisture stress of 1, 3 and 5 bar tension in upper 0-30cm soil depth except first irrigation which was applied irrespective of moisture stress (M1, M2 & M3 respectively).
Fertilizer	2	Low NPK (F1) 0-25-0 kg/ha High NPK (F2) 25-75-0 kg/ha
Application	4	
Total No. of plots:	3x2x4=24	

Full dose of fertilizer @ 0-25-0 and 25-75-0 kg/ha NPK was applied to the respective plots at the time of sowing. Pure tubewell water of good quality was used for irrigation. The depth of each irrigation applied was calculated by pre-irrigation soil moisture contents which were determined by soil sampling down to 152cm depth. Each irrigation restored the soil moisture contents down to 152 cm depth to field capacity.

The consumptive use was estimated by gravimetric measurement of soil moisture deplition. The crop coefficients kc for each irrigation interval were calculated, by dividing actual evapotranspiration by potential evapotranspiration and ETA/ Pan evaporation. The yield estimation was made by cutting a unit area of 4x4 M. from centre of each plot. In all 5 cuttings were taken throughout the growth period of crop. The following conclusions were drawn:

* The consumptive use of berseem (variety synthetic 1/79) was determined as 65.92, 58.64 and 50.50 cm when irrigation was applied at 1,3 and 5 bar tension, respectively.
* Berseem yield(fodder) of 104.4, 100.3 and 84.30 T/ha was recorded for M1, M2 and M3 moisture treatments.
* Berseem crop utilized water most efficiently at 3 bar stress treatment having a crop water use efficiency of 165.48 kg/mm.

Sorghum:

Sorghum(variety Sindi white) was sown on April, 13, 1981 using seed at the rate of 49 kg/ha. Sowing was done in 23cm apart lines, The experiment was conducted on medium textured non-saline, non-sodic soil. Moisture treatments were applied in a completely randomized design. .The following treatments were tested.

Treatment	Level	Description
Moisture	4	Irrigation applied at 1,3,6 and 9 bar tension in upper 0-30 cm soil except 1st irrigation which was applied irrespective of moisture stress development.
Fertilizer	1	30-15-0 kg/ha.
Replications	4	
Total No. of plots	4x1x4=16	

Half dose of nitrogen alongwith full dose of phosphorous was applied at sowing while the remaining nitrogen was applied when the crop was at knee height. Irrigations were applied on the development of required moisture stress and the deficit was made good to bring back the moisture contents to field capacity. The depth of irrigation applied was calculated by pre-irrigation soil sampling. The irrigations were applied from good quality tubewell water already installed at the site. Yield(fodder) was recorded by harvesting a unit area of 3x3 metre and then it was converted into ton per hectare. The maximum yield of 42 ton per hectare was recorded for M1 treatment. The data is under compilation for report write up.

Cotton:

Cotton B-557 was sown in lines 76 cm apart on 9th May, 1980 using seed at the rate of 27 kg/ha and its harvesting was made on 7.1.1981. The soil under study was medium textured non-saline, non-sodic. The ground water table was more than 4.5 m and there was no chance for the crop to utilize ground water. The moisture and fertilizer treatments were applied in 3x2 factorial design as per detail given.

Treatment	Level	Description
Soil moisture	3	Irrigation applied at 1,5 and 9 bar tension on surface 0-15, 0-30 and 0-46 cm soil depth(M1, M2 and M3, respectively).
Fertilizer(NPK)	2	Low (F1) 28-0-34 kg/ha. High (F2) 84-45-34 kg/ha.
Replications	4	

Total No. of plots=3x2x4= 24

Full dose of phosphorous and potash alongwith low dose of nitrogen was applied to the respective plots at the time of sowing Nitrogen in case of high dose was split in two equaval halves. The Ist half was applied at sowing and 2nd at the time of flowering. Pure tubewell water of good quality was used for irrigation. The depth of each irrigation applied was calculated by pre-irrigation soil moisture contents which were determined by soil sampling down to 152cm depth. Each irrigation restored the soil moisture contents down to 152cm depth to field capacity. The consumptive use estimation was made by gravimetric measurements, The crop coefficients were worked out dividing the actual evapotranspiration (EtA) by potential evapotranspiration (EtP) and EtA/pan evaporation. The yield estimation was made by picking the cotton separately from each plot on whole plot basis. The following conclusions were drawn:

1. The consumptive use of cotton(B-557) was estimated as 74,49,69.72and 64.26 cm when the crop was irrigated at 1,5 and 9 bar tension respectively.

2. Actual evapotranspiration remained lower than EtP and pan evapotranspiration throughout the growth period of crop in M2 and M3 moisture treatments.EtA in case of M1 was high,crossed EtP and pan evaporation during last two weeks of July. EtA started from .206, .203 and .176 cm and reached to a maximum of .681, .596 and .598cm/day in case of M1,M2 and M3 treatments,respectively.

3. Crop coefficients calculated by EtA/pan evaporation were lower than EtA/EtP upto August after which it slightly increased.

4. Yield significantly decreased with the increase in moisture stress from 1 to 9 bar tension. The maximum yield 1.43 ton/ha.was obtained under M1 moisture stress level and minimum 0.96 tons/ha.for M3 moisture level. Fertilizer improved the yield at each moisture stress level.

5. Cotton crop utilized the water most efficiently at M1 moisture treatment. Fertilizer application did cause improvement in moisture utilization capacity of crop.

MAIZE, JOWAR AND BAJRA

Consummation and relevance of this scheme is to increase the production of maize, jowar and bajra grown on 1.96 million hectare in Pakistan. Pakistan having favourable agro-climatic conditions and largest irrigation system in the world has lower per acre yield when compared with many other countries where soil and climatic conditions are not so good. In other words, we have great potential to increase per acre yield by discarding the traditional management practices and can thus maximize benefits from the available resources. Which requires great deal of investigations under different ecological zones of the country to evaluate the effect and interaction regarding yield and ultimately to develop optimum level of different growth limiting factors. With this end in view research programme is going on in Mona Reclamation Experimental Project on the studies detailed below:

STUDY NO. 1: NATIONAL COOPERATIVE YIELD TRIALS ON MAIZE, SORGHUM AND MILLET

1. Maize: (Full and Short Season)

PROCEDURE

An area of 0.8 hectare under the command of tubewell MN-66 was selected for this experiment where soil was well drained medium textured non-sodic non-saline. Two sets of maize varieties (Full and short season) as detailed below were tested:

Full season varieties	Short season varieties
1. Sarhad yellow	1. Chongez
2. Frawen	2. Faisal
3. SIDA-7534	3. Zia
4. Sarhad white	4. Evi-early
5. Talatizapan-7633	5. Shaheen
6. Yousafwala-7845	6. PAC Yellow
7. Ukiriguru-7534	
8. Ukiriguru-7542	
9. Composite-15	
10. Pirsabak-7734	

One set each of full and short season varieties was sown in a completely randomized block design with four replications on 13.7.80 by dibbling in lines 75cm apart with 30 and 25cm distance from hill to hill in case of full and short season respectively. Each variety was sown in four rows of 5 metre length in each plot.

Fertilizer application:

Nitrogen and phosphorous was applied in the form of urea and DAP respectively @ 150-75-0 NPK Kg/ha. All phosphatic fertilizer was applied at the time of sowing, while the nitrogenous fertilizer was divided into three parts. The first dose was applied with phosphatic fertilizer at sowing time and rest was applied at knee deep and tasseling stage.

Irrigation:

In all seven irrigations were applied through out the growth period. Weeding was carried out properly after each irrigation preferably in early stages.

Rainfall:

Total rainfall received during growth period of maize was recorded as 135.35 mm.

Plant protection:

Diazinon Gr.@ 13 kg/ha was applied against maize borer attack and dimicron @ 1.5 litre/ha. was sprayed against the maize insects.

Yield and yield components:

Yield estimation was made by "crop cutting method" for this purpose two central rows were taken as test rows and the out side rows as border. Data was collected from the central rows only. The observations like days to tassel, ear height, plant height, lodging percentage, number of plants harvested, No. of cobs, field weight, stalk weight and moisture percentage were recorded.

Indication:

From full season varieties Sarhad yellow gave the maximum field weight and it was statistically insignificant from other five varieties namely Composite-15, Ukiriguru-7542, Ukiriguru-7534, Sarhad white and Pirsabak-7734. The minimum field weight was recorded as 5.8 tons/ha for tatalizapan 7633.

In case of short season varieties Faisal gave the maximum field weight which differ non significantly from changez and Zia. PEC yellow gave the minimum yield.

2. Millet:

All area of 0.05 hectare was selected in the command of tubewell M.-66. The soil was free from salinity and sodicity.

Treatment:

Treatments	No.	Description
Fertilizer	1	80-40-0 NPK kg/ha
Varieties	6	
Replications	4	
Total plots = 1x6x4=24		

The following six varieties were tested.

(1) Y-72 (2) C-47 (3) Hairy dwarf, (4) 18-BY,
(5) Composite-75 (6) L.B.2

Layout:

Experimental field was divided in 24 equal sized plots. Six varieties were tested in a completely randomized block design in four replications. Five rows of each variety of 5 metre length were sown in each plot. Row to row distance was kept 45 cm and plant to plant 15 cm.

Crop sowing:

Sowing was done by dibbling method dropping 2 seeds per hill on 14.7.1980.

Irrigation application:

Five irrigations were applied during growth period of the crop and total rainfall was recorded as 135.35 mm.

Fertilizer application:

Nitrogen and phosphorous was applied in the form of urea and DAP, respectively. All phosphatic fertilizer was applied at the time of sowing and nitrogenous fertilizer was divided in two parts. First half was applied with phosphatic fertilizer at sowing and the 2nd half with 2nd irrigation.

Indications:

C-47 gave the maximum ear head weight, stalk and grain yield and took maximum period of maturation while Y-72 gave minimum stalk yield, although the grain yield was low but not satistically significant from C-47 and took minimum period for maturation.

STUDY NO.2: DEMONSTRATION OF IMPROVED SOWING METHODS FOR MAIZE 1980

OBJECTIVE

It is fact that improved varieties have greater yield potential. But maximum yield can only be obtained by adopting the proper planting methods, fertilizer application, water management, pest and weed control. The per acre yield in Pakistan is low because our farmer is still following the traditional means and methods for cultivation. Therefore, this study was planned to convince and motivate the farmer to follow the improved technology for successfull crop husbandry by its demonstration in the field.

PROCEDURE

An area of 0.4 hectare was selected at each tubewell MN-81 and 44. It was further divided into two plots measuring 0.2 hectare at both sites for ridge(Egyptian) and basin sowing methods. The soil at both sites was medium textured non-sodic and non-saline.

Treatment:

Treatment	No.	Description
Fertilizer	1	134-56-0 NPK kg/ha
Sowing methods	2	Ridge and Basin sowing
Replications	2	
Total plots	2x2=4	

Layout:

Experimental field was divided into 2 portions at each site for ridge and basin sowing.

Crop sowing:

Akbar variety of maize was sown on 14.7.1980 at both the sites using seed @ 35 kg/ha by dibbling in case of ridge sowing where as in basin hand planter was used. Row to row and plant to plant distance was 75 cm and 25 cm respectively. Thinning was done at its proper time.

Fertilizer application:

Urea and DAP were the source fertilizer for N&P respectively. All the phosphatic fertilizer was applied at sowing time. While the nitrogenous fertilizer was divided in three equal doses. First dose was applied with phosphatic fertilizer at sowing and rest of the fertilizer was applied when the crop was at knee height and tasseling stage.

Irrigation application:

Five and six irrigations were applied during growth period at tubewell MM-44 and 81, respectively. Total rainfall was recorded as 115.58 and 135.33 mm, respectively at tubewell MM-81 and 44.

Weeding/Earthing:

Two weedings were done at each site. Earthing was completed when the crop was 75cm high.

Plant protection:

Diazinon @ 13 kg/ha and dimicron @ 1.25 L/ha were applied against borer attack.

Indication:

Ridge sowing method in case of maize also gave the better results over basin method.

STUDY NO. 3: EVALUATION OF WATER REQUIREMENTS OF SPRING MAIZE UNDER DIFFERENT WATER TABLE DEPTHS

OBJECTIVE

Water is a scarce source as compared to land area in Pakistan and is considered an important plant growth limiting factor for raising the crop yield. The situation has been considerably accomplished in scarp area by the installation of tubewells. The underground watertable has direct relation with water requirements of plants.

But the farmers apply total delta of water recommended for crop irrespective of their water requirements. Therefore, by under and over irrigations the yields of the crops is being badly affected.

PROCEDURE

Site Selection:

Two research plots each of 0.8 hectare in the command of tubewell MM-66 were selected for this experiment. While selecting the sites due consideration was given to under ground water table depth which was 0-1 and 1-2 metre deep respectively at site A & B. Soil was medium textured and free from sodicity and salinity.

Treatment:

Treatment	No.	Description
Soil moisture	2	Irrigation applied at 25% & 50% of soil moisture deplition called as M1 and M2, respectively.
Water table depth	2	D1 0-1 metre D2 1-2 metre
Fertilizer	1	134-56-0 NPK kg/ha
Replications	3	
Plots:	2x2x3=12	

Layout:

The experimental field was divided into 12 equal sized plots measuring 12.2 x 10.67 and 10.96 x 10.67 metre, respectively at each site. Treatments were tested in a completely randomized block design in three replications.

Crop Sowing:

Akbar variety of maize was sown on 15th February, 1981 at each site using seed @ 37 kg/ha. Every effort was made to equalise the cultural practices.

Fertilizer application:

Ammonium nitrate and single super phosphate were the source fertilizers for N&P. All phosphatic fertilizer was applied at sowing time and nitrogenous fertilizer was divided in two parts. First dose was applied with phosphatic fertilizer at sowing and second dose at knee high stage of crop.

Irrigation application:

Irrigations were applied at 25% and 50% soil moisture deplition respectively to M1 and M2 in top 0-30 cm soil depth. Soil sampling was done before each irrigation for assessing the irrigation requirements. Total rainfall was recorded as 80.00 mm during crop growth period.

Indications:

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 water table 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.

STULY NO.4: SALINITY IN RELATION TO GROWTH AND DEVELOPMENT OF SORGHUM STRAINS(POT STUDY)

OBJECTIVE

Most of the area in Pakistan is saline and waterlogged. By which the growth and yield of different crops is being adversely affected in most part of the country.The plant response to different crop growth limiting factors varies widely among different species and varieties. Therefore,it become imperative to evaluate the varieties of different crops which can resist the abnormal saline condition of soil and can produce the optimum yield.

Sorghum is an important forage crop and some time it is also used by human as diet.Therefore,this crop has been taken up in this study to evaluate the response of different varieties under different salinity levels.

For this purpose 33 varieties have been collected from all over the country.Only six varieties namely Pak-SSII,Giza-3,Giza-114, D.S-75,A-625,A-3637 have been tested in this year.

Treatment

Treatment	No.
Varieties	6
Salinity levels	4
Replications	2
Total No.of plots	6x4x2=48

These varieties were sown on 14.4.80 in 10 kg glazed pots under four salinity levels treatments were tested in a completely randomised block design in two replications. Ec was created artifically by adding $CaCl2$, $MgSO_4$, NaCl and Na_2SO_4.

Indications:

Maximum fresh and dry yield was observed for Giza-3 and D.C.75 under Ec-4 and 8. All varieties survived at all salinity levels but yield was very low at Ec-12 and 16.

CHAPTER-IX

HYDROLOGY AND WATER MANAGEMENT

This section continued to further improve technology for efficient conveyance and application of irrigation water. Specifically research was conducted on 3 studies as per detail given below:

STUDY NO.1: FEASIBILITY STUDY ON INTEGRATED DEVELOPMENT OF WATERCOURSE COMMAND AREA.

OBJECTIVES

* To test and evaluate the impact of integrated development of watercourse command area on agricultural production.

* To work out cost benefit ratio of this concept.

Tubewell MN-93 had been selected for this study. The topographic survey of the main and branch watercourses had been completed. The design of linings to be constructed at this tubewell had been finalised and estimate preparation completed.

STUDY NO.2: JET PUMP INSTALLATION

Low head jet pumps were installed with the following 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 pumps.

Installation at T/well MN-51:

Jet pump was installed at tubewell MN-51. About 450 feet watercourse was lined in connection with the installation of the jet pump. The installation of jet pump has completely eliminated the mogha submergence.

Installation at T/well SHP-46:

At this site, tubewell water bifurcates into two different watercourses and was submerging the canal out-lets. The jet pump was installed by using the bifurcated tubewell water for pushing the canal water. The installation of jet pump has completely eliminated the submergence of mogha and the farmers are getting authorised canal supply.

STUDY NO.3: SKIMMING WELLS

OBJECTIVES:

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

Skimming wells were installed at tubewells SHP-20, SHP-26 and MN-116. The data collection regarding the upcoming of saline water is in progress. Installation of one tubewell with adjustable plate arrangement was also completed.

Modification or re-boring of closed tubewells:

In Hona Unit of SCARP-II there are 17 tubewells which have been closed due to high salinity. It was proposed to rebore or modify the closed tubewells to improve their water quality. The following was done in this connection:

i) Tubewell SHP-25 and 24-A:

The original bore was pluged leaving only 20' strainer resulting decrease in discharge of tubewell. To increase the discharge of tubewell water. Two additional bores were drilled. Each bore consisted of 25' strainer and 15' blind pipe. These bores were connected with one pumping plant unit.

ii) Tubewell MN-94:

Two new bores were drilled. Each consisted on 40' strainer and 20' blind pipe and these bores were connected with the old pumping system. The old bore was pluged in order to get good quality water.

WATERCOURSE IMPROVEMENT AND MANAGEMENT(WMR)

This section is responsible for measurement of watercourse conveyance and field application losses,development of techniques to minimise their losses,ground water management research to develop techniques for expliotation of thin layers of fresh water overlying saline aquifer and tubewell maintenance.Research on these aspects was continued and progress achieved during the year was as under:

Studies carried out at Mona Project indicate that significant deficiency of water is due to excessive loss of water during conveyance in the water system. Considerable work has been carried at Mona Project to minimize the loss of this scarse resource.This includes convential and partial lining of watercourses with concrete,brick and soil cement block masonry,precast concrete pannels, earthen improvement with farmer's involvement.Although some of the techniques have received national acceptance,research in this field was continued by incorporating some of the previous findings to test develop more economically feasible techniques for improving the entire watercourse system rather than selected branches of watercourse and also to determine the useful life of various improvement techniques.Research was also conducted to monitor the impact of watercourse improvement,efficient utilization of the saved water, elimination of mogha submergence etc.

a)WATER LOSS MEASUREMENTS

a) Water loss measurements have been completed at tubewell MN-94.

b) Comparison of flow measurement with sparling meter and cut-throat flume was conducted at tubewell MN-95 watercourse.

c) Water loss measurement by ponding method at branch watercourse lined with polythelene sheet has been completed.

d) Water loss measurements have been completed in the section lined with chicken wire and cement plaster.

b)WATERCOURSE IMPROVEMENT

1.Concrete lining:

Watercourse at tubewell MN-69 was selected for concrete lining with (1:3:6) mix both in bed and side walls in trapezoidal shape.The watercourse was lined with 3 inch thick cement concrete walls and 2" bed over 3400 feet.Another 4400 feet length was lined with 2" thick cement concrete thus making the total as 7800 feet.

2. Lining with chicken wire:

Watercourse at tubewell MN-94 was selected for chicken wire lining 1000' long section was lined with chicken wire and $\frac{1}{4}$" thick cement sand plaster. The chicken wire was used to provided the reinforcement. The lined section with chicken wire and cement plaster proved cheaper compared to other lining alternatives.

3. Lining with thin brick masonry:

i. Tubewell MN-81 watercourse:

840 feet long watercourse section was lined by using $4\frac{1}{2}$" thick brick masonry in the side walls and 3" thick 1:4:8 concrete in the bed.

ii. Tubewell MN-22 watercourse:

Watercourse at tubewell MN.22 was selected because of its poor condition as the main watercourse passed through a low lying area in 4-6 ft fills. It was lined with $4\frac{1}{2}$" brick masonry and 3" 1:4:8 concrete in bed.

iii. Tubewell SHP-20 watercourse:

The watercourse runs along the distributry and 16000' length is in fill. The bed and banks of the watercourse are high as compared to the surrounding fields. This situation was providing more chances for breakage of banks and wastage of water. Data regarding the watercourse profile and topographic survey was conducted and watercourse was designed. 1600' long section was lined. The bed of watercourse was lined with 3" thick . The wall along the fields was built 9" thick and along the distributory $4\frac{1}{2}$" thick.

iv. Tubewell MN-146 watercourse:

The main watercourse at tubewell MN-146 tubewell is infill and passes through sandy soil. The loss measurements of this watercourse showed that 0.60 cfs/1000 ft was being lost in the first 2200' section. The section was lined using $4\frac{1}{2}$" thick masonary walls and 3" thick 1:4:8 concrete in the bed.

4. Lining with precast slabs at Tubewell SHP-54 watercourse:

Watercourse at SHP-54 was selected for lining. 5182' long section with precast R.C.C. slabs of (2.15' x 3' x 2") size with minimum reinforcement, in trapizoidal shape and 1500' tail section of the same watercourse was lined with 3" thick brick masonry walls. Watercourse bed was also lined with 3" thick brick masonry. The height of the walls was 1.50 feet.

5. Installation of impervious cores in watercourse banks:

Studies carried out on a limited scale indicate that the losses could be considerably reduced by installing impervious cores in the watercourse banks. In order to carry out further tests over longer sections the following cores were installed:

i. Clay cores:

Two sections of 500' length each at MN-81 were tested by installing 2.0' and 1.50' deep clay cores.

ii. Concrete cores:

Two section at MN-81, each 600' long were completed by installing 2' and 1.50' deep cores.

iii. Polyetheline sheets:

At MN-94, 750' long section of watercourse was constructed by burying polyetheline sheets in bed and sides, under 10" layer of earth.

LAND LEVELLING

Precision land levelling is essential for better and efficient utilization of water. Land levelling act as catalyst and enhance the use of other inputs for crop production. Levelling was carried out at five sites mentioned -, below:

i. 10 acre plot at ground water management site-I
ii. 6 acre plot at tubewell SHP-20.
iii. 3 acre plot at tubewell MN-94.
iv. Final touch up of 4 acres at Sher Muhammad Wala.

GROUND WATER MANAGEMENT RESEARCH

The purpose of this study is to develop efficient methods for lowering the fresh saline water interface and the water-table to reduce water logging and salinization and to provide fresh water reservior in the aquifer which can accept monsoon rains and provide water for peak season irrigation use.

The following work was completed under this programme.

1. Site No.2 was energised and two shallow wells were put into operation.
2. Water sampling from 2 observation wells at tubewell D-147 and site No.1 were carried out for water quality tests.

3. Watertable survey of Sakesar area remained in progress after specified intervals.

HYDRAULIC CALIBRATION TANK

Accurate measurement of water is very important for improved water management. Methods for accurate measurement of water, which could easily be adopted in field conditions have continually been sought. A large number of structures and devices are developed for this purpose. Weirs and flumes are among the most widely used devices for water measurement. A hydraulic calibration tank already constructed at the project was utilized to achieve the following main objectives.

* Volumetric calibration of water measuring devices such as flumes, flow meters, weirs, orifices etc.
* Measurement of friction head loss and flow characteristics through culverts, check structures, outlet structures and constructed channels of all types.

90° V-Notch and Cut-throat flume (8"x3' made of fiber-glass were tested and following results were achieved.

a) The equation for 90° V-notch weir was much closer to the core formula i.e.

$$Q = 1.49\ H^{2.4884}$$

b) The equation obtained for 8" x 3' cut throat is different from that developed by Mr. Gaylord, V. Skogerboe and others.

It was recommended that the cut-throat flumes being used in water management research may be tested and calibrated for free as well as for submerged flow conditions so that precision in data collection may be achieved. However, further studies are required to finalize the statement.

Flow measurements with cut-throat flume (12"x3') were compared with the sparling meter. The difference between the two devices was not more than $\pm$ 4%.

CHAPTER-X

TUBEWELL OPERATION AND MAINTENANCE

The operation Division is responsible for the operation and maintenance of tubewells and distribution of water. The activities are summarized below:

TUBEWELL PERFORMANCE

Out of 138 tubewells in Mona Unit the following tubewells remained closed through the year due to brackish water and no demand.

MN-30,33,34,36,37,39,40,41,45,48,49,73,80,83,84,94,100,and 116.

Notification has since been issued by the Secretary,Irrigation and Power for charging double water rates in case of above tubewells into single rates. The tubewell MN-93 was damaged in January,1980 It has been replaced in May,1981 and now the tubewell is running smoothly.

Tubewell MN-44 was closed due to no demand and brakish water but it was partially running through-out the year for research Farm.

Tubewell MN-100 remained closed through out the year due to no demand as the water started over flowing over the drain banks and inovated the area around tubewell drain needs cleaning.

The remaining tubewells have been operating fully or partially depending upon the demand of share holders. Discharge and specific capacity of some of the tubewells has decreased on account of pump well problem and also due to depression of water table.

TUBEWELL UTILIZATION

During previous years all possible measures were taken and efforts were made to run the tubewells for the highest possible percentage utilization in order to provide adequate tubewell water supply to achieve the maximum cropping intensity.Percentage utilization of tubewells on yearly basis during the previous years is given at the end Table A-1.

The Finance Department of the Government of the Punjab put a restriction on utilization percentage to effect maximum economy in expenditure.Accordingly the yard stick was sanctioned on the basis of 60% tubewell utilization with an adjustment of other items in the yard stick.Prior to year 1971-72 the object of tubewell operation was to achieve the highest possible tubewell utilization and cropping intensity,but with the restriction on utilization. Percentage by the Government of the Punjab,emphasis was laid on observing economy rather that achieving higher utilization percentage and cropping intensity. An operation/schedule for running of tubewells

was prepared on the basis of minimum water requirement for the crops. In view of the ban imposed by the Government of Pakistan on SCARP tubewells during peak load hours i.e from 1700 hours to 2100 hours the project tubewells could only be operated for 20 hours a day, which is the major cause for low utilization percentage. Operational schedule is attached at the end.

Total supply pumped out during the year 1980-81 was 1,12,109 acre ft. The monthly utilization of tubewells varies from 31.79 to 60.25 and the average project utilization percentage comes to 45.32 on the basis of 24 hours daily running of tubewells. The maximum percentage of utilization in the perennial area was 67.60% in October-November 1980 and in non-perennial area maximum 65.54% in November 1980, and in un-commanded area maximum percentage utilization was 64.31% in the October-November, 1980 (Table X-2 & 3) are attached at the end.

WORKING HOURS

On the basis of actual operation of tubewells i.e. 24 hours daily from 16.6.1980 to 15.6.1981 percentage of total hours lost due to various faults and closure due to operational schedule is 56.61% while during the session 1979-80 it was 53.4'%, which shows decrease in total losses is due to the strict bandis according to schedule. Mostly in all warabandies the tubewell have been running on the demand of Zamindars. A brief description of total hours lost due to various faults is as below and shown in Table X- 4.

Electrical Faults:

During the year 1980-81 there was still shortage of electric power supply, due to which the electric shut down occurred usually and 59131 hours were lost due to electrical fault during the operational period, which is 5.30% of total available hours as shown in Table X-4 and 5.

Mechanical Faults:

Total hours lost due to various mechanical faults are 56136 hours, which comes to be 5.31% of total available hours while in the session 1979-80 it was 5.99% which shows decrease in mechanical fault during the session 1980-81. (Table X-4 to X-5).

No Demand Factor:

Certain tubewells in operationable condition, were kept closed for a certain period in view of the request of water users. Farmers were also reluctant to use the water of certain tubewells due to the reasons that it was brackish and hence not fit for direct irrigation. Tubewells Nos. LH-44, 48, 93, 100, 116 remained closed constantly more or less continuously for this very reason. Total hours lost due to no demand during the year are 96591 hours which is 9.05 of total available hours. (Table X-4 to X-5).

Watercourse Faults:

Total hours lost due to watercourse fault work out to be 32076 hours which is about 2.89% of total available hours. It may be added here that construction of link watercourses has improved the situation in most of the cases. (Table X-4 to X-7).

Equipment Performance:

The equipment in this project was received from USAID and was of different makes and varieties. Pumps were of Byron Jackson USA made, electric motor were Newman English made, panels, were Lancashire English made and transformer wezeno Yugollavia made. This equipment remained exposed to open weather for about four years before it was sorted out and installed in the Project. The equipment which was not found fit for use was replaced with local BECO pumps and Siemens Motor Control etc. Out of 150 BJ pumps only 73 were found suitable for use after necessary repair. It was because of this that vibration trouble was observed in certain cases. Similar was the case with the electric motor, which were even initially installed after over havling..

Pumps:

During the first two years of operation, spare parts of Byron Jackson were ready available at Lile 33 strores but after some time, that part of spare parts too exhausted and their procurement became a problem as they were not available in the local market and a lot of foreign exchange was required for their import.

Due to trouble some performance of Byron Jackson pumps, as alleged by M/s Tipton and Kalmbach Inc., The WAPDA, Consultants for Reclamation Project recommended phased replacement of these pumps withlocally manufactured KSB pumps etc. This replacement was carried out during 1969-70, 1970-71 and then later on this replacement was with held due to shortage of funds.

A detailed study was carried out about the performance of BJ Pumps after Dec, 1971 and it was found that replacement of the BJ pumps with KSB pumps (as previously undertaken) by M/s Tipton and Kalmbach Inc) was neither necessary nor economical.

It was noted from the study that though there was some increase in discharges, but it did involve heavy expenditure which had to be curtailed because practically no funds were available to take up the modification on the lines as recommended by M/s Tipton and Kalmbach Inc. At the same time it is not considered advisable from Technical point of view to replace the entire bowl assembly, which on one hand involved heavy expenditure and on the other hand old pump assembly and discharge head were scraped.

Keeping in view the above position comparative study of head discharge curve of BJ single and BJ double stage pumps has been made which reflects clearly that there is a rapid increase in discharge of BJ single pump with increase in pumping level, but the discharge of BJ double stage is constant with working limits of pumping head presently in the project area. Therefore it was decided that instead of replacing the new bowl assembly and at the same time carrying out the modification to change the oil pump to water lubricated pumps , the pumping set should remain in the same position and only one stage should be added to make the double stage and to repair/replace the worn out components and part. Later on the results were studied on tubewell No.MN-67 on 13.4.1972 after changing the BJ/1 stage to BJ/II stage and found increase in the discharge of the well to be 36% which was much appreciable and also it was noted that:

i. It involved less expenditure.

ii. The old pumping set was reused only with little repair and replacement.

iii. This modification could be carried in local market at Sargodha.

iv. The time for modification was also much less.

Thus keeping in view the above results this proposal was considered much more advantageous as compared to M/s Tipton and Kalmbach Inc; proposal and about all the BJ/single stage have been changed to BJ/double stage. All the tubewells are now double stage in our project and which are single stage will be changed to double stage when it will be required.

Motors:

All motors are three phase, hollow shaft vertical type of Newman made of 20,25 and 30 H.P. spare motors are available in the store for immediate replacement of burnt out or damaged motors which are got rewind from the workshops of repute in local market.

Motor Controls:

The project is in operation since long as such the components of the motor controls are deterorating day by day on account of excessive wear and tear, Ldnce shire control pannels at various tubewells had gone out of order due to burning of single phasing, timing relay's and as a result several tubewells remained closed temporarily since no replacement was available in our stores. The replacement of the whole pannel requires a lot of money which could not be met with due to shortage of funds and also that is not economical to replace the whole pannel. Keeping in view the non-availability of sufficient funds and emergent need and also considering economical point of view, it was decided to replace the single

table conditions and reduction in discharge due to lowering of water table was unavoidable. To avoid this proble BJ single stage pump were almost changed to double stage and decrease in discharge was now reduced very much as compared to single stage BJ pumps.

Pump Problem:

There are five different types of pumps installed in Mona Unit as shown below:

K.S.B. pumps.
BJ double stage pumps.
BECO Jacuzzi single stage pump.
BECO Jacuzzi double stage pump.

With numberous types of pumping equipment as installed in Mona Project, Maintenance and operation problems are manifold for obvious reason. In fact, it is the wrong selection of pumping equipment which is root cause for the condition of tubewells, building up adequate stock of spare's for the various categories of pumps noted above had although its own difficulties yet concrete procedure should have been followed to ensure that worn out parts and components of pumps are replaced in time. In addition to normal wear and tear of components the pumping equipment is open and susceptible to all types of hazards. But in the present study, only an importment factor which effects more seriously the pumping equipment, is being mentioned, which is "CORROSION" . These phenomenon of corrosion is a science in itself and commence immediately after the pump is lowered into the tubewell casing. Effect of corrosion on the pumps pulled out during the year under report, has been noticed to be very severe. Damage to pumping equipment on account of corrosion is quite considerable leading to reduction in discharge of the tubewells and some time adding the cost of repairs.

Well Problems:

This is a problem which is the result of deterioration of tubewell strainer caused byclogging of slot's on account of "Incrustation" and all types of corrosion. This problem, since not directly related to the tubewells equipment is not being discussed in detail in this study.

This trouble can be decreased by the blasting of the tubewells in the project, and decrease in discharge can be reduced whenever required on any well in the project.

phasing only. In session 1973-74 the replacement of circuit breakers and air breakers were arranged and installed on the required No.of tubewells which operated satisfactorily.

Every year on availability of funds the replacement of the air breaker and circuit breaker has been carried out in place of deteriorated motor controls since 1973-74, similarly in the year 1979-80 the replacement of the circuit breakers of the badly deteriorated motor controls has been carried out and replacement will be continued in the year 1980-81 according to the availability of sufficient funds and also the no. of motor controls deteriorated.

Decrease in Discharge of Tubewell:

Total pumpage capacity of the 138 tubewells at the time of final acceptance test was 456 cusecs. During the session 1979-80 the tubewells numbers MN-30,33,34,37,39,40,41,44,45,48,49,7? 80, 83,84,94,100 and 116 remained closed through out the year due to brackish water,no demand and watercourse defect etc.The designed pumping capacity of the remaining 119 tubewell comes to 370.5 while the actual capacity is 333.40 cusecs, which shows reduction of discharge of 9.45 cusecs while during the previous year the short was 12.23 cusecs in discharge as 77.26%.
The decrease in discharge of tubewells can be attributed to the following factors.

1. Lowering of water table.
2. Pump problems.
3. Well problems.

Lowering of Water Table:

Lowering of water table with time is a normal feature which is rather desired being the objective to be achieved for control of waterlogging in the Project area.The reduction in discharge on account of lowering of water table has thus no remedy except that while selecting a pump this factor needs to be kept in view,so that within a reasonable limit,effects of lowering of water table is not so much that the pump loss its usefulness. Lowering of water table in Mona Project has been very much felt in case of BJ (Byron Jackson) single stage pump, which are designed only for constant water table conditions. From the "Head Discharge Characteristics Curve" of BJ single stage pump it was observed that discharge of these pump reduces rapidly with increase in pumping level,even if all other operational conditions remained the same. Thus BJ pumps selected for installation in Mona Project were unsuitable for the depressing water

WATER MANAGEMENT

At the start of the project,a total area of 103,986 acres was under irrigation.The cropping intensity was 99%.Total cropped area has increased to 102026 acre as a result of which the project cropping intensity has been attained.

WATER DISTRIBUTIONS

The revenue staff of the Mona Project framed chakbandis and warabandis on 30 tubewells in un-commanded area.For the remaining tubewells installed on outlets the decision for sanctioning of chakbandis and warabandies was referred to Divisional Canal Officer of the Irrigation and Power Department.There are a few tubewells where consolidation of holdings has been in progress and as such chakbandies could not be framed.

The chakbandies and warabandies for the following tubewells were framed during 1980-81.

Field books	MN-133	(1 No)
Chakbandies	=	MN-137,143,118,148 = 4 Nos.
Warabandies	=	MN-136,135,148,141, 47 ,133,137 and 143=8 Nos.

LINK WATERCOURSE

Since the start of operation of the project in 1965 there were many tubewells where link watercourse were constructed by the department.Due to long use these watercourse have been damaged and similarly there are some tubewells where still no link watercourses have been constructed. A number of the complaints have been received from the Zamindars for irregular supply of water due to lack of link watercourses and their deteriorated condition. The construction of link watercourses was undertaking on tubewells Nos. MN-74,MN-46,MN-139,MN-118, MN-21 ,MN-148, MN-146 nd MN-47L for saving losses in irrigation water for efficient water management(Table X-8).

OPERATIONAL SCHEDULES OF TUBEWELLS OF KONA UNIT
FOR THE YEAR 1980-81

OPERATION SCHEDULE

Month	Perennial Area (6 A.M to 6 A.M)	Non Perennial Area (6 AM to 6 A.M)	Un-commanded Area (6 A.M to 6 A.M
7/80	7.7.80 to 14.7.80 21.7.80 to 28.7.80	7.7.80 to 14.7.80 21.7.80 to 28.7.80	7.7.80 to 28.7.80
8/80	28.7.80 to 4.8.80 11.8.80 to 25.8.80	28.7.80 to 4.8.80 11.8.80 to 25.8.80	28.7.80 to 4.8.80 11.8.80 to 25.8.80
9/80	1.9.80 to 15.9.80 22.9.80 to 29.9.80	1.9.80 to 15.9.80 22.9.80 to 29.9.80	1.9.80 to 28.9.80
10/80	6.10.80 to 27.10.80	6.10.80 to 27.10.80	6.10.80 to 27.10.80
11/80	3.11.80 to 24.11.80	3.11.80 to 24.11.80	3.11.80 to 24.11.80
12/80	1.12.80 to 15.12.80 22.12.80 to 29.12.80	1.12.80 to 15.12.80 22.12.80 to 29.12.80	1.12.80 to 15.12.80 22.12.80 to 29.12.80
1/81	5.1.81 to 26.1.81	5.1.81 to 26.1.81	5.1.81 to 26.1.81
2/81	2.2.81 to 23.2.81	2.2.81 to 23.2.81	2.2.81 to 23.2.81
3/81	2.3.81 to 9.3.81 16.3.81 to 30.3.81	2.3.81 to 9.3.81 16.3.81 to 30.3.81	2.3.81 to30.3.81
4/81	6.4.81 to 27.4.81	6.4.81 to 27.4.81	6.4.81 to 27.4.81
5/81	4.5.81 to 18.5.81 25.5.81 to 1.6.81	4.5.81 to 18.5.81 25.5.81 to 1.6.81	4.5.81 to 18.5.81 25.5.81 to 1.6.81
6/81	8.6.81 to 29.6.81	8.6.81 to 29.6.81	8.6.81 to 29.6.81

TABLE:X-1

YEARWISE PUMPAGE PERCENTAGE UTILIZATION OF MONA UNIT

24 HOURS DAILY WORKING

Period	Pumpage Acre feet	Percentage utilization
October,1965 to June 1966	83736.00	39.68
July,1966 to June,1967	120027.00	37.54
July,1967 to June,1968	138231.00	43.11
July,1968 to June,1969	204127.00	63.84
July,1969 to June,1970	215107.00	67.28
July,1970 to June,1971	207531.00	64.91
July,1971 to June,1972	143158.00	44.65
July,1972 to June,1973	117576 .00	36.77
21st June,1973 to 20th June,1974	122245.00	39.92
21st June,1974 to 20th June,1975	134583.43	48.21
21st June,1975 to 20th June,1976	111708.44	40.66
21st June,1976 to 16th June,1977	126185.72	47.18
16th June,1977 to 15th June,1978	113934.77	41.91
16th June,1978 to 15th June,1979	117037.35	48.91
16th June,1979 to 15th June,1980	124207.25	50.87
16th June,1980 to 15th June,1981	112108.97	45.32

TABLE:X-2

AVERAGE AVAILABLE AND ACTUAL PUMPAGE UTILIZATION OF

(24 HOURS WORKING HOURS)

Period	Available pumpage Acre feet. Perennial area	Non-Perennial area.	Un-commanded area.	Actual Pumpage Acre feet Perennial area.	Non-perennial area.	Un-commanded area.	Percentage Utilization Perennial area.	Non-perennial area.	Un-commanded area.
16.6.80 to 15.7.80	10110.80	4564.20	5929.20	2929.20	1167.13	2263.03	28.97	25.57	38.15
16.7.80 to 15.8.80	10447.62	4716.34	6126.84	2819.74	1611.97	2216.95	26.98	34.17	36.18
16.8.80 to 15.9.80	10447.62	4716.34	6126.84	4048.61	1917.72	2963.00	38.75	40.66	48.36
16.9.80 to 15.10.80	10110.60	4564.20	5929.20	4575.39	1760.35	3137.19	45.25	38.56	52.91
16.10.80 to 15,11.80	10447.62	4716.34	6126.84	5955.32	2557.63	3940.69	57.00	54.22	64.31
16.11.80 to 15.12.80	10110.60	4564.20	5929.20	4791.51	2991.76	3360.44	47.39	65.54	56.67
16.12.80 to 15.1.81	10447.62	4716.34	6126.84	3014.52	1889.96	2033.15	28.85	40.07	33.18
16.1.81 to 15.2.81	10447.62	4716.34	6126.84	3834.55	2254.54	2702.23	36.70	47.80	40.10
16.2.81 to 15.3.81	9436.56	4259.92	5533.92	4854.49	2195.05	2935.73	51.44	51.52	53.04
16.3.81 to 15.4.81	10447.62	4716.34	6126.84	3979.84	2166.73	2485.35	38.09	45.94	40.56
16.4.81 to 15.5.81	10110.60	4564.20	5929.20	5833.54	2419.70	3510.52	57.69	53.01	59.20
16.5.81 to 15.6.81	10447.62	4716.34	6126.84	5516.10	2224.67	3259.72	52.79	47.16	53.05
Total:	123012.30	55531.10	72138.60	52152.81	25162.21	34799.00	42.49		
Average.							42.49	45.35	38.30
Grand Total:	(250682)			(1121114.02)					

TABLE:X-3

UTILIZATION OF HOURS AND VARIOUS DURING 1980-81
24 HOURS DAILY WORKING HOUR UNIT TUBEWELLS

Period	Available hours.	Running hours	Total lost hours during rest hours.	Total percentage hours.	Elec. faults	Mech. fault	W/C caults	No demand	Rest hrs. including operational schedule
16.6.80 to 15.7.80	86400	26689	54702	69.10	7.03	9.82	6.10	26.72	19.43
16.7.80 to 15.8.80	89280	28286	60994	68.32	5.89	3.00	2.46	16.03	40.94
16.8.80 to 15.9.80	86400	39734	46666	54.01	6.13	5.90	1.88	3.43	36.67
16.9.80 to 15.10.80	89280	37404	51876	58.10	7.28	6.57	2.25	12.72	29.28
16.10.80 to 15.11.80	86400	39734	46666	54.01	6.13	5.90	1.88	3.43	36.37
16.11.80 to 15.12.80	89280	51556	37724	42.25	4.52	4.65	1.04	3.13	28.91
16.12.81 to 15.1.81	86400	47327	39073	45.22	6.74	5.08	3.83	10.97	18.60
16.1.81 to 15.2.81	89280	29184	C0096	67.31	3.88	4.67	2.88	6.05	49.82
16.2.81 to 15.3.81	89280	36778	52502	58.80	2.63	4.79	5.74	10.36	35.28
16.3.81 to 15.4.81	80640	41762	38878	48.21	2.06	3.38	2.50	3.33	36.94
16.4.81 to 15.5.81	89280	36597	52683	59.01	4.83	7.02	2.93	10.20	34.03
16.5.81 to 16.6.81	89280	46225	43055	48.22	6.56	2.98	1.23	2.26	35.19
Total:	1051200	461285	584915						
Average:				56.04	5.30	5.31	2.89	9.05	33.48

TABLE:X-4 MONTHLY AVAILABLE ACTUAL PUMPAGE UTILIZATION OF MONA UNIT TUBEWELLS DURING 1980-81

Period	Available pumpage in acre feet.	Actual pumpage in acre feet.	Percentage Utilisation
16.6.80 to 15.7.80	20004.00	6359.36	31.79
16.7.80 to 15.8.80	20670.80	6648.66	32.16
16.8.80 to 15.9.80	20670.80	8929.23	43.20
16.9.80 to 15.10.80	20004.00	9472.93	47.35
16.10.80 to 15.11.80	20670.80	12453.65	60.25
16.11.80 to 15.12.80	20604.00	11143.72	54.09
16.12.80 to 15.1.81	21290.80	6937.63	32.59
16.1.81 to 15.2.81	21290.80	8791.32	41.29
16.2.81 to 15.3.81	19230.40	9985.27	51.92
16.3.81 to 15.4.81	21290.80	8631.95	40.54
16.4.81 to 15.5.81	20604.00	11763.76	57.09
16.5.81 to 15.6.81	21290.80	10991.49	51.63
Total:	247622 .00	112108.97	543.90
Average.	206335.16	9342.41	45.32

TABLE:X-5 WORKING HOURS LOST DUE TO VARIOUS FAULTS
(24 HOURS DAILY WORKING)

Period	Working hours lost due to various faults				Working Hours
	Elec. faults	Mech. faults.	No demand faults	Water-course faults	
16.6.80 to 15.7.80	6074	8490	23084	5271	26698
16.7.80 to 15.8.80	5265	2679	14307	2189	28286
16.8.80 to 15.9.80	6496	5874	11358	2006	37404
16.9.80 to 15.10.80	5292	5106	2962	1620	39734
16.10.80 to 15.11.80	4038	4149	2798	929	51562
16.11.80 to 15.12.80	5825	4388	9481	3309	47327
16.12.80 to 15.1.81	3466	4168	5405	2568	29184
16.1.81 to 15.2.81	2350	4280	9251	5128	36778
16.2.81 to 15.3.81	1661	2725	2688	2016	41762
16.3.81 to 15.4.81	4311	6266	9105	2613	89280
16.4.81 to 15.5.81	8492	5347	4134	3325	49375
16.5.81 to 15.6.81	5859	2665	2018	1102	46225
Total:	59131	56136	96591	32076	523609

TABLE X-6

VARIOUS FAULTS IN MONA UNIT TUBEWELLS FOR THE YEAR 1980-81

24 HOURS DAILY WORKING

Period	Various faults due to Electrical faults.	Various faults due to Mechanical faults.	Various faults due to Watercourse fault.	No Demand.	Total Hours including Operational schedule	Total losses including rest hours & Operational Schedule.
16.6.80 to 15.7.80	4.42	10.89	8.84	27.07	19.99	71.21
16.7.80 to 15.8.81	3.06	3.34	2.85	17.93	35.04	62.22
16.8.80 to 15.9.80	5.57	7.90	3.77	14.68	30.62	61.54
16.9.80 to 15.10.80	3.76	5.53	1.39	2.73	41.31	54.72
16.10.80 to 15.11.80	3.61	5.46	0.50	2.77	33.66	46.00
16.11.80 to 15.12.80	4.91	5.44	4.94	17.90	19.19	52.38
16.12.80 to 15.1.81	3.12	3.61	5.53	7.09	50.48	70.73
16.1.81 to 15.2.81	2.55	5.96	7.65	12.28	35.14	63.58
16.2.81 to 15.3.81	2.48	3.44	2.96	3.95	36.31	49.14
16.3.81 to 15.4.81	4.11	7.81	3.39	12.48	33.60	61.39
16.4.81 to 15.5.81	7.09	6.13	4.73	4.94	18.39	42.18
16.5.81 to 15.6.81	6.24	2.76	0.99	2.23	34.42	46.64
Average.	4.31	5.68	3.87	10.57	32.34	56.81

TABLE X-7

VARIOUS FAULTS IN MON. UNIT TUBEWELLS FOR 1980-81

24 HOURS DAILY WORKING UN-COMMANDED AREA

Period	Various faults Due to			No Demand	Rest hours including Operational schedule.	Total losses including Rest hourse & Operational schedule.
	Electrical faults	Mechanical faults	Watercourse faults			
16.6.80 to 15.7.30	15.58	8.81	4.82	25.08	19.99	74.28
16.7.80 to 15.8.80	11.47	2.79	0.88	10.62	40.19	65.95
16.8.80 to 15.9.80	9.95	3.32	2.70	13.38	31.09	60.44
16.9.80 to 15.10.80	6.63	8.09	0.38	6.11	41.86	63.07
16.10.80 to 15.11.80	4.05	4.19	0.01	1.92	34.69	44.86
16.11.80 to 15.12.80	9.70	3.96	0.22	4.01	17.02	34.91
16.12.80 to 15.1.81	3.90	2.91	-	1.55	52.04	60.40
16.1.81 to 15.2.81	1.50	3.97	4.16	7.21	35.31	52.15
16.2.81 to 15.3.81	1.13	5.05	2.31	2.99	37.66	44.14
16.3.81 to 15.4.81	1.44	6.95	2.23	9.93	33.76	54.36
16.4.81 to 15.5.81	10.66	5.96	2.98	2.87	18.39	47.86
16.5.81 to 15.6.81	6.58	4.72	0.95	5.35	[illegible]92	56.52
Average.	6.88	5.06	1.80	8.17	33.16	55.32

TABLE:X-8

A-LINK WATER COURSES CONSTRUCTED IN MONA UNIT DURING 1968-70

Tubewell No.	Length of Link watercourses ft.	Type of Link Water-courses.	Remarks.
MN-15	575	Brick lined	Constructed in 1969
MN-30	1060	"	"
MN-33	1100	"	"
MN-40	2400	Kacha.	Lining done in 1970
MN-56	900	Brick lined.	Constructed in 1969
MN-69	3050	Kacha.	Constructed Pacca in 1971.
MN-70	3200	Part kacha and part Brick lined.	Constructed in 1969. Constructed in 1969.
MN-81	1630	Pipe link W/Course.	Constructed in 1969
MN-82	1310	Brick lined.	"
MN-	1460	"	"
MN-123	2000	"	"
MN-124	2240	Kacha	Line in 1970
MN-129	2650	Brick line.	Constructed in 1969

B-LINK WATER COURSES CONSTRUCTED IN MONA PROJECT DURING 1970-71

MN-14	3540	Part kacha.	Completed.
		Part pacca	"
MN-66	4400	Kacha.	"
MN-69	3050	Part kacha part pacca.	"
MN-74	1450	Pacca	"
MN-104	3000	Pacca.	"
MN-113	2150	Pacca.	"
MN-114	3100	Part pacca.	"
MN-115	1900	Pacca.	"

TABLE:X-8(Contd)

LINK CHANNEL AND LINK WATERCOURSE

1974-75

T/well No.	Length of Linkwatercourse(Ft)	Length of Link water-channel(ft)	Type of link water-course & channel	Remarks
1	2	3	4	5
MN-12	340	-	Pacca	Completed
MN-13	100	-	"	"
MN-20R	120	-	"	"
MN-20L	90	-	"	"
MN-20	-	-	"	"
MN-21	340	36	"	"
MN-123E	70	-	"	"
MN-123	80	-	"	"
MN-57	-	140	"	"
MN-124R	90	-	"	"
MN-57	100	-		
	1975-76			
MN-16	200	-	Rect.Angular	"
MN-3	400	-	"	"
MN-96	50	50	"	"
MN-126	500	-	"	"
MN-127	150	-	"	"
MN-66	300	-	"	"
MN-6	1500	-		
	1976-77			
MN-56	1100	-	"	"
MN-55	600	-	"	"
MN-54	200	-	"	"
MN-76	200	-	"	"
MN-54	Accudt 25	-	"	"
	1977-78			
MN-129	2520	-	"	"
MN-140		-		

Cont'd...

TABLE:X-8 (Cont'd)

C- LINK WATERCOURSE CONSTRUCTED IN MONA UNIT DURING 1972-73

MN-111	450	Pucca	Completed
MN-81	570	"	"
MN-28	380		

D- LINK WATERCOURSE IN MONA PROJECT DURING 1973-74

T/well No.	Length of link watercourse (Ft)	Type of link watercourse	Remarks
MN-14	230	Pucca	Completed
MN-22	1300	"	"
MN-77	250	"	"
MN-100	28	"	"
MN-110	106	"	"
MN-111	76	"	"
MN-112	350	"	"
MN-127	30	"	"
MN-128	230	"	"
MN-130	150	"	"
MN-131	87	"	"
MN-132	133	"	"
MN-138	410	"	"
MN-144	470		

E- LINK WATERCOURSE CONSTRUCTED BY ZAMINDARS BUT REQUIREMENT RECONSTRUCTION

T/well No.	Tubewell Discharge	Discharge of Link watercourse	Approximate length of watercourse (ft)
MN-21	4.00	1.20	600
MN-22	4.00	4.00	1300
MN-39	3.00	2.47	1500
MN-41	2.50	1.85	3200
MN-46	3.50	1.23	500
MN-77	3.00	1.59	500
MN-128	4.00	1.93	1700
MN-37	3.50	3.00	1500
MN-129	3.50	2.75	100
MN-130	3.50	1.75	190
MN-130 L	3.50	1.87	150
MN-132	3.50		

Cont'd....

TABLE:X-8(Cont'd)

1	2	3	4	5
		1978-79		
MN-62	200	-	Rect. Angular	Completed
MN-130	200	-	"	"
MN-115	400	-	Pucca	"
MN-139	350	-	pipe lined	"
MN-115	1700	-	Vertical	"
MN-120	450	-	"	"
MN-135	350	-	"	"
MN-53	350	-		
		1979-80		
MN-47R	600	30	Rect. Angular	"
MN-137	700	-	"	"
MN-124	500	-	"	"
MN-128	450	-	"	"
MN-59	150	100	"	"
MN-123	1500	-	"	"
MN-97L	220	-	"	"
MN-145	400	-	"	"
MN-113	250	-	"	"
MN-10	200	-	"	"
MN-46	700	-		
		1980-81		
MN-47L	450	32	"	"
MN-148R	500	21	"	"
MN-148L	500		"	"
MN-73	2000	-	"	"
MN-21R	143	113	"	"
MN-118L	400	50	"	"
MN-139	450	-		

SHAHPUT UNIT-I

Shahpur Unit-I is a narrow strip nearly 3 to 7 miles in width and 30 miles in length with River Jhelum marking its Northern boundary and Malkwal Town on its east. It was taken over by Mona Project Director from Sargodha SCARP Construction in February,1979.

It consists of 161 Nos. tubewells with 134 Nos Operator quarters The Operator quarters have been constructed in such a way that on the two No.tubewells located within half mile's radious there is only one No.quarter constructed for two No.tubewells.

EQUIPMENT INSTALLED And ITS PERFORMANCE

The equipment installed in the Shahpur Unit-I is mostly locally manufactured with the pumps motors and control pannels of different makes.

The detail of different types of tubewell pumps and motors is given below:

A. Type of Tubewells:

In this unit both turbine and centrifugal pumps have been used in the tubewells.Centrifugal pumps have been used in shallow tubewells with less capacity while turbine pumps have been installed on comparatively bigger capacity tubewells. The depth of bore holes for centrifugal pump well varies from 100-140 feet for 1.0 and 1.5 cusec capacity wells respectively. For 1.0 cusec wells an average length of 60 feet of 6" diameter strainer and for 1.5 cusec capacity wells 90 feet of 8" diameter strainer has been used.The length of the Suction pipe has been determined on the basis of specific draw-down of 10 feet per cusec and depth to water table at 15 feet.

For turbine pump well the bore hole varies from 175-210 feet for 2 and 3 cusec capacity wells respectively. For 2.0 cusec wells an average length of 100 feet of 6" dia strainer and for 3 cusec capacity wells 120 feet of 8" diameter strainer has been used.

In view of compositively low price useful life span and strength to undergo secondary development operation mild steel strainer have been used.

B) Type of pumps:

Pumps of different types and makes have been used in this unit which are being given below:

i. PECO

ii. K.S.B.

C) Type of Motors:

Motors of different and make with the horse power varying from 10 to 30 have been used which are given below:

i. FICC
ii. SIEMENS

D) Type of Motor Controls:

The motor controls used in this scheme are all of Siemens Pakistan made.

All the machinery like pumps,motors and control pannels are of indiginous make and repair/replacement is eaisly available in the local market which is economical as well as rapid for carry out. All machinery is performing well and no typical type of defect is noticed in the pumps,motors and motor controls.

WATER DISTRIBUTION

The revenue staff is working for collection of data and framing chakbandies and warabandies for the area to be served by the tubewells. The chakbandis and warabandis are being taken up for only those tubewells which are the source of irrigation supplies to the uncommanded areas and due to limited staff constraints the remaining ones with canal supply have been left for the irrigation and Power Department to settle the issues involved.

Chakbandis Framed:

Tubewell Nos. SHP-24A,150,23A,77,73A,16,139
140,17,27 and 14 = 12 Nos.

Warabandis Announced:

SHP-17,98,97,103,137,147&110=7 Nos.

Field Books Completed:

SHP-70,112,113,114,150&151 = 6 Nos.

LINK WATERCOURSES AND DISTRIBUTION SYSTEM

The distribution system consisting of water channels,kutcha and pucca link water courses and discharge boxes were constructed by the Sargodha SCARP Construction Circle.After finalization of chakbandis some modification in the distribution system had to be carried out and so some modification structures and link water courses were constructed.In sandy areas,loss of considerable quantity of water was occuring and so to avoid this pucca loss link watercourses were constructed.The tubewells where these

modifications and construction of distribution work and watercourses have been carried out are mentioned below:

Detail of tubewell Nos: SHP-12,123,55,81,27,54,122,25 and 26=10 Nos.

Decrease in Discharge of Tubewells:

The actual capacity of 161 Nos. tubewells at the time of final acceptance test was 267.50 cusecs against the designed discharge of 254.50 cusecs. During this year the actual discharges of tubewells were measured and found to be 263.80 cusecs which shows a reduction of 0.014% over the discharge of tubewells observed at final observance test. The insignificant reduction in discharge can be attributed to the following factors.

i)Lowering of Water Table:

Due to the continuous running of tubewells the water table has been lowered from 2' to 10' since the start of operation of tubewells.

ii) Wearing and Tearing of Machinery:

Due to the continuous running of the tubewells the wearing and tearing of the pumps has taken its toll and thereby the reduction in discharge has occurred.

Lowering of Water Table

Before the installation of the tubewells,the water table in most of the areas of this scheme was within 5 feet.Now with the operation of tubewells considerable lowering of water table has occurred with the result that badly waterlogged lands have been brought into cultivation.

A comparison of static water levels in representative wells taken at the time of final acceptance test and observed during the year gives good indication of the good results achieved towards the attainment of major objective of eradication of waterlogging and salinity by lowering of water table.

Sr.No.	T/well No.	Static water level time of installation in 1979 in ft.	Measured in 1980 in ft.	Decrease in level
1.	SHP-3	12.00	17.10	5.10
2.	SHP-23	10.25	14.50	4.25
3.	SHP-28	3.25	12.40	9.15
4.	SHP-50	12.25	15.85	3.60
5.	SHP-56	8.40	15.10	6.70
6.	SHP-80	7.75	13.00	5.25
7.	SHP-92	3.00	14.20	11.20
8.	SHP-117	6.80	13.90	8.10
9.	SHP-139	9.50	11.90	2.40
10.	SHP-154	9.25	12.80	3.55

TUBEWELL PERFORMANCE

There are 161 Nos. tubewells in Shahpur Unit-I which have been operating fully or partially dependent upon the project utilization to meet with crop water requirements. Some of the tubewells remained closed temporarily due to no demand and electrical or mechanical faults.No single bore has damaged during the year.

TUBEWELL UTILIZATION

During the period July,1980 to June,1981 all the possible measures were taken and efforts were made to run the tubewells for attainment of the highest possible percentage utilization in order to provide adequate supply of water for achieving the maximum cropping intensity. Average percentage utilization worked out over the whole year is 45.35% which is 14.65% less than the projected percentage utilization.

The percentage utilization during the period varies from 37.16% to 76.95 on 24 hours basis.The average percentage utilization in uncommanded area was 55.50% and in the non-perennial area was 45.06%. Thus actual average pumpage in the non-perennial area was 7132 acre ft. against the average available pumpage of 15842 acre ft. Similarly in uncommanded areas actual average pumpage was 236.0 acre ft.against available pumpage of 426 acre ft.

The following tables are attached.

1. Yearwise pumpage utilization (Table X-9)

2. Monthly available and actual pumpage utilization. (Table X-10).

3. Monthly available and actual pumpage utilization in Non-perennial and un-commanded areas. (Table X-11).

The reason for the low percentage utilization are mentioned below:

WORKING HOURS:

On the basis of actual operation of tubewells on the basis of 24 hours daily working from 16.6.80 to 15.6.81 average percentage of total hours lost due to various faults and closure due to operational schedule is 60.20%. A detail of working hours lose due to different reasons and percentage lost against the available working hours in the shape of table X-12 to X-16.

ELECTRICAL FAULT

74995 hours lost out of 1410460 hours, which is 5.30% of the total working hours available on the basis of 24 hours.

The detail of the tubewells closed on account of transformer/ electric fault is given below with relative period.

Sr.No.	Month	No. of tubewell closed
1.	7/80	37
2.	8/80	12
3.	9/80	20
4.	10/80	16
5.	11/80	4
6.	12/80	4
7.	1/81	4
8.	2/81	3
9.	3/81	4
10.	4/81	6
11.	5/81	5
12.	6/81	5

NO DEMAND CLOSED

A No.of tubewells in operatable condition were kept closed for certain periods in view of the request of the share holders due to brackish water.

Total hours lost due to this reason was 167963 out of 1410460 working hours which is 11.89% of the total working hours.

A separate detail for the hours lost due to no-demand in perennial,non-perennial and uncommanded area is attached herewith Table X-12 to X-16.

LOSS DUE TO REST HOURS

Rest hours fixed due to fluctuation of voltage in peak load hours from 1700 hours to 2100 hours and to give proper rest to the machinery.

LOSSES DUE TO ELECTRICAL FAULT

A number of tubewells which have been closed fully for the month or partially due to non-availability of proper distribution system such as faults in bifurcation structure link water courses, non-scheduling of chak bandis etc. In the period reported about 59174 hours were lost due to this reason which is 4.19% of the total hours,the detail of which is shown in the Table X-12to X-16.

LOSSES DUE TO MECHANICAL FAULTS

A number of tubewells remained closed partially due to the mechanical faults mentioned below:

1. Pump defect.
2. Motor defect.
3. Starter defect.

Major repair is to be carried out from the local market at Sargodha which takes some time.Thus the total hours lost during the period due to mechanical faults are 81769 hours out of 1410460 hours which is 5.78%. Separate detail for the losses in perennial,non-perennial and uncommanded areas are shown in the Table X-12 to X-16 .

OPERATIONAL SCHEDULE OF TUBEWELLS IN SHAHPUR UNIT-I
OF MONA PROJECT FOR THE YEAR 1980-81

OPERATIONAL

Month	Non-perennial Area (6 A.L. to 6 A.L.)	Un-commanded Area (6 A.L. to 6 A.L.)
July	7.7.80 to 14.7.80 and 21.7.80 to 28.7.80	7.7.80 to 28.7.80
August	28.7.80 to 4.8.80 and 11.8.80 to 25.8.80	28.7.80 to 4.8.80 and 11.8.80 to 25.8.80
September	1.9.80 to 15.9.80 and 22.9.80 to 29.9.80	1.9.80 to 29.9.80
October	6.10.80 to 27.10.80	6.10.80 to 27.10.80
November	3.11.80 to 24.11.80	3.11.80 to 24.11.80
December	1.12.80 to 15.12.80 and 22.12.80 to 31.12.80	1.12.80 to 15.12.80 and 22.12.80 to 31.12.80
January	1.1.81 to 26.1.81	1.1.81 to 26.1.81
Febmuary	2.2.81 to 23.2.81	2.2.81 to 23.2.81
March	2.3.81 to 9.3.81 and 16.3.81 to 30.3.81	2.3.81 to 30.3.81
April	6.4.81 to 27.4.81	6.4.81 to 27.4.81
May	4.5.81 to 18.5.81 and 25.5.81 to 1.6.81	4.5.81 to 18.5.81 and 25.5.81 to 1.6.81.
June	8.6.81 to 29.6.81	8.6.81 to 29.6.81

TABLE: YEAR WISE PUMPAGE AND PERCENTAGE UTILIZATION
(24 HOURS DAILY WORKING)

Period	Available pumpage Acre feet	Actual pumpage Acre feet	Percentage Utilization
16.2.79 to 15.6.79	64814	13640.26	20.66
16.6.79 to 15.6.80	193417	78865.63	40.69
16.6.80 to 15.6.81	195152	88425.01	45.35

TABLE: X-11 VARIOUS FAULTS IN SHAHPUR UNIT-I FOR 1980-81 IN LOWA PROJECT (24 HOURS DAILY WORKING) (UN-COMMANDED AREA)

Period	Various Faults			No demand	Rest hours including operation schedule	Total losses including rest hours & operational schedule
	Elec. faults	Mech. faults	Water-course faults			
16.6.80 to 15.7.80	1.70	1.00	0.91	45.04	16.66	65.31
16.7.80 to 15.8.80	0.14	9.01	20.06	6.04	23.46	58.71
16.8.80 to 15.9.80	7.99	10.82	-	1.52	23.16	43.49
16.9.80 to 15.10.80	4.27	-	-	-	24.72	28.99
16.10.80to 15.11.80	2.32	-	2.01	17.82	24.48	46.63
16.11.80 to 15.12.80	1.38	-	9.18	12.50	17.35	40.41
16.12.80 to15.1.81	0.24	-	-	24.06	16.66	40.96
16.1.81 to 15.2.81	1.52	-	25.26	12.91	35.47	75.16
16.2.81 to 15.3.81	-	4.61	6.78	1.04	32.28	44.71
16.3.81 to 15.4.81	1.48	-	-	12.76	31.32	45.56
16.4.81 to 15.5.81	1.66	1.19	-	1.38	21.53	46.53
16.5.81 to 15.6.81	7.08	2.08	1.87	0.40	35.46	44.70
Average	2.48	2.39	5.50	11.25	25.21	

TABLE:X-12 MONTHLY AVAILABLE ACTUAL PUMPAGE UTILIZATION OF SHAHPUR UNIT-I MONA PROJECT BHALWAL DURING 1980-81

Period	Available pumpage in Acre ft.	Actual pumpage in Acre ft.	Percentage utilization
16.6.80 to 15.7.80	16050	3611.00	22.50
16.7.80 to 15.8.80	16585	5019.91	30.25
16.8.80 to 15.9.80	16554	5747.31	34.72
16.9.80 to 15.10.80	16020	6231.12	38.90
16.10.80 to15.11.80	16554	10378.04	62.69
16.11.80to 15.12.80	16050	9623.33	59.96
16.12.80 to15.1.81	16585	10656.84	64.25
16.1.81 to 15.2.81	16585	6001.70	36.19
16.2.81 to 15.3.81	14980	7888.37	52.66
16.3.81 to 15.4.81	16585	6639.50	40.03
16.4.81 to 15.5.81	16050	8589.83	53.51
15.5.81 to 15.6.81	16554	8038.06	48.55
Total:	195152	88425.01	544.22
Average:	16262.66	7368.75	45.35

TABLE:X-13 UTILIZATION OF HOURS AND VARIOUS DURING 1980-81
(24 HOURS DAILY WORKING SHAHPUR UNIT -I)

Period	Available hours.	Running hours.	Total lost hour during rest hours.	Total percentage hours.	Elec. faults.	Mech. faults	W/C faults	No demand	Rest hours during operational schedule
16.6.80 to 15.7.80	115920	26721	89199	76.95	9.52	12.07	6.56	32.13	16.67
16.7.80 to 15.8.80	119784	35958	83826	69.98	4.56	6.05	3.75	9.20	46.42
16.8.80 to 15.9.80	119784	43048	76736	64.06	8.23	5.78	2.65	12.96	34.44
16.9.80 to 15.10.80	115920	43604	72316	62.38	3.00	2.80	2.47	7.95	41.16
16.10.80 to 15.11.80	119784	72849	46935	39.18	6.32	4.10	2.68	9.04	17.04
16.11.80 to 15.12.80	115920	70601	45319	39.10	3.98	4.15	3.15	9.46	18.36
16.12.80 to 15.1.81	119784	75278	44506	37.16	4.59	3.76	3.21	8.54	17.06
16.1.81 to 15.2.81	119784	43837	75947	63.40	5.37	3.92	6.83	11.80	35.48
16.2.81 to 15.3.81	108192	57104	51088	47.22	3.44	4.03	4.02	4.11	31.62
16.3.81 to 15.4.81	119784	45831	73953	61.73	3.54	4.91	4.48	14.99	31.81
16.4.81 to 15.5.81	115920	60101	55819	48.15	4.79	5.06	4.52	14.78	19.00
16.5.81 to 15.6.81	119784	59527	60257	50.30	6.27	12.78	6.01	7.74	17.50
Total:	1410960	634459	775901						
Average:				54.96	5.30	5.78	4.19	11.89	27.63

TABLE:x-14 WORKING HOURS LOST DUE TO VARIOUS FAULTS(SHAHPUR UNIT-I)
KONA PROJECT BHILWAL(24 HOURS DAILY WORKING)

Period	Hours lost due to various faults				
	Elec. faults	Mech. faults	No demand faults	Watercourse faults	Working hours
16.6.80 to 15.7.80	11036	13988	37247	7608	26721
16.7.80 to 15.8.80	5467	7251	11013	4496	35958
16.8.80 to 15.9.80	9868	6929	15525	3164	43048
16.9.80 to 15.10.80	3481	3256	9215	2862	43604
16.10.80 to 15.11.80	7580	4901	10821	3218	72849
16.11.80 to 15.12.80	4615	4810	10965	3649	70601
16.12.80 to 15.1.81	5496	4503	10229	3841	75278
16.1.81 to 15.2.81	6431	4692	14139	8181	43837
16.2.81 to 15.3.81	3726	4365	4450	4342	57104
16.3.81 to 15.4.81	4239	5886	17950	5367	4583
16.4.81 to 15.5.81	5550	5874	17136	5245	60101
16.5.81 to 15.6.81	7506	15314	9273	7201	59525
Total:	74995	81769	167963	59174	593211

TABLE: X-15 AVERAGE AVAILABLE AND ACTUAL PUMPAGE UTILIZATION
SHAHPUR UNIT-I KONA PROJECT BHALWAL

(24 HOURS DAILY WORKING)

Period	Available pumpage Acre ft. Non-perennial area	Un-commanded area.	Actual pumpage Acre ft. Non-perennial area	Un-commanded area	Percentage Utilization Non-perennial area	Un-commanded area
16.6.80 to 15.7.80	15630.000	420.000	3464.00	147.00	22.16	35.00
16.7.80 to 15.8.80	16151.00	434.00	4836.50	183.41	29.94	42.26
16.8.80 to 15.9.80	16120.00	434.00	5539.54	207.83	34.36	47.88
16.9.80 to 15.10.80	15600.00	420.00	5976.87	254.25	38.31	60.53
16.10.80 to 15.11.80	16120.00	434.00	10082.29	288.00	64.32	66.35
16.11.80 to 15.12.80	15630.00	420.00	9365.50	257.83	59.92	61.38
16.12.80 to 15.1.81	16120.00	434.00	10368.84	288.00	64.32	66.35
16.1.81 to 15.2.81	16120.00	434.00	5890.59	111.16	36.54	25.61
16.2.81 to 15.3.81	14588.00	392.00	7696.37	191.00	52.76	48.72
16.3.81 to 15.4.81	16151.00	434.00	6281.17	358.33	38.89	82.56
16.4.81 to 15.5.81	15630.00	420.00	8268.33	321.50	52.90	76.54
16.5.81 to 15.6.81	16244.00	434.00	7814.81	223.25	48.10	51.44
Total:	190104.00	5110.00	85585.76	2839.30		
Average	15842.00	426	7138.00	236.00	45.06	55.53
Grand Total		195214		(88425.06)		

TABLE:X-16 VARIOUS FAULTS IN SHAHPUR UNIT-I FOR THE YEAR 1980-81
MCM PROJECT BHALWAL (24 HOURS DAILY WORKING HOURS)

NON-PERENNIAL AREA

Period	Various faults due to: Elec. faults	Mech. faults	Watercourse faults	No. demand	Rest hours including operational schedule	Total losses including rest hours and operational schedule
16.6.80 to 15.7.80	6.83	12.35	6.70	31.80	16.66	73.34
16.7.80 to 15.8.80	4.68	5.91	3.33	9.27	46.82	70.01
16.8.80 to 15.9.80	8.25	5.66	2.70	13.25	37.46	67.32
16.9.80 to 15.10.80	2.98	2.88	2.53	8.15	36.43	52.97
16.10.80 to 15.11.80	6.43	4.19	2.72	8.81	17.04	39.19
16.11.80 to 15.12.80	4.05	4.25	3.00	9.38	18.38	39.06
16.12.80 to 15.1.81	4.70	3.85	3.28	8.14	17.08	37.05
16.1.81 to 15.2.81	5.47	4.01	6.36	6.36	35.47	57.67
16.2.81 to 15.3.81	3.53	4.02	3.95	4.19	31.59	47.28
16.3.81 to 15.4.81	3.60	5.03	4.60	15.04	33.88	62.15
16.4.81 to 15.5.81	4.86	5.08	4.64	15.13	18.91	48.62
16.5.81 to 15.6.81	5.47	4.01	6.36	6.36	35.47	57.67
Average:	5.07	5.10	4.18	11.32	28.76	54.36

TABLE:X-17 VARIOUS FAULTS IN SHAHPUR UNIT -I MONA PROJECT BHALWAL
(24 HOURS DAILY WORKING)

UN-CONTROLLED AREA

Period	Various faults due to: Elec. faults	Mech. faults	W/c faults	No demand	Rest hours including operational schedule	Total losses including rest hours & operational schedule
16.6.80 to 15.7.80	5.07	8.78	2.44	27.33	18.01	61.63
16.7.80 to 15.8.80	6.53	2.58	2.95	16.83	34.59	63.48
16.8.80 to 15.9.80	8.17	6.68	1.02	8.93	25.58	50.38
16.9.80 to 15.10.80	9.75	4.91	3.78	3.78	24.99	47.21
16.10.80 to 15.11.80	6.42	3.63	2.74	4.65	16.57	34.01
16.11.80 to 15.12.80	7.66	5.29	4.66	4.45	21.06	43.12
16.12.80 to 15.1.81	5.14	7.78	0.58	6.12	37.05	66.67
16.1.81 to 15.2.81	3.60	3.43	3.73	9.45	36.47	56.68
16.2.81 to 15.3.81	2.03	2.02	1.87	2.55	37.46	45.93
16.3.81 to 15.4.81	8.59	5.73	2.68	6.49	34.94	58.43
16.4.81 to 15.5.81	12.31	6.44	3.00	0.73	17.78	40.26
16.5.81 to 15.6.81	-	13.77	0.64	13.58	16.66	44.65
Average:	6.27	5.92	2.50	7.60	27.59	51.03