Mechanization, Forestry, Others etc.	*4,051*
Capital Liability for Agricultural Credit	528
	7,019
Electric Power	
Generation	2,070
Transmission	1,115
Distribution	3,070
General	62
	6,317
TOTAL:	22,735

ii) In the opinion of the Bank Group the main emphasis on irrigation development in the future, say upto 1975 should be on getting more water on the land. The drainage effect of public tubewell will be important, especially in some areas where the ground water table needs to be lowered before additional surface supplies can prudently be absorbed. But the practice of public tubewell development for reclamation of saline and waterlogged lands, should be reduced in favour of efforts to exploit ground water resources as rapidly as possible for irrigation purposes in areas where the wells can yield the highest returns.

At the same time public tubewell development should on no account be undertaken in any large area where private wells are spreading rapidly. The recommended public tubewell projects generally cover substantially smaller areas than those that have been initiated in the past to enable more discrimination with respect to water quality and drainage needs, and to leave for private development all possible areas where private wells can make a substantial contribution.

iii) Nearly 50 per cent of the public sector expenditures on irrigation and drainage works in the recommended programme are allocated to public tubewells. The programme foresees the installation and energizing of some 6,700 public tubewells between July 1966 to June 30,1970. 5,900 of these tubewells would be in the four projects that WAPDA has underway; while the remainder would be in the four high priority projects, viz., Wagah, Shorkot-Kamalia, Rohri North and Panjnad Abbasia - that the Bank Group recommends for early implementation.

iv) The programme has excluded SCARP-V excepting Shorkot-Kamalia Unit, a major tubewell project prepared by WAPDA because there are good prospects of private tubewell development continuing over most of the area.

v) The Bank Group found that all the projects proposed would yield high rates of return and it has included each of them in the recommended programme. The areas in Bari Doab, however, have only marginal advantages over the alternative of continued private development. The indications are that substantial private development taken place in Bari Doab shall continue in the absence of public tubewell projects.

vi) No provision is included for private tubewell development because expenditure shown relates to public sector only. The Bank Group recommends that Pakistan authorities implement policies conducive to rapid private development as an insurance against shortfalls in public sector performance.

Comments of Indus Basin Review Mission(1970)

The programme presented by the World Bank Group was evaluated in 1969-70 by an Indus Basin Review Mission deputed by the World Bank. In their report, the Review Mission explained that some of the basic assumptions made by the World Bank Group at the time of preparing their plan have rapidly changed. These changes included:

a) Substantially smaller sizes of resources will be available during the Fourth Plan period(1970-75) for public sector development programme.

b) A more rapid increase has taken place in the availability and use of agricultural inputs. For example, fertilizers, private tubewells, improved seed varieties etc.

c) Private tubewell development has far exceeded the expectations of the World Bank Group and Government of Pakistan now appears to be assigning a more important role than before to it as it becomes necessary to defer part of the public tubewell investment recommended by the World Bank Group in their action programme.

d) Surface water supplies may be greater than anticipated throughout the Fourth Plan period.

e) The incentives provided by the Government during 1965-70

in the agriculture sector were unequally distributed. Whereas the policy gave windfall gains to owners of large farms, it benefited in a little way the small farmers.

Development Strategies Recommended by Messrs. Tipton & Kalmbach (T & K) (1967)

For the detailed planning, design and execution of reclamation programme, WAPDA had to engage a foreign firm which could meet the specific requirements of the aid-giving agencies. Messrs. T&K of U.S.A. were accordingly engaged. Besides preparation of the feasibility studies, project reports and contract documents for various individual projects, they supervised the implementation of these projects as well as prepared development plans for the northern region of the Indus Basin. For the southern parts, Messrs. Hunting Technical Services of U.K. were engaged to prepare regional development plans covering the ground water development and reclamation projects. The regional plan prepared by Messrs. T&K had a number of similarities and dissimilarities with the action programme presented by the World Bank Group. Major areas of difference have been identified hereunder:

1) T&K plan has been justified on the concept of mining ground water to lower the water table to pre-irrigation level of 75-100 feet. World Bank plan on the contrary recommends pumping out balanced recharge only and suggests stabilizing water table at 10-15 feet from the ground surface. Except for occasional withdrawal from the ground water reservoir, in the estimate of the World Bank, mining of ground water is neither economically feasible nor is it technically desireable as it would involve unncessarily lifting of highly saline water which could not be profitably used for agriculture nor it could be disposed of without making huge investments in its disposal.

2) World Bank plan attached due importance to the contribution made by the private tubewells and recommended that the Government should encourage private tubewell development as an assurance against shortfalls in the public sector programmes. Messrs. T&K on the other hand attached least importance to the private tubewell development and

assumed that ultimately public tubewells will cover the entire irrigable area in the Indus Basin even if it meant substitution of private tubewells by public tubewells.

3) Messrs. T&K plan strongly advocates the substitution of surface water supplies by the tubewell water in areas underlain by ground water of good quality so that the canal supplies so spared from this area could be utilized to mix with the ground water of poor quality in the saline areas to reduce salinity hazards and minimize the problem of disposing saline affluent from the marginal and poor quality zones. This concept was not endorsed by the World Bank plan. World Bank on the contrary recommended judicious integration of surface and ground water supplies within the project areas and export only saline effluent from the project area.

Contribution made by Foreign Agencies

The magnitude of the problem as well as its complexities attracted a number of foreign countries/institutions such as FAO, UNDP, US AID, US Bureau of Reclamation, U.S. Geological Survey, Commonwealth countries, World Bank, Federal Republic of Germany(KFW), Yugoslavia and USSR to partake in Pakistan's efforts to eradicate the twin menace of waterlogging and salinity. The contributions made by various countries/ institutions are briefly mentioned below:

1) Mr. C.R. Maierhefer, Drainage and Ground Water Engineer of US Bureau of Reclamation visited Pakistan in April 1952 and discussed waterlogging and salinity control problems and their solution with FAO experts already working in Pakistan. At the end of this visit, a report was issued by the US Bureau of Reclamation.

2) FAO participated in the first reclamation project launched by Pakistan Government in 1954 called Chuharkana Project. This was followed by a number of small reclamation projects in adjoining areas between 1955-60.

3) A number of US Geological Survey engineers and experts were associated during the field surveys and investigations carried out between 1954-65. A number of Pakistani engineers were also sent over to USA for their training with US Geological Survey as well as US Bureau of Reclamation in various aspects of salinity control and reclamation projects.

4) In conducting the aerial photography of the affected area, Canadian Government provided technical as well as financial assistance.

5) The Government of Australia and U.K. provided some pumps, motors and pipes for various reclamation projects. This was a great relief in the short run but ultimately it resulted into a wide diversification of equipment to be operated and maintained by the project agency who faced great difficulty in procurement of spare parts from different sources.

6) US AID contributed liberally to finance a number of projects executed in the northern zone. This assistance was in the form of technical advice, training of Pakistani personnel in US, equipment, experts, foreign exchange to buy equipment from sources other than America and in some cases even the Rupee component from PL-480 funds. Most of this financial assistance was, however, in the form of loans and credits.

7) KFW Loan was made available by the Federal Republic of Germany for the purchase of foreign machinery and equipment such as turbine pumps, electric motors and pipes for some of the project tubewells.

8) A large number of electrical goods such as transformers, insulators and other equipment was imported from the East European countries under a number of barter deals for commodity exchange between Pakistan and these countries. Yugoslavian firms were also engaged in the installation of some tubewells and the electrification of tubewells installed by Yugoslavian as well as other foreign contractors.

9) UNDP is currently financing a ground water development project in Baluchistan as well as preparation of a comprehensive Master Plan covering the entire irrigated area of Pakistan. The local agency implementing this programme is Water & Power Development Authority who are carrying out the assignment with the assistance of some experts seconded by the World Bank and Messrs. HARZA Engineering Company of USA as their consultants. UNDP funds are being administered through the World Bank.

10) For the implementation of Salinity Control and Reclamation project Rehim Yar Khan (SCARP-VI), an IDA credit has been sanctioned to which the contributors are KFW and United Kingdom under Development Credit Agreement No.

754-PAK. The administrator of this IDA credit would be the World Bank. A number of other loans/credits are currently under negotiation with the World Bank for implementing similar projects which have been planned recently.

11) The Government of USSR invited a group of Pakistani engineers in 1963 to visit Russia for acquainting themseleves with the modern techniques adopted there to fight out the problem of waterlogging and salinity. The useful experience gained by the delegation was reflected in a brief report submitted by the delegation on their return to Pakistan. A gist of this report is included as Appendix-II.

A Russian Professor, Victor Kovda of UNESCO, visited Pakistan during 1964 in connection with a seminar on waterlogging and salinity organized with the active collaboration of FAO and other international organizations. During his visit, he travelled very extensively throughout the affected areas and made a number of extremely useful suggestions to tackle these problems effectively. Relevant extracts from a report made by him on his visit are included as Appendix-III.

12 For the planning and development of southern zone of Indus, a number of U.K. credit facilities were available in the form of finances for the project consultants, technical training programmes, visits of experts, equipment and machinery and foreign exchange for the import of machinery and material from sources other than U.K.

PHYSICAL PROGRESS OF IMPLEMENTATION

The Indus Basin has been divided into two distinct zones based on the physiographic and hydrological characteristics. The northern zone comprises primarily the province of Punjab and NWFP. The southern zone covers the irrigated parts of the province of Sind and Baluchistan. The progress achieved in planning, designing and execution of various projects in the northern and southern zones is shown in the following tables:

TABLE-III*

SALINITY CONTROL AND AND RECLAMATION PROJECTS IN NORTH ZONE

Name - Area	Location	Works involved	Completion Status
SCARP-I(Rechna Doab)Area 1.14 million Acres-C.C.A.	Covers parts of districts Sheikhupura, Gujranwala,Faisalabad and Jhang (Central Rechna Doab)	2069 tubewells	1796 tubewells installed by WAPDA and 273 by Irrigation Department, Govt. of Punjab, in fresh ground water area. It was completed in 1963.
SCARP-II(Chaj Doab)Area 1.96 million acres-C.C.A.	District Gujrat, Sargodha and Jhang under command of Upper Jhelum and Lower Jhelum Canals.	2478 tubewells 375 miles of surface drains	2205 tubewells in fresh ground water area and 273 in saline zone area completed. Various components of the project completed progressively between 1963 and 1973. Out of 375 miles of surface drains, 358 miles completed.
SCARP-III (Lower Thal Doab)Area 1.05 million acres-C.C.A.	Districts Muzaffargarh and Jhang (Lower portion of Thal Doab) under command of Muzaffargarh and Rangpur Canals.	1710 tubewells 115 miles of surface drains.	1635 tubewells in fresh ground water area completed between 1969 and 1973. Out of 75 tubewells in saline zone, 61 had been energized upto June 1978. 115 miles of surface drains completed.
SCARP-IV (Upper Rechana Area 56,000 acres-C.C.A.	Districts of Gujranwala, Sheikhupura and Sialkot (Upper portion of Rechna Doab)	935 tubewells	All 935 tubewells in fresh ground water area completed in 1973.
SCARP Shorkot-Kamalia(Pilot Project) Area 154,000 acres-C.C.A.	District Faisalabad (Lower portion of Rechna Doab)	101 tubewells	All 101 tubewells in fresh ground water area completed in 1977.

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Name - Area	Location	Works involved	Completion Status
SCARP Panjnad Abbasia(Phase-I)Area 2,10,000 acres-C.C.A.	Districts Bahawalpur and Rahimyar Khan(under command of Panjnad & Abbasia Canal System).	623 tubewells	Construction of all 623 tubewells and energization of 454 tubewells completed. Work in hand on energization of remaining tubewells.
SCARP Fordwah Sadiquia(Pilot) Area 73,000 acres- C.C.A.	Bahawalpur Division(under command of Fordwah Canal)	100 tubewells	All the 100 tubewells completed upto June 1978.
SCARP Shahpur Area 90,000 acres C.C.A.	District Sargodha (under command of Lower Jhelum Canal).	263 tubewells	256 tubewells drilled and 252 put into operation.Work in hand on drilling and energization of remaining tubewells.
SCARP Satiana (Pilot)Area 1,10,000 Acres-C.C.A.	District Faisalabad(under command of Lower Jhelum Canal).	71 tubewells	All the 71 tubewells completed upto June, 1978.
Paharang Drain(52 miles of drains)	To provide drainage relief to about 222 square miles and to minimise flood risk to Faisalabad City.	Earth work for drains	84.1 million cubic feet of earth work completed. Remaining earth work of 17.4 million cubic feet in hand.
Replacement of Deteriorated tubewells.	In areas of SCARPS I to IV.	800 tubewells to be replaced because of either reduced discharge or complete stoppage.	Contract for 704 tubewells awarded, out of which 679 tubewells energized and recommissioned. Work in hand on the remaining 25 tubewells.
Anti-Waterlogging Peshawar City.	In and around Peshawar City.	9 tubewells 56 dugwells, 4700 ft. of tile drains and 4 miles of surface drains.	Completed except energization of six dugwells and 2 tubewells which is in hand.

Name-Area	Location	works involved	completion status
Kafur Dheri Unit	In and around Peshawar City.	48 tubewells and remodelling of 43 miles of surface drains involving 32 Mcft earth work.	All the 48 tubewells energised and 28 Mcft earthwork done. Work in hand on excavation of drains.
Pabbi Unit II	In and around Peshawar City.	55 tubewells and 54 miles of open drains involving 70.03 Mcft. earth work.	All 55 tubewells energized. 65.5 Mcft each work done. Work in hand on excavation of drains.
Jue Shaikh Unit	In and around Peshawar City.	22 tubewells and remodelling of 59 miles of open drains involving 81.0 Mcft of earth work.	All 22 tubewells energized. 23.17 Mcft earth work done. Work in progress on excavation of drains.
Mardan SCARP Phase-I	District Mardan	47 tubewells,20 dugwells and 172 miles of open drains involving 114.4 Mcft each work.	All 47 tubewells and 16 dugwells energized. 14.71 Mcft earth work done. Work on energisation of remaining 4 dugwells and earth work in progress.
Bannu SCARP	District Bannu	176 tubwells and remodelling of 17 miles of drains.	50 tubewells constructed and 45 energized. Work on construction and energization of tubewells and earth work in progress.
Kohat SCARP	District Kohat	Four test holes	Two test holes in Lachi plain and two test holes in Kohat Plain completed. Geophysical survey and hydrogeologic studies in progress.

Name-Area	Location	Works involved	Completion Status
Hazara SCARP	District Hazara	Four test holes	Test holes drilled and work on reconnaissance survey and hydrogeologic studies in progress.

TABLE-IV*

SALINITY CONTROL AND RECLAMATION PROJECTS IN SOUTH ZONE

North Rohri 6,90,000 acres-C.C.A.	District Nawabshah-Sukkur Barrage Left Bank Command	1392 tubewells (Revised Scope)	1192 tubewells energised and put into operation
Larkana Shikarpur Stage-I 16,99,000 acres-G.C.A.	Right Bank of Indus covering partly the command of North West Dadu Rice Canals of Sukkur Barrage & Bagari Sind Feeder of Guddu Barrage.	Construction of 646 miles sub-drains, 5162 structures, extension of 4 pump stations. 2 additional pump stations and remodelling of Ghaibi Dero Channel.	4387 structures completed and 513.04 Mcft earth work done. Work is in progress.
Left Bank Outfall Drains (Phase-I) (catchment area of 1.31 million acres)	For ultimate disposal of saline effluent and storm water from the area on Left Bank of Indus.	Main and Branch drains, subdrains, field drains and structures associated with these involving earth work of 1759 Mcft.	Earth work of 15.00 Mcft done during the year. Total earth work done 299 Mcft.

Name - Area	Location	Works involved	Completion Status
Kotri Surface Drainage	Major parts of districts Thatta and Badin in the command of Kotri Barrage.	Construction of 2045 miles of drains involving earth work of 2506 Mcft and 11,850 structures	Earth work done during the year 38.00 Mcft and total to-date 1448 Mcft.
Sukkur Right Bank(Fresh Ground water) 1,51,000 acres G.C.A.	District Sukkur and Larkana on the right command of Sukkur Barrage.	400 tubewells	All tubewells energised and put into operation.
East Khairpur Tile Drainage Project, 44000 acres	Districts Sukkur & Khairpur within command boundaries of Khairpur East Feeder Canal off-taking from Sukkur Barrage.	Construction of Tile drains.	Construction of WAPDA Colony at the site was in an advanced stage of completion.
North Dadu Surface Drainage Project 4,45,000 C.C.A.	Districts Larkana and Dadu in the command of Rui Canal and Dadu Canal.	Digging of 131 miles of main and branch drains and 305 miles of sub-drains.	68 Mcft of earth work done.
Hairdin Surface Drainage Project.	Baluchistan(between Pat Feeder and Desert Canal of Guddu Barrage)	To provide disposal of surface run-off from rice fields and drainage of low lying lands through a network of shallow surface drains.	Total earth work involved-150 Mcft, out of which 84.63 Mcft had been done. Work in progress.

* Information obtained from WAPDA Annual Report 1977-78.

MANAGEMENT OF COMPLETED RECLAMATION PROJECTS

Isolated small reclamation schemes conceived, planned and implemented upto 1958 were looked after by the provincial Irrigation Department through Directorate of Land Reclamation and Irrigation Research Institute,Lahore. As the scale of operations was stepped up under the Reclamation Programme

launched by Water and Power Development Authority, a separate organization called the Land and Water Development Board was created in 1964 for the coordination of inter-agency activities, policy implementation,operation and managment of these projects on the pattern of 'coordinated area development' recommended by Dr. Revelle's panle of experts. This institutional framework was as new and experimental as the area development approach Each project was proposed to be placed under a separate project director having almost autonomous powers over engineering, agriculture, cooperative, marketing, revenue and budget for the project area. The salient features of this apporach as followed in the first major reclamation project designated as SCARP-I for seven years(1964-70) are listed below:

1) Project Director had the power and option to select engineers and experts in other fields from different public and private agencies.

2) Extensive in-service training was imparted to engineering, administrative and other staff of the project both within the country and in the USA.

3) Foreign expert's advice both in technical and managerial aspects was available on regular basis. Technical assistance, research facilities and expert advice was also available from the local institutions such as Directorate of Land Reclamation, Irrigation Research Institute, Lahore, engineering and agriculture universities as well as individual experts.

4) Flow of annual funds required for operation and management of the project was almost unrestricted.

5) Except for a year or two, adequate canal supplies were available in the project area to mix with the poor quality of ground water being pumped out by the tubewells for the integrated use of surface and ground water for agriculture purposes. Under a compaign for self-sufficiency in food, most of the farm inputs such as good variety of seeds, appropriate type and quantity of fertilizers, pest and advisory services, cooperative and marketing facilities were made available as package deal in the project area. To improve the mobility of operating

agencies, a number of vehicles of various description such as jeeps, pick-ups and trucks were made available to the project director for prompt operation and management of the project facilities.

6) A number of pilot projects were set up to demonstrate the benefits of land-levelling, improvement of on-farm water management, rehabilitation of watercourses, construction of bifurcations, trifurcations, mixing chambers and link watercourses to connect public tube-wells with the farmers' ditches(watercourses).

It is clear that unlimited efforts were put in by the government to make this foreign-aided international project a real success. Agriculture being the mainstay of the Pakistan's economy and survival of the nation linked with the production of sufficient food to sustain the exponentially increasing population, no pains were spared to eliminate waterlogging and salinity and boost agriculture production in the project areas. However, post-project monitoring data for a number of consecutive years during the operation period and its evaluation by a number of individual experts and committees appointed by the government from time to time has attracted critical appraisal of the basic philosophy of the whole reclamation programme as advocated by WAPDA consultants as well as other foreign agencies.

On the basis of repeated recommendations, the concept of separate agency for the operation and management of SCARPS was given up and the various activities handed back to the original line departments of the provincial government in 1971-72. Although there is a status quo till date but there are rethinkings in various spheres about the optimum institutional framework to derive maximum benefits from these projects. It is possible that as a result of continued search for optimising the project benefits, some organizaional reform is introduced in future.

EX-POST EVALUATION OF SCARP-I

While major progress has been made in applying efficiency and

equity analysis to proposed public investment decisions, little has been done to evaluate the results of past policy decisions. One could not agree more with Howe(1974) that even the best predictions which can be made, on the basis of ex-ante evaluation of large water projects' impacts on the economy and society, there remains sufficient uncertainty about the ensuing events as to warrant provision of resources for continued monitoring and ex-post assessment of such projects, so that useful lessons may be learnt from the experience gained on them and adverse development, if any, corrected by taking timely actions. Haveman(1972) discovered a serious bias incorporated into agency ex-ante evaluation procedures resulting in persistent over-statement of expected benefits. Likewise, he found numerous variances between the estimated and actual cost on completion of many projects. Naturally, these discrepancies had little to instil confidence in current project evaluations carried out by different water resource planning agencies. Inefficient and inequitable public programmes, apparently immune to evaluation or criticism have continued to thrive all over the world but their impact is more severe in case of poor nations. Therefore, accountability and to ensure continued improvement of planning and management critique, regular ex-post evaluation not only of technical performance, but of actual benefits both tangible and intangible has to be an integral part of a national planning infrastructure. Appreciating the need for a continued post-project monitoring, the Government of Pakistan created a central Monitoring Organization within WAPDA with the prime object of evaluating the performance of complted projects and feed back the results of their evaluation to the planners and decision-makers. In addition to this regular institutional framework, a number of evaluation committees were appointed from time to time. Individual experts also made efforts to study the impact of implementing the reclamation programme to compare the achievements with the projected goals.

Projected goals of SCARP-I

a) To lower the water table so as to eliminate waterlogging and improve soil drainability.

b) To increase water application to various crops to take care of leaching of salts in addition to consumptive water uses.

c) To reclaim 0.425 million acres of saline soils and restore them to full agricultural productivity.

d) To increase the annual cropping intensity to 150 per cent of the culturable areas(on full development,agricultural production per unit area was expected to increase by 100 per cent.).

Indices for ex-post Evaluation

A range of tools has been proposed in recent years to assist in the evaluation and management of water projects. For a comprehensive overview of these techniques, attention is drawn to the useful work done by MacCrimmon(1973), Cohan (1973), Duckstein(1974) and Cohan and Marks (1975). Some of the known methods are cost-benefit analysis, collective utility theory, Bayesian decision theory, multi-objective or multi-criteria models and cost-effectiveness approach. It is important to note that most of these techniques are valid for comparing the merits of an array of alternative water projects, rather than comparing the achievements of a completed project with its planned targets. The only exception to this rule is the criteria of cost-effectiveness which has been applied for ex-post evaluation of completed water projects. For such an evaluation of SCARP-I, following tangible and intangible indices have been picked up:

i) Capital and recurring cost.
ii) Operation and utilization efficiencies.
iii) Control of waterlogging.
iv) Land reclamation.
v) Increase in cropping intensities.

vi) Increase in crop yields.

vii) Financial return on investment.

viii) Operation and management problems

ix) Local participation.

x) Prospects of improved land and water management.

xi) Environmental quality considerations.

A comparative evaluation of private tubewell development with SCARP-I tubewells has been made by the author(1975) by applying the cost-effectiveness approach. The results of this study are summarized in Appendix-IV. It is clear that present project design of SCARP-I has only partially succeeded in achieving the planned objectives. If the alternative for private tubewell development was given due consideration at the time of planning of this project, the resulting project would have been much more productive and effective.

Causes of Shortfall

a) Conceptual

i) The ground water aquifer was considered continuous, homogeneous, having a specific yield of 0.25. The location and capacity of the tubewells was fixed accordingly. Both of these assumptions were found to be unrealistic. Continuity of aquifer was broken by variable water quality as well as clay lenses , and specific yield ranged between 0.1 to 0.14.

ii) The capacity of tubewells was overly designed to meet the peak demands of the proposed cropping pattern during the short critical periods of plant growth. This resulted in under utilization of the over-capitalized hardware facilities in the earlier years when cropping intensities were low but when demand built up, the qualtity and quantity of water pumped degenerated so much that these demands could be only partially met, even at a cropping intensity much lower than the planned for ultimat development(e.g., only 109 per cent in SCARP-I against 150 per cent).

iii) Water having salt concentration ranging between 1500 to 4000 ppm was proposed to be used in conjunction with canal supplies assuming that farmers of Indus Basin, who were mostly uneducated and had very small holdings(less than 20 acres) would follow scientific land and water management to ensure supplemental leaching commensurate with the salinity of applied water. This assumption was apparently too ambitious to be achieved in practice. If highly educated farmers of Wellton Mohawk(USA) claiming to follow the best possible cultural practices spoiled their ground water having the same range of salinity, during 1920-52 and were forced to abandon the tubewell irrigation by reverting to surface water irrigation and using tubewells only for drainage purposes, how such relaxed water quality standards could produce any better results in Pakistan. It was too optimistic to assume that just to consume poor quality ground water, poor farmers of Indus Basin would beg, borrow or steal money and technology to renovate their land and water management practices spontaneously. This did not take place. Extensive research to renovate management techniques is underway at Mona Experimental Station and if the results of this research can throw up some cheap and manageable methods, conditions might improve. Failing this, disposal of saline effluent will eventually pose formidable problems which may require costly desalinization plants like the one on the US-Mexican border to avert ecological degeneration witnessed in Mesopotamia, Nile Valley and Wellton Mahawk.

iv) The provision of horizontal drains to export salt was provided in the tentative reclamation programme drawn up by WAPDA and endorsed by Dr.Revelle's group.However, to economize on the capital cost of this project, the concept of salt export was dropped during its actual execution. This was a serious omission and increase in the salt concentration both in the soil and ground water was just inevitable due to closed recirculation of poor qualtity ground water for irrigation uses. Vertical and horizontal salt intrusion is mainly on account of this.

v) Suitability of ground water was mainly based on the total dissolved salts without giving due weight to more important parameters such as SAR, RSC and other toxic elements. These elements were particularly harmful to alkaline soils, where the infiltration index of the soil was already low(Appendix-V).

vi) Law of average used to determine the quantities of canal water and total tubewell pumpage, which if mixed properly would have yielded a harmless mixture according to the relaxed standards of water qualtity, did not operate in practice. This was due to a number of reasons including uneven distribution of the canal water and salinity index of ground water. So that locally, for about 50 per cent of the tubewells actually installed, enough canal supplies were not available for proper mixing, and in the remaining areas, mixing arrangements were inadequate.

b) Design and Construction

Despite corrosive nature of the aquifer, mild steel pipes and strainers were imported from abroad, which had life much shorter than stated by the foreign contractor for this project. The reaction of the local experts against the mass scale use of mild steel strainer was taken lightly. Although each tubewell is a discrete project, both at the design and execution stages proper weight was not given to the local conditions which distinguish individual well sites. The aggregation no doubt helped in commissioning the project wells within the shortest possible time but their usefulness was obviously limited. Locally manufactured pumps and motors were not used on the considerations of quality and operating characteristics. Also the local contractors were not engaged presumably on the pretext that they were not fully equipped to handle sophisticated imported equipment and to complete such projects within the stipulated time schedule. Consequently, the project entailed huge investment in foreign exchange both for initial installation and subsequent maintenance and repairs. This naturally eroded the cost-effectiveness of this project.

c) Distribution and Managerial

With the commissioning of tubewells the project was declared as completed without realizing that physical means to convey the pumped water to the point of use did not exist on the ground. As most of the tubwells were meant to serve two to four outlets, hundreds of small farmers were to share the tubewell supplies. This involved construction and maintenance of long link water-courses connecting tubewells to the farmers' ditches and rehabilitation of watercourses to carry water twice to thrice their present capacities. A number of on-farm changes were also necessary for efficient utilization of supplemental water. This required time, money and machinery, which majority of farmers could not afford to invest, so that all the commissioned tubewells could not be put to profitable use.

Superimposed over these inadequacies were the patterns of tubewell operation in the public sector, their frequent electrical and mechanical breakdowns, long delays in carrying out major repairs, late replacement of damaged or deteriorated wells, power shut downs and behaviour of tubewell operator, which resulted in underutilization of the over-capitalized hardware project facilities, which had limited life.

d) Lack of farmers' participation

Upto 1958-59, the salinity control and reclamation measures were being conceived, planned and implemented as a purely social responsibility of the government to provide relief to the farming community from a calamity which was the by-product of irrigation system which did not have complementary drainage facilities as its integral part. For these remedial measures, farmers had no contribution or responsibilities to shoulder any physical or financial burden. The new reclamation philosophy evolved by WAPDA with the help of foreign consultants implied that without formal education of the farmers and their association at various stages of plan formulation and implementation, it would be still possible for the farmers to shoulder full responsibilities for modernizing their farm practices by visulizing that the project facilities provided under this plan are not only meant for reclamation and drainage but also for optimizing agricultural production from their farms. Farmers are also expected to pay back the capital as well as the recur-

ring cost of these projects. Both of these expectations were based on lack of adequate knowledge about the human attitudes in general and traditional perception of the local farming community in particular. This was partly because the problem was viewed as a purely an engineering and economic problem and the remedial measures were also restricted to the realm of engineering economics. This did not happen, as most of the farmers considered that it was the moral responsibility of the government to eradicate the menance of waterlogging and salinity rather than expect farmers to make any financial contribution to sustain the public sector programme. They also could not grasp so quickly the tremendous development potential shrouded in the new project design, particularly in areas where the quality of water being pumped out was sweet and fit for direct irrigation application. The situation was different in other areas where the water being pumped was marginal or poor in quality. Here the farmers developed the attitude that instead of any help to them, the public sector facilities have been created to perpetuate a curse in the form of increased soil salinity. This was so because the management of saline water could not produce any better results under the prevalent environment of primitive farming practices. The proponents of the new reclamation concept no doubt succeeded in a few odd cases where a rich educated farmer well aware of the international farming practices immediately switched over to precise land levelling, rehabilitation and lining of watercourses and mechanization of his farming practices. All these improvements were, however, beyond the reach of more than 70 per cent of the farmers who owned or operated a farm of less than 20 acres.

In view of the above socio-cultural considerations, a majority of the farming community did not accept the new project approach as an enterprise worth participation and contributing to. Therefore, a number of farmers asked for closing down their tubewells, some of them went to the Courts to obtain stay orders against the levy of reclamation fee as well as enhanced water rates and in some areas, there was even law and

order situation. Already over 200 wells have been closed in SCARP-I and eventually some more may have to be closed, as not more than 33 per cent of the tubewells originally installed are pumping out ground water fit for direct application(1973).

REVISED STRATEGY

Under the combined influence of unprecedented financial squeeze, sub-optimum performance of completed public sector reclamation projects, heavey financial subsidies involved in the operation and management of completed projects, wars of 1965 and 1971, severance of East Wing of the country and dramatic increase in the number of private tubewells throughout the country during 1967-72, re-appraisal of the earlier concepts and strategies high-lighted the following crucial issues for decision making:

1) How to make the best use of projects already executed.

2) What major changes are called for in the basic approach followed so far in planning, designing and implementation of future salinity control and reclamation projects, to avoid pitfalls of earlier projects.

To make the best use of Completed Projects

The major problems areas which needed attention were identified as under:-

1) Institutional arrangement best suited for the proper maintenance, repair and management of project facilities.

2) Adequate finances for operation and management of project facilities.

3) Inter-agency cooperation to optimize project benefits.

4) Completion of the project with respect to the left over components which were expected to be completed