

PLANNING THE DEVELOPMENT OF PAKISTAN'S WATER RESOURCES

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INTRODUCTION

Water is the most natural vital resource. On its planned development depends the agricultural and to a great extent the industrial production of Pakistan. Without abundant water and hydro-power, industrial and agricultural production which contributes mainly to the gross national product cannot make progress. Therefore, Pakistan has accorded a very high priority to the development of water resources in the past and this priority will continue to be given to this sector also in the future.

DEVELOPMENT PLANNING OF WATER RESOURCES

A water resource project from the time it is conceived to the time benefits start flowing from it to the people, passes through the following main stages:

1. Conception of the scheme through reconnaissance;
2. Preliminary investigations and surveys;
3. Project planning which may include detailed investigations, feasibility determination, designs and preparation of the Project;
4. Determining the policies and methods pertaining to the financing of the water resource project and the repayment of the project cost;
5. Fitting the new water resource project into the overall water resources plan of the country;
6. Integration of water resources plan with the National Economic Development Plan;
7. Construction of the water project and periodic evaluation of its progress as the construction proceeds;
8. Economic evaluation of the project after its completion;
9. Efficient management, operation and maintenance of the water resource project.

After the need for water resource development in a particular area has been established, each separate phase in the evolutionary process of a water

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project involves a decision as to whether to proceed to the next stage or whether to defer or abandon the project. The wisdom of proceeding from one stage to the next depends on the intrinsic merits of the proposal and on the soundness of the investigations that have been undertaken.

The object of the preliminary step of reconnaissance is to define the scope of investigation, to limit it to the more promising lines of development and to their most crucial elements. The more detailed but none the less preliminary investigation that follows reconnaissance attempts to define, by means of an examination of the hydrologic, topographic, geologic and economic features of the project, the best alternatives to pursue and to assess the merits of the schemes in terms of other development projects as well as in absolute terms. Subsequent planning and design gives the project a presentable shape and provides a base for financial planning taking into consideration prospective costs and benefits and the means by which the project can be financed and the costs repaid. At this stage, a water resource project is geared into the overall water resource plan of the country when the feasibility studies have been completed and the potential benefits of the scheme justify the projected capitals outlay involved in construction.

The capital resources required to bring large projects to function are both domestic and foreign. Domestic resources include the resources of the Central and Provincial Governments; and other local financing institutions, such as, the Development Banks, Savings Banks, Loan Associations etc. Foreign resources include the resources of multi-lateral financing agencies, such as, the International Bank for Reconstruction and Development and the International Development Association, foreign Government's offer of bilateral assistance, regional financing institutions, such as, the Asian Development Bank and the Foreign Suppliers Credit. The terms under which these resources are offered vary widely from non-repayable and interest free grants to short-term hard loans offering commercial rates of interest. Soft loans having low interest rates and long-terms of maturity and outright grants are generally required to finance water resources projects constructed primarily for purposes other than power and water supply because of their initially low rate of return. However, the current shortage of development capital has affected international and bilateral lendings as well as domestic lendings. The grant limitation of foreign assistance is declining and more assistance is being financed through loans rather than outright grants. Although public funds are the particular and in some instances the sole source of finance for water resources development in some countries but private capital also plays a role in water resources development. In Pakistan, for instance, the private capital is financing the installation

of many tubewells and the construction of ditches and water-courses leading from the outlets to the lands of the farmers.

The source that will finance a water resource project has become increasingly important in project formulation because physical constraints are no longer so important as they used to be; the main constraints now-a-days are economic. However, in the planning process, consideration is also to be given to the non-economic and social aspects of planning side by side with the conventional engineering and economic aspects. For instance, projects basic to the welfare of the community should not be turned down on account of the strict application of economic and financial criteria.

After the water projects have been fitted in the water resource plan, the next stage is of integrating the water resources development plan with the National Economic Development Plan. This is not an easy task. Detailed co-ordination of water resources development programmes including hydro-electric, irrigation, flood control, drainage or reclamation projects or multi-purpose projects with all other sectors of a national plan though desirable is difficult to achieve. The difficulties are sometimes inherent in the investigation and planning of these projects, as for example, may be when water resources projects are scheduled or initiated by a Government Ministry or a corporation exclusively responsible for project development and without sufficient attention to the prospective course of demand for the output of the project undertaken. In other cases, the agency in charge of the water resource development might simply assume that the demand would be large enough or would automatically develop when the supply may become available. On the other hand, industrial programmes might be formulated and implemented without paying sufficient attention to the systematic development of the sources of electric power or water on which the feasibility of the industrial projects depends to a significant extent. In developing countries like Pakistan where agriculture is the main stay of our economy, the need for planned development of water resources is particularly important. An effective water resource development programme requires a careful co-ordination both vertical and horizontal between water agencies and other agencies concerned. Therefore, a co-ordinated administration of the water resources development agencies is necessary for the successful implementation of water projects.

After a water project has been incorporated in the National Plan and is approved by the competent authority and finances secured, the next stage in water resources development is execution of the project. Execution calls for management skill of the highest order in mobilising and deploying large quantities of equipment, material and labour and in ensuring that the project is to the

exact standards of the designers and according to a carefully prepared construction schedule. Here the shortage of strategic manpower constitutes one of the most formidable impediments in the developing countries in the effective implementation of the water resources development projects and in the fullest utilisation of the benefits accruing from them. This is one of the reasons why a Manpower & Education Commission has been set up in Pakistan to augment as speedily as possible our human resources in professional, technical and skilled manpower through well-conceived programmes of vocational and technical training and then plan their effective utilisation and deployment in proper positions.

When a project is completed, the next important stage is its economic evaluation. The financial analysis differs from the economic analysis in several important respects. The economic analysis takes into consideration all benefits, tangible and intangible—primary and secondary and all costs including direct and indirect costs as well as construction operation, maintenance and replacement costs. The financial analysis includes only the direct monetary terms accruing to the project which are normally less than the over-all benefits. The economic analysis covers the expected life of the project, assessed as regards physical deterioration and obsolescence, whereas the financial analysis spans the terms to maturity of the loans raised to finance the project. These are in keeping with the economic life of the project but generally shorter. The interest rate used in the economic analysis is the rate payable on long-term government securities; the interest rates used in the financial analysis are the rates demanded or likely to be demanded by the financing institutions at the time of borrowing. The economic analysis assesses the total benefits and costs but makes no attempt to define who should pay for the project or how much they should pay for the facilities provided. The financial analysis does this; it distributes the total cost according to the various functions of the project and assesses the rates and charges needed to repay the cost.

The financial analysis is the ultimate test of viability; for no matter how attractive a project may be from the economic standpoint, finance will have to be found to build and operate it; and it is the stream of payments stemming for construction and operation in relation to the revenues accruing to the project that finally determines whether or not it should go ahead.

Therefore, while it is essential that a financial analysis of a water project be conducted before undertaking its execution, an economic analysis may precede or succeed the execution of a project. An economic evaluation after the project's completion takes stock of the financial returns promised at the

time of approving the project and in addition analysis, the project with a view to signifying and quantifying the economic gains yielded from it.

The last but by no means the least important stage in water resource development planning is the efficient management operation and maintenance of the water resources projects. The early achievement of project benefits and the recouping of capital expenditure on schedule depends on the efficient management and operation of the project. Timely and efficient maintenance is necessary to ensure a long and useful life for a project. The transition from construction to management, operation and maintenance is one of the more critical periods in project development. Experience has demonstrated that it is undesirable to phase out a construction programme abruptly and it is better to continue it through an annual scale of operation to disclose and correct any design, construction or hydraulic defects there might be. The establishment of the operational organisation well before the construction is completed and the assumption of some constructional personnel to it during the transitional period is always helpful. A detailed formula of inspection of all facilities including the operation of any mechanised or of moving parts is necessary in disclosing minor defects and placing on record conditions at the time of transfer from construction to operation. An annual refresher course for project personnel particularly those in the lower grade is an excellent device of acquainting them with the most efficient procedures in operation and maintenance. Further, an efficient operation of water resource project institutes an adequate cost and benefit programme, well established standard operating procedures and comprehensive record keeping and reporting procedures. Funds for a planned replacement of items that could not be expected to last the life of the project and a budget provision for an emergency fund to be built up gradually over the years to meet emergency and unforeseen repairs apart from the routine maintenance costs would keep the efficiency of the management operation and the maintenance of water resources projects high and the over-all operating costs low which in turn should maximise the project returns.

REVIEW OF THE WATER RESOURCES DEVELOPMENT IN PAKISTAN—1955-65

Pakistan started integrating its water resources plans with the National Economic Development Plans in 1955 when the irrigated area in the country was 22.7 million acres. By 1960, this figure had reached 24 million acres giving an increase of 1.3 million acres at the end of the First Five-Year Plan. The areas improved through drainage, flood and irrigated supplies showed an increase of 2.57 million acres during the same period. During the Second

Five-Year Plan—1960-65 the objectives of the Water Development Programme were broadly:

- (1) to raise the productivity of existing agricultural lands through increased and rational applications of water, and the control of salinity and waterlogging;
- (2) to increase farm acreage through irrigation, drainage and flood regulation; and
- (3) to provide electric power cheaply and abundantly in order to accelerate and strengthen agricultural and industrial development.

During the Second Five-Year Plan, East Pakistan prepared a Master Plan for water and power development that outlined a large number of irrigation and flood control projects which seemed to be both technically sound and economically feasible. A number of major water development projects were completed during the Second Plan chief among which were the Karnafuli Multi-purpose Project, the Faridpur Drainage Scheme, the Low-lift and Pump Irrigation Scheme in the districts of Rajshahi, Pabna and Bogra and improvement of the Gumti river. EP WAPDA's programme provided cultivation of additional 70,000 acres during the Second Plan in East Pakistan and ensured improved yields of some 2.3 million acres.

In West Pakistan, the Second Plan brought an increased tube-well drilling and electrification programme both in the public and private sectors. WAPDA's operations under the various SCARPS began over an area of 8 million gross acres. In the SCARP I area, the water table was lowered about 7 feet. The private tubewells were estimated to have provided an additional 5 million acre feet of water on some 3 million irrigated acres during the Second Plan-period. In addition to the ground water development during the Second Plan substantial progress on surface diversions was also made in West Pakistan outside the Indus Basin which accounted for another 1.5 million acres. The total irrigation water availability was increased by over 15% during this period.

STRATEGY FOR WATER RESOURCES DEVELOPMENT DURING THE THIRD FIVE YEAR PLAN 1965-70

The Third Five-Year Plan of Pakistan began in July, 1965 with a sudden drop in foreign assistance and unforeseen stresses and strains on the country's internal resources. The economy faced the challenge of preserving the growth rate of the plan despite the reduced financial resources. To obtain the projected growth rates with lower levels of investment, the priorities in the water and power sector of the economy were revised in favour of quick yielding projects. Although the agricultural growth rate remained stunted during 1966-67 giving a rise of only 1.4% per annum as compared to the Third Plan target of 5% the

agricultural economic made a remarkable recovery during the year 1967-68 when the growth rate by major crops went upto 10%. The development of water resources was assigned a high priority in the Third Plan and nearly 14% of the total public sector resources of Pakistan amounting to 4199 million rupees were allocated for the water sector. Out of this, 1960 million was intended for projects in East Pakistan, 2181 million for West Pakistan and the rest for agencies under the Central Government. Out of this Plan allocation, an estimated sum of Rs. 1262.12 million was estimated to have been spent during the years 1966-67 and 1967-68.

The strategy for water resources development in East Pakistan during the Third Plan was dictated by several factors—one of the most important being the necessity for accelerating the provincial growth rate particularly in agriculture. The strategy was also dictated by the need for intensive collection of hydrological data of East Pakistan, the extremely difficult nature of many of the flood control projects and the limited number of projects fully engineered. In addition there was the dilemma of having many projects with long gestation periods while at the same time requiring projects that could produce economic growth in the short run. Thus, the course chosen was to proceed as rapidly as possible with the engineering preparations and exercises necessary for the regional and project planning of large flood control programmes and of course to start work on the finally engineered projects and to rely for economic growth on several selected schemes with short gestation periods typified by the low lift pumps and the tubewell schemes to augment the water supplies of East Pakistan during the winter season.

In West Pakistan, the objectives were to maximise the relatively easy development of sweet ground water in the province through expanded integrated public and private tube-well programme and to begin work on canal modification and enlargement schemes that will allow a greater proportion of the river flow to be utilised and to increase the investigation research, engineering, co-ordination and master planning efforts required to provide an adequate technical and economic base for later and more difficult surface water and ground water developments. These objectives were designed to provide the most rapid possible development of water potential with a view to supporting our aims for the sharp increase in agricultural production. In addition, the "Implementation of the Indus Basin Project" was to be ensured for completion as scheduled.

WATER RESOURCES DEVELOPMENT IN EAST PAKISTAN DURING 1965-68

By the end of the financial year, June, 1968 the following main on-going water projects in East Pakistan had been completed:

1. Dacca-Demra-Narayanganj Project

The project has provided irrigation facilities to 15,000 acres and flood protection for an area of 12,740 acres at a cost of 21.5 million rupees.

2. Brahmaputra right bank flood embankment project

This project has been completed about one year ahead of schedule by constructing 135 miles long embankment and has provided flood protection facilities for 5,79,500 acres plus 93,200 acres for the reach from Serajgunj to Bera which was not included earlier in the project. This has been accomplished at a cost of Rs. 69.7 million.

3. The groundwater development and pump irrigation project in the northern districts of East Pakistan.

With the completion of this project, an area of about 1,86,800 acres has been provided with irrigation facilities by installing:

- (i) 362 tube-wells with power and transmission line facilities;
- (ii) 689 diesel engine driven low-lift pumps in 95 stations; and
- (iii) 60 electrically driven low-lift pumps.

The northern districts of Dinajpur, Rangpur, Bogra and Rajshahi will benefit from this project.

4. Improvement of old Dakatia and little Fenny river in Noakhali and Comilla Districts (Phase I).

This scheme involved solving the problem of drainage congestion of an area of 242 sq. miles. This will bring benefit to the paddy growing lands in the Noakhali and Comilla districts of East Pakistan.

5. Dredging the Gumti River in the District of Comilla.

This drainage scheme which benefits Comilla district has been completed at a cost of 11.9 million rupees during the period under review.

6. Comprehensive Drainage Scheme for Faridpur District.

This scheme has been completed at a cost of 41.1 million rupees and will benefit the areas of Faridpur District.

7. Teesta Sub-Project

This project was completed during 1967-68 with a view to boosting up food production by bringing under cultivation an area of about 33,000 acres of land in the Rangpur District by constructing a diversion dam over Buri-Teesta river with a canal system and related structures.

In addition to the above projects completed during the period under

review, the following main on-going projects have made further progress in East Pakistan.

(1) The Coastal Embankments Project—Phase I

This project is one of the most important ventures in East Pakistan in the field of water resources development. It aims at saving 2.6 million acres of land from tidal inundation. The tidal inundation destroys ground crops and makes the land unfit for cultivation unless the salts could be leached. Heavy flooding during the monsoon rains also damage standing crops. The coastal embankments when completed will save the areas in parts of Khulna, Barisal, Noakhali and Chittagong districts from such damage and will add to the agricultural production in East Pakistan. Salinity studies have been conducted and are continuing to determine what areas require protection from salinity incursion. Out of the total length of 2600 miles anticipated to be completed under this project, 1617 miles of embankments had been completed by June, 1968 which have brought production to an area of 1.5 million acres. The scheme is estimated to cost 1145 million rupees.

(2) Ganges-Kobadak Project—Kushtia Unit

The phase I of this project on the Ganges river is nearing completion which will bring 1,20,000 acres of land under irrigation. This will be followed by the completion of Phase II and then by the Jessore Unit of this project for benefitting the areas lying further south in the Jessore and Khulna districts of East Pakistan. The Kushtia unit is estimated to cost 509.4 million rupees. This project is based on the existing supplies of the Ganges river and its scope could be seriously affected by any withdrawals from the river upstream of this site.

All these projects are being executed by the East Pakistan Water & Power Development Authority. In addition, the East Pakistan Agricultural Development Organisation has embarked upon small-scale irrigation schemes using low-lift pumps to lift small quantities of water for winter irrigation of the boro-rice crop. The extent to which the low-lift pump irrigation scheme could be implemented will however depend upon the availability of water in the various streams during the winter close to the cultivable lands. The Pakistan Academy for rural development is also undertaking a project for installing tube-wells in the Comilla district for the benefit of local irrigators.

As a result of completion of these schemes, and progress on the on-going schemes, an area of about 0.362 million acres of new land has already been brought under irrigation and about 1.07 million acres has been improved by providing irrigation flood control and drainage facilities,

**WATER RESOURCES DEVELOPMENT IN WEST
PAKISTAN 1965-68**

Out of a sum of 2181 million rupees provided for water sector in the Third Five-Year Plan, nearly 52% were allocated to drainage, reclamation and tube-wells and 22.7% for irrigation, about 3% for flood regulation and the balance was to be distributed almost evenly on investigations and surveys, multi-purpose development and open canals.

Surface Water Development

The Tanda Dam in Kohat District was completed. The work on the Khanpur Dam Project in the northern parts of West Pakistan and Hub Dam Project in the southern parts of West Pakistan progressed during the period. A few schemes of executing small dams on minor streams were also completed. Side by side, the land reclamation and surface drainage operations proceeded as planned.

Groundwater Development and checking salinity and waterlogging in the irrigated areas of West Pakistan.

A public sector programme under various salinity control and reclamation projects (SCARPS) remained under execution during the period 1965-68. As a result of this tube-well drilling activity, 3475 additional tube-wells had been installed and 1470 out of these electrified by June, 1968.

Due to this developmental activity in West Pakistan, about 1.5 million acres of new area was brought under irrigation and 5 million acres was provided with improved facilities. In addition, an estimated 30,000 tubewells at the rate of 10,000 per year were installed in the private sector during the year 1965-68.

Indus Basin Project

The Indus Basin Project is being executed under the Indus Water Treaty for which a separate Indus Basin Development Fund Agreement was executed to which the World Bank agreed to act as administrator. This fund included commitments of the equivalent of about 895 million dollars. This amount was further supplemented by an additional amount equivalent to 315 million dollars under a Supplemental Agreement of 1964 wherein Pakistan undertook to meet the full rupee cost of the completed works from her own resources. The Indus Basin Project proceeded according to schedule during the period 1965-1968 and in fact the Mangla Dam was completed in 1967, a year ahead of the schedule.

RESEARCH PROGRAMME

The Irrigation Research Institute at Lahore, West Pakistan, conducted several research and model studies typical to the problems of irrigation and agriculture in West Pakistan and expanded its activities with the import of new equipment and erection of a new research building. Similarly, the hydraulic research laboratory set up at Dacca, East Pakistan was developed further with the latest equipment and model erection facilities to cope with the requirements of hydraulic research relating to irrigation, navigation, flooding and tidal inundation problems of East Pakistan.

An organisation for collection of hydrological data set up in either wing of the country continued to collect information regarding the river discharges, rainfall and evaporation records and analysis of sediment loads in streams.

**STRATEGY AND OBJECTIVES FOR WATER RESOURCES
DEVELOPMENT DURING THE FOURTH FIVE-YEAR
PLAN—1970-75.**

The water resources development planning during the Fourth Five Year Plan should aim at:

- (1) evolving a programme commensurate with the financial resources of the country which will be mobilised both internally and externally during the five year period;
- (2) reducing, if not altogether eliminating the intra-regional and inter-regional disparity in the per capita income of the people;
- (3) relying more on internal resources than on foreign assistance following the policy of self-reliance;
- (4) taking the fruitful on-going projects to the stage of speedy and satisfactory completion so that benefits of investments made during the Third-Plan period are noticeable in the Fourth Five-Year Plan;
- (5) eliminating the duplication of efforts by various executing agencies engaged with water resource development;
- (6) undertaking a flood control programme in East Pakistan and controlled irrigation supplies through tubewells, lift-pumps together with strengthening the agencies executing this programme;
- (7) completing the Tarbela Dam on schedule in West Pakistan and planning through surveys and investigations of projects complementary to Tarbela such as, the Second Stage Storage Development on the Indus and the ground-water and surface drainage programmes in the Indus Basin;

- (8) further encouraging tubewell installations programme in the private sector in West Pakistan.

CONCLUSIONS

Pakistan is mainly faced with the two problems of flood control in East Pakistan and checking water-logging and salinity in West Pakistan. In order to evolve and execute a comprehensive flood protection plan for East Pakistan and eradicate the menace of salinity, alkalinity and water-logging in West Pakistan, concerted efforts by engineers, research workers, planners, financiers, land and water resource management experts would be necessary. The need for such a co-operative and co-ordinated action cannot be over-emphasised. In addition, the rapid rate of water resources development in Pakistan in the past years warrants that research on scientific principles for the long-term planning of the more sophisticated water projects and the more complex water problems of Pakistan may be developed. As the time goes research for optimum utilisation and economic planning of our remaining water resources would be more urgently needed than ever before.