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TITLE	:	PLANNING AND IMPLEMENTATION OF INDUSTRIAL-CUM-IRRIGATION WATER RESOURCES PROJECTS DEVELOPMENT MODELS - EXPERIENCE OF MAHANADI AND HASDEO PROJECTS IN MADHYA PRADESH STATE - INDIA
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SYNOPSIS

India is a very populous country, having about 700 million people and the 7th largest country in area in the world. 70% people are engaged on agriculture, as such, more than 90% of total water use in the country is on agriculture and irrigation. Projections from 1968-69 to 2000 AD for industrial water use have been indicated, which reveal that only 6% of the potential would be required in the industrial sector and that too in concentrated pockets like Chhatisgarh region in Madhya Pradesh State, the largest State in India. Planning in construction of two Major Multi-purpose Projects - Hasdeo and Mahanadi Projects have been discussed. These Projects, constructed in phased programme, were initially started by according very high priority to the needs of gigantic industrial Projects like Steel and Aluminium Plants, Thermal Power generation in thousands of MWs and other allied sectors, besides providing irrigation in million of hectares in the rice bowl tracts. Important policy decision in industrial and irrigation development programmes to be planned in an integrated approach in river basin planning, have been suggested, to make the desired economic growth in the area. Else industries themselves would not have been able to afford the cost of construction of such Projects for meeting their water needs in such circumstances. Unusual features advance planning in Hasdeo Project in three phases have been discussed. Development plans related to the industrial areas in countries like India would be different from those formulated for developed countries. Emphasis has been laid for water saving technology, collection of authentic data for industrial use and use of model tools in economic evolution and investment programmes.

RESUME

L'Inde est un pays très peuplé, avec une population d'environ 700 millions d'habitants; c'est aussi le 7ème pays du monde par sa superficie. L'agriculture emploie 70% de sa population et c'est ainsi que 90% de la consommation d'eau totale va à l'agriculture et à l'irrigation. Des études portant sur la consommation d'eau de l'industrie des années 1968-69 à l'an 2000 ont été rapportées; elles ont révélé que 6% seulement du potentiel serait utilisé par le secteur industriel et cela uniquement dans des zones à forte concentration industrielle, comme par exemple la région de Chhatisgarh, dans l'état de Madhya Pradesh, qui est l'état le plus vaste de l'Inde. On a discuté de l'étude pour la construction de deux grands aménagements à usages multiples-les aménagements d'Hasdeo et de Mahanadi. Ces aménagements-construits par étapes-ont, dès le début, accordé la priorité aux besoins d'ensembles industriels gigantesques, aciéries, usines d'aluminium, production de thermo-électricité en milliers de MW. et autres industries connexes, tout en permettant d'irriguer des milliers d'hectares de terre dans les régions de rizières. Pour atteindre le degré de développement souhaité dans la région, on a fait des suggestions importantes concernant les projects de développement industriel et l'irrigation en envisageant l'aménagement intégré du bassin fluvial. Sinon, les industries elles-memes n'auraient pu envisager de telles dépenses pour la construction d'aménagements de cette sorte en vue d'assurer leurs besoins en eau. L'on a discuté des particularités, et de l'éxécution en trois étapes du project d'aménagement à Hasdeo. Les plans de développement des régions industrielles dans un pays comme l'Inde sont différents de ceux formulés pour les pays développés. L'on a mis l'accent sur les technologies permettênt d'économiser l'eau; l'on a rassemblé des données authentiques à usage industriel et l'on a insisté sur l'emploi d'outils modèles dans l'évolution économique et les programmes d'investissement.

RESUMEN

La India es un país más poblado con una población de 700 millones de habitantes y la séptima más grande del mundo en su extensión. 70% de la gente está ocupada en agricultura, como tal, más de 90% del uso de agua total en el país esta en el campo de agricultura y regadío. Se han señalado las proyecciones para el uso industrial de agua total desde 1968-69 hasta el año 2000 que indican que se requerirían solamente el 6% del potencial en sector industrial, lo cual estaría en las zonas concentradas como la región de Chhatisgarh en Madhya Pradesh, el estado más grande de la India. Se ha discutido la planificación en la construcción de dos proyectos principales con varios propósitos tales como los proyectos de Hasdeo y Mahanadi. En el principio se comenzaron estos proyectos, con construcción en etapas, dando una perioridad mas alta a las necesidades de los gigantes proyectos industriales, tales como las plantas siderúrgicas y de aluminio, la generación de la energía térmica en miles de MWs y otros sectores relacionados. Además, facilitando el regadío en millones de hectáreas en las zonas propicias para el cultivo de arroz. Para conseguir el deseado crecimiento económico en la zona se han sugerido varias decisiones importantes de política en los programas de desarrollo industrial y de regadíos. Estos programas han de planificarse en una manera integrada para la planificación de la cuenca del río. Si no, las industrias no habrían podido permitirse el costo de la construcción de tales proyectos para satisfacer sus necesidades de agua en estas circunstancias. Se ha discutido la planificación de antemano para el proyecto de Hasdeo en tres etapas. Los planes de desarrollo relacionados a las areas industriales de los países como la India serían differentes a los de los países desarrollados. Se ha puesto más énfasis sobre la technología de ahorro de agua, el acopio de datos auténticos para el uso industrial y el uso de las herramientas en la evolución económica y los programas de inversión.

1. INTRODUCTION

India is a most populous and seventh largest country in the world. The present population is about 700 million and represents over 1/6th of the world population. Water resources are estimated at 179 Million Hectares Metres, but on account of other limitations the utilisable figure may be about 70 million hectares metres of surface water and 27 million hectares metres of ground water. Agriculture and irrigation alone involve more than 90% of the total use in the country as dominantly more than 70% people are engaged on agriculture. Today with more than 1/5th of the world irrigated land India leads in irrigation. In 2000 A.D. against the projected irrigated agriculture withdrawal involving 3600 Billion Litres per day (BLD), the corresponding figure for industrial use is 151.66 BLD and that for steam electric power is 237.80 BLD involving respectively consumptive use of 11.58 BLD and 2.06 BLD respectively. During 1978-79, the figures for irrigated agriculture are about 955 BLD, industrial use withdrawal about 47.03 BLD, steam electric power 88.00 BLD with consumptive use of 1.49 and 0.55 respectively. It is, therefore, apparent that the withdrawal use even in the year 2000 would also be about 6% of the potential, as such industrial water supply requirements would not pose major problems, although the demand will be concentrated in pockets in industrialised areas like the one in Chhatisgarh region in Madhya Pradesh State in India where number of gigantic Projects like Steel Plants, Aluminium Plants, Thermal Power Stations, Fertilizers Projects etc. have been constructed and commissioned and severeal other are proposed to be undertaken. Thus the 2000% increase in the return flows would, therefore, be a serious pollution hazard. Compared to the industrialised nations, the industrial wastes may be low but the comparatively higher temperatures and low levels of summer flows with increasing withdrawal use pose serious pollution problems and several other environmental impacts which would be discussed. Experiences on the construction of Hasdeo and Mahanadi Reservoir Projects in that region which had to be planned and constructed on crash programme basis under various phases essentially to meet the needs of industrial water supply and Thermal Power cooling purposes dove-tailed with the irrigation requirements of the commanded areas from these Barrages-Dams-Projects, as a planning strategy in the over-all water plan in the basin of the river Mahanadi, are indicated. These aspects need a careful integrated approach for development of water resources programmes and environmental protection task to provide needs for industrial water supply alongwith the main consumptive use for irrigation of the thirsty lands. This also confirms that otherwise taking up of gigantic projects only for the needs of the industrial use would not have been possible to be funded or considered economical since even otherwise other conventional or minor Projects for the supplies of industries and Thermal Power generation were neither techanically feasible nor could be financially viable. Experiences on the construction of Hasdeo and Mahanadi Projects provide some glimpses as to how industrial as well as agriculture growth have been able to proceed together.

Fortunately, less than 10% of the industrial plants including power demands account for 80% of the total industrial water intake and the other major sectors are paper industries, cotton and jute industries, sugar industry, fertilizer and steel plants and refineries etc. Some other industries like tanneries and distilleries are note-worthy on account of special pollution characteristics. The estimated withdrawal demands according to the categorised grouping of industries is as follows:

ESTIMATED INDUSTRIAL WATER USE (BLN.LTRS.DAY)

Industries	Withdrawal Use				
	1968-69	1973-74	1978-79	1988-89	2000-01
Food Products	9.12	0.16	0.22	0.46	1.37
Textiles	0.30	0.38	0.52	1.21	3.43
Paper	0.19	0.32	0.51	1.18	3.48
Mines and Metals	5.25	8.85	13.42	32.50	106.00
Glass, Cement	0.15	0.24	0.37	0.85	2.85
Chemical products	0.41	0.91	1.61	4.30	14.20
Petroleum products	0.45	0.76	1.13	3.54	10.20
Machinery	0.42	0.67	1.08	2.88	9.80
Miscellaneous	0.01	0.02	0.03	0.11	0.33
Total	7.30	12.31	18.89	47.03	151.66

2. GLIMPSES OF MAHANADI & HASDEO MAJOR MULTI-PURPOSE PROJECTS

(a). Mahanadi Reservoir Project:

Mahanadi Reservoir Project in Madhya Pradesh, envisages construction of a 1828.8 m long composite dam across Mahanadi river. A masonry dam comprising non-over-flow blocks and gated spillway is proposed to be located from RD Om to RD 585.2 m on the left flank, whereas an earth dam is proposed to be located for the remaining length across main river. The salient features for the earth dam are indicated below:

Location:

Distt. Raipur (Madhya Pradesh)
Latitude : 20.038'
Longitude : 81.034'

Hydrology:

Length of river upto dam site : 115 Km^2
Width of river : 488 m.
Total catchment area : 3670 Km^2
Maximum rainfall : 2 286 mm.
Ave. rainfall : 1 430 mm.
Max. Designed flood : 23 500 cusses.
Moderated through spillway : 17 230 cusses.

Capacity:

Gross storage at R.L. 348.68 : 909.32 m^3
Dead storage at R.L. 336.21 : 143.60 m^3
Live Storage at R.L. 348.68 : 765.72 m^3

Rs. 400 million Mahanadi Reservoir Project was undertaken during 1973-74 and constructed on crash programme basis in record time and commissioned in 1978-79 for meeting the industrial water supply requirements for the expansion of gigantic Bhillai Steel Plant in the area for its proposed expansion from the present production of 2.5 million tonnes to 4 million tonnes, augmenting irrigation in the existing .35 million acres and providing irrigation in new areas again in .35 million acres. Looking to the importance of the benefits due to increased industrial economy and agriculture production, the Project was constructed with high priority involving new construction techniques and completed about two years ahead of schedule.

Mahanadi River in the Madhya Pradesh State has a catchment area of about 77300 Sq.Kilo metres with usuable water resources of 22.4 million acre feet. Mahanadi Project was also planned in such a fashion that it supplemented irrigation of the existing Rudri Barrage constructed Downstream in the past during 1912-1915, and also to supplement the needs of intensive irrigation in this rice bowl track and also to cover the areas which were deprived of irrigation on account of water supply for industrial purposes. Further new Projects of Sondur and Pairi have been contemplated. Thus a sort of regional water grid was established.

It may be mentioned that during 1986-87 soon after the famine in this area, several canal projects for irrigation of rice crop were contemplated, planned and implemented. Multiple irrigation for the rice as well as wheat crops and to meet the the needs of steel plants and water supply requirements of Raipur City, intensive water resources development plans, as indicated

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above, were taken up, to ensure an integrated approach for optimum utilisation of river basin potential, particularly to meet the needs of industrial water supply requirements, as indicated above, when the industries themselves would not be able to afford the cost of construction of such dams and canal systems. What is, therefore, required is an approach treating them like large production farmers, who are taking water for industries instead of crops for which canals systems are normally constructed from this Project.

Due to the above approach, against the live storage capacity of Mahanadi Reservoir Project of 765.72 Million Cubic Metres, about 1/3rd could be reserved for meeting the needs of Bhillai Steel Plant requirement of about 255 million cubic metres.

(b). Hasdeo Major Multi-purpose Project:

The estimated cost of the Project is 2388 million Rupees providing for estimated additional annual production of food-grains of 5.2 million tonnes, assured irrigation of about 4.4 million hectares with irrigation in intensity of 160%. In addition, it will meet the needs of the gigantic 4000 MW Thermal Power Station proposed to be constructed at Korba in State and Central sector, besides meeting the needs of 200 MW Thermal Plant under Phase-I of Hasdeo Barrage, and meeting the requirements of the existing Aluminium Plant as well as the proposed fertilizer plant and several other industries.

Hasdeo Bango Project complex is one of the most economical project, in the country with immense multiple benefits envisaged. It has been planned to undertake a phased development of the Hasdeo river valley by the above projects in the 3 phases. The multiple benefits from this complex will usher an area of prosperity in the otherwise severely/chronically drought affected area of the Bilaspur district in the Chhattisgarh region of the State by the assured irrigation supplied for Kharif and the multiple crops and also catering to the requirement of the industrial complexes near about Korba.

The unique feature of the three phased development of this complex has many built-in specialities in each of its three phases as could be seen below.

In the planning of the Phase I of this complex, advance provision was made to be able to release the irrigation waters from the two head regulators to cater to the ultimate irrigation requirement from this complex. The capacity of both the Left and the Right Bank Head Regulators was planned in advance to release 3000 cou. each.The sill level of both the regulators was kept in such a way so as to command the entire command that was to come up ultimately.

In the planning of the Phase II of this complex, the capacity of the Right Bank MainCanal has been planned so as to accommodate the final requirement of irrigation releases to the

tune of 3000 cou. even though for the Phase II requirement the irrigation releases was to be 1350 cou. only. The construction of the Right Bank Main Canal was done in such a way that the entire masonry works and the filling reaches of the canal were constructed for the final phase. This has become very handy in accommodating the Phase III requirements in the form of just constructing one additional branch canal system only without disturbing the main canal, except to widen the cutting reaches only.

By this unique advance planning and built in provisions in the already completed two phases, it became very easy to take up the work of the third phase without in any way having to disturb the already completed works in the first and second phases.

An insight into the three phases of the Hasdeo Bango Project complex will not be complete without looking into the immense benefits that have been/are to be achieved from this complex. The long list of benefits include:

(a). Assured supplied of cool/silt-free waters to the 2000 MW Thermal Power Stations at Korba -constructed by Madhya Pradesh Electricity Board.

(b). Assured irrigation supplies to 42,000 hectares (1.04 lakh acres) of paddy area from the Janjgir Branch Canal System in Janjgir Tehsil.

(c). Extending the irrigation benefits to include double cropping to a final area of 4.05 lakh hectares (10.0 lakh acres) annually after the completion of the Phase III works.

(d). Supplying the much needed industrial water requirements to the below mentioned industrial units near Korba:

(i). Bharat Alluminium Company at Korba.

(ii). Fertilizer Corporation Factory at Korba.

(iii). Western Coal Fields complex at Korba.

(iv). Other small plants and industries to come up near Korba.

(e). Assured supplies of cooling waters for the two super thermal power stations that are under construction on the Right Bank of Hasdeo river near Korba, namely;

(i). 2100 MW power house being constructed by the National Thermal Power Corporation,

(ii). 1260 MW Power station being constructed by Madhya Pradesh Electricity Board.

(f). Assured domestic water supplies to the entire township of Korba as well as for all the various industrial complexes near Korba.

(g). Hydro power generation asan ancilliary benefit in the foot of the dam power house below Bango Dam. Incidentally, this is proposed to be used as a small peaking station of hydro power by Madhya Pradesh Electricity Board.

(h). Environmental benefits by the creation of the huge storage reservoir as a result of all the three phases.

(i). Immense indirect benefits as a result of the construction of the storage reservoirs.

A close look at the multiple/immense benefits from this complex exploited in three phases will reveal that this complex is one of the finest landmarks in the advance planning/phased construction techniques for exploiting major multipurpose river valley projects, that have been undertaken by the Madhya Pradesh Government IrrigationDepartment and will go a long way in adding laurels to the irrigation Engineers of the State of Madhya Pradesh.

From the above, it would be seen that Hasdeo Project is another example which was initiated and started for meeting the silt-free cooling water requirements of a Thermal Power Station at Korba which consequently was linked with the power needs of the Bhillai Steel Plant in that area. Thus the water management for agriculture is of secondary importance while the first importance was given for meeting the needs of industries and this perhaps could be a very important policy and crucial decision-making strategy in the economic development of a region or a sub basin in the over-all river basin development programmes.

Development plans specially those related to industrialised areas in respect of water resources management should be different from those formulated for the developed countries.A stress would need to be given for the use of water and adoption of water saving technology. Greater emphasis in a planned manner would need to be introduced in respect of selection criteria so that industrial and agriculture development proceed side by side. Based on the experiences on the construction of Hasdeo and Mahanadi Water Resources Development Projects, authentic data for industrial water use - both in respect of withdrawal and consumptive will have to be collected for greater care, reliability and codification so as to serve as a valuable tool in the planning of water resources system.

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1. The author was the Chief Engineer,Mahanadi Bodhghat Hasdeo Major Multi-purpose Projects,during the construction of the above Project before joining the present assignment in 1978.
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