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A case study to increase the benefits on Interlinking of Par-tapi-narmada Link Project

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ABSTRACT

The research is aimed to conduct critical analysis of project benefits, Irrigated area, quantum of water to be transferred and enhancement of benefits of one of interlinking project viz Par-Tapi-Narmada link basic genesis of feasibility level proposal of Par-Tapi-Narmada link. An attempt has been made to review the proposal at Feasibility Stage and suggest measures for improvement. The Par-Tapi-Narmada Link ILR proposal at Feasibility Stage (2005) was finalized with diversion of 1350 MCM of water out of which a major portion was used for supplementing Narmada Command and later use of saved water by substitution in Narmada Command of Saurashtra and Kutch. The cost of Rs. 60,164 Million was mainly for 7 Dams and 400 km long canal only. Thus, there was a need to optimize benefits by using better irrigation techniques. There is possibility of optimizing water utilization by reducing irrigation intensity in enroute command. Reduction of water can be done by deleting dams and B-C ratio can be increased from 1.08 to 1.29 as observed in various combinations. Therefore, there is need for re considering 7 dams in position and adopting 5 to 6 dams. An introduction of micro irrigation in the command area by switching over from gravity flow irrigation increases the Benefit Cost ratio of the project considerably. Also aspect of increasing water through Ukai Dam and maximization of crop yield are established. All these gives concrete shape to sustainability of Project.

Key words *: Rivers interlinking, Par-Tapi-Narmada Link Project, Micro irrigation, Irrigation intensity, Benefitcost ratio.*

Introduction

The complexity of uneven distribution of rainfall in time and space necessitates need for storages and transfer of water from water surplus region to water deficit regions. Here, it is also emphasized that Interlinking of Rivers Project is nothing but alike normal water resources Projects which are having depending upon type of utilization canal or piped network in own command area. The ILRP advocates diversion of water outside command area of catchment up to storage site to fill up gap between availability and requirements of water.

The National Perspective Plan (NPP) of Government of India

The ILRP was conceptualized by Government of India in 1980 as a National Perspective Plan of Water Resources Project which included two components of Himalayan and Peninsular are shown in Table 1 (NWDA FR 2005).

Research Methodology

The case study has been done to critically examine the Par-Tapi-Narmada Link Feasibility Report and suggest measures to enhance its viability. The study

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is an analytical research work First the head works link canal, water transfer, command area benefits costs and internal rate of return etc. are studied. Thereafter detailed analysis has been done to maximise project parameters. The broad parameters are reduction in irrigation intensity increase in command, cost, cost per MCM storage of 7 Dams-possibility of now reducing storage dams in various combinations and visualising impacts and step by step introduction of micro irrigation in the command area replacing gravity flow irrigation increasing crop yield and impact on Benefit-Cost Ratio and internal rate of return (IRR) of theproject considerably.

Results and Discussion

PAR— TAPI — Narmada Link Project Survey

For any water resources project including ILRP the steps in framing out any project include preparation of pre-feasibility/feasibility reports based on secondary data and preparation of Detailed Project Report based on primary data to establish the viability of link project. The project envisages link canal backed up by storages to interlink west flowing rivers from Mumbai to Tapi and transfer water for needy areas of Mumbai (Southward) and Narraada (Northward) to Saurashtra and Kutchh area of Gujarat. During preliminary feasibility studies (1990) it was established that water can be stored in dams proposed on Damanganga River to be transferred to needy areas of Mumbai city and seven Dams from small rivers excluding Damanganga to Tapi and transferred to needy areas en-route canal and Tapi by link canal cover command of existing Sarda Sarovar Narmada Project by substitution. The arrangement was twin links concerning and benefitting both Gujarat and Maharashtra States. The Par-Tapi-Narmada Link Project at PFR level was planned to link (i) Par river in Par basin with Tapi river near existing Ukai Dam on Tapi river through seven storage Dams, weirs 185km link Canal. (ii) To link Tapi river in Tapi basin with Narmada river by 173km link terminating at RD 39.60 km of existing Miyagam branch of Sardar Sarovar Narmada canal. The water diverted at 1. Miyagam branch will be used in extension of irrigation in Kutch and Saurashtra area through substitution. The pre-feasibility study proposal was later found suitable for taking up feasibility studies. The feasibility studies were first carried out in 1995 and later revised in 2005as it was established that Tapi river up to Ukai Dam is not having surplus water thus, it is not possible to divert water from existing Ukai reservoir, thus total diversion 1350 MCM only. The revised reach wise length of canal and irrigation benefits are tabulated below. Seven Dams were proposed at FR level and a 400 km long canal connecting Par to Tapi reach-I and Tapi to Narmada 190 Km was proposed. The details of reservoirs in the project and divertible water yield based upon simulation studies as given in Figure 1. The abstract of CCA and area to be irrigated and at FR stage and Cost and Benefits from Par-Tapi-Narmada Link (FR 2005) are given at Table 3.

Table 1. National Perspective Plan of Water Resources Projects

S.No.	Himalyan component	Peninsular component
1	Manas-Sankosh-Tista-Ganga	Mahanadi (Manibhadra)-Godavari (Dowlaiswaram)
2	Sone Dam – Southern Tributaries of Ganga	Godavari (Inchampalli)-Krishna (Pulichintala)
3	Kosi-Ghagra link	Godavari (Inchampalli)-Krishna (Nagarjunasagar)
4	Gandak-Ganga	Godavari (Polavaram)-Krishna (Vijayawada)
5	Ghagra-Yamuna	Krishna (Almatti)-Pennar
6	Sarda-Yamuna	Krishna (Srisailam)-Pennar
7	Yamuna-Rajasthan	Krishna (Nagarjunasagar)-Pennar (Somasila
8	Rajasthan-Sabarmati	Pennar (Somasila)-Cauvery (Grand Anicut)
9	Chunar-Sone Barrage	Cauvery (Kattalai)-Vaigai-Gundar
10	Ganga-Damodar-Subernarekha	Ken-Betwa
11	Subernarekha-Mahanadi	Parbati-Kalisindh- Chambal
12	Kosi-Mechi	Damanganga-Pinjal
13	Farakka-Sunderbans	Par-Tapi-Narmada
14	Jogighopa-Tista-Farakka (Alternative to Sl. No.1)	Bedti-Varada
15		Netravati-Hemavati
16		Pamba-Achankovil-Vaippar

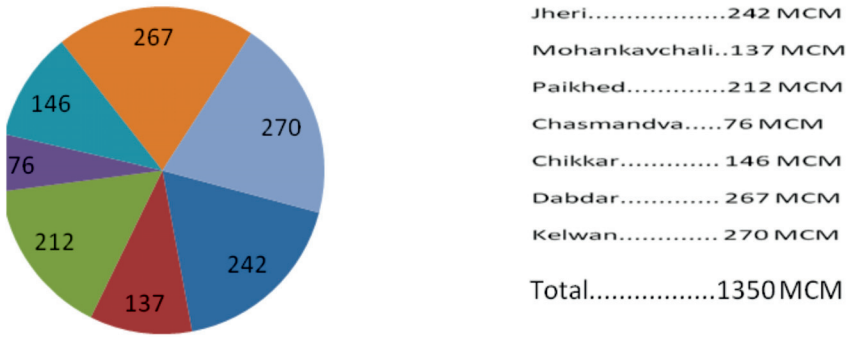

Fig. 1. Divertable quantity from different dams in MCM (FR)

Table 3. Benefits from Par-Tapi-Narmada Link (FR 2005)

Sl. No.	Reach	Canal Capacity	CCA (ha.)	Irrigation (ha.)	Irrigation intensity	Hydro Power generation (Million KWH)
1.	Par-Tapi	44 to 91 Cumecs	17411	21764	125%	93
2.	Tapi-Narmada	71 to 45 Cumecs	23940	29925	125%	
3.	Sub-Total		41351	51689	125%	
3.	Target Narmada Command	–	147063	117650	80%	
	Total		188414 ha	169339 ha	—	93

Review of Proposal at Feasibility Stage and need for improvement

The paper mainly concentrates study and analysis of available material at PFR/FRDPR stage, what has been done and what to be done, review of existing papers done at preliminary stage by Author. An attempt has been made to review the proposal at Feasibility Stage and suggest measures for improvement. The Par-Tapi-Narmada Link MR proposal at Feasibility Stage (2005) was finalized with diversion of 1350 MCM of water out of which a major portion was used for supplementing Narmada Command and later use of saved water by substitution in Narmada Command of Saurashtra and Kutch. The

Table 4.

Intensity (%)	Water (MCM)
125	1350
100	1271
90	1213
80	1138
70	1032

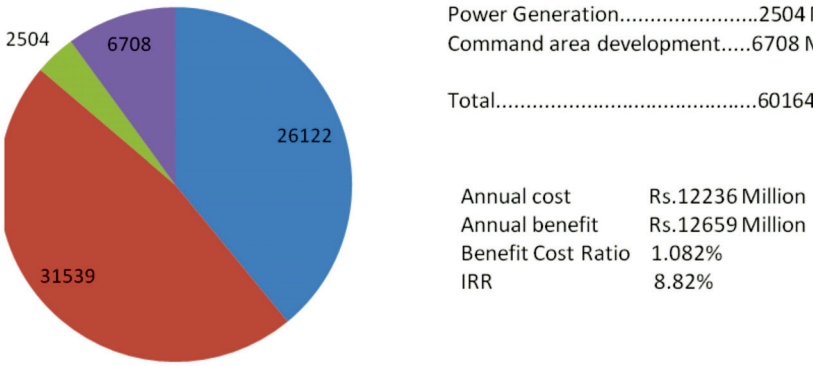

Fig. 2. Abstract of cost in Rs. Million and Annual Cost Benefit

cost of Rs. 60,164 Million was mainly for 7 Dams and 400 km long canal only. Thus, there was a need to optimize benefits by using better irrigation techniques. At that time perhaps there was less or no practice of micro irrigation in Project Command which could have served 169 thousand hectare in less or no water thus making more water available for target command in Saurashtra and Kutch region.

Analysis and Results

Analysis I. Savings in water requirement adopting lower irrigation intensity in enroute command area

Presently the litigation intensity in enroute areas of Par-Tapi and Tapi-Narmada reaches of Par-Tapi-Narmada link is 125% against 80% in Target Narmada Command. In case this is kept 80% in all command, there will be saving of 175 MCM. The saving of 175 MCM can be used to provide additional irrigation of 20412 MCM. Otherwise out of 7 dams proposed in Par-Tapi-Narmada link, possibility of omitting one dam having higher cost per MCM storage can be done. The abstract of saving is given in Figure 3.

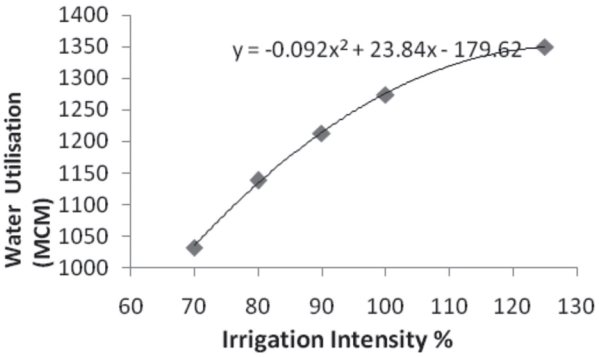

Fig. 3. Graph showing the irrigation intensity vs water utilisation

Table 5. Impact of omitting dams in various cobinations

Option	Quantum of diversion	Capital cost of project Rs. Million	Annual benefits	Annual cost	B-C ratio with power	B-C ratio Without power	IRR(%)
All dams in position (Base line)	1350	60164	6182	5716	1.08	1.02	8.07
Delete Chasmandva (I)	1274	53895	5814	5106	1.14	1.08	8.35
Delete Mohankavchali (II)	1213	52398	5611	4967	1.13	1.07	8.85
Delete Chikkar (III)	1204	54570	5979	5189	1.15	1.10	8.86
Delete Paikhed (IV)	1138	49366	5993	4687	1.28	1.24	8.68
Delete Jheri and Chasmandva (V)	1032	45084	5509	4281	1.29	1.25	8.34

Table 6. Replacement of Gravity irrigation with Pressurized irrigation
Increase in Irrigated Area and positive impact on Cost-Benefit ratio and IRR

Sl. No.1	Ratio of Gravity to Pressurized irrigation 2	CCA 3	AI Under Gravity (ha) 4	AI Under Micro (ha) 5	B C ratio with 10% de-escalation 7	IRR 8
1.	Base line as per FR: 100% Gravity: 0% Pressurized	188414	169339	0	1.0255	8.08
2.	90:10	204516	152403	31408	1.0933	8.23
3.	80:20	221205	135469	63341	1.1613	8.68
4.	70:30	237309	118536	94748	1.2241	9.06
5.	60:40	253414	101602	126156	1.2850	9.47
6.	50:50	269812	84669	157827	1.3448	9.83
7.	40:60	286500	67735	189760	1.4041	10.19
8.	30:70	302897	50801	221431	1.4603	10.54
9.	20:80	319001	33868	252837	1.5135	10.84
10.	10:90	335398	16934	284508	1.5661	11.14
11.	0:100	351795	0	316179	1.6169	11.4

Analysis II. Impact of omitting dams in various combination to increase Benefit-Cost ratio

There are seven dams viz. Jheri, Paikhad, Mohankavchali, Chasmandva, Chikkar, Dabdar and Kelwan and one main HR at Tapi River. In order to have an optimization of cost and maximizing benefits, attempt has been made to visualize cost of dam (head work) per MCM of divertible quantum of water and omit the dams in various combinations. The B-C ratio analysis and internal rate of return analysis has been done in base line scenario i.e. all dams in position and the deleting one or more dam in isolation or combination. The results of various combinations and analysis are briefly summarized in Table 5 and Figure 4.

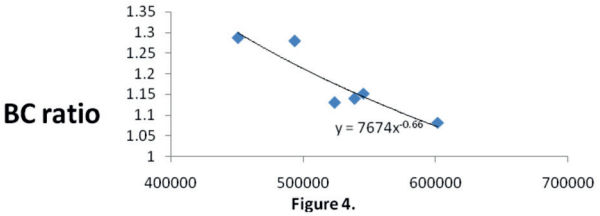

Fig. 4.

Analysis III. Impact of replacing gravity irrigation with micro irrigation in phased manner and impact on B-C ratio and IRR

The study has been done to visualize impact of replacing gravity with micro irrigation in phased manner varying from baseline to 100% replacement and obtain the increase in annual irrigation and calculate the Benefit cost ratio and IRR and established upto 60% increase; and given at Table 6.

The increase in percentage of BC Ratio varies from 41% to 51 % under excluding power component condition whereas the same varies from 56% to 67% under including power component condition.

Conclusion

- There is possibility of optimizing water utilization by reducing irrigation intensity in enroute command.
- Reduction of water can be done by deleting dams from 7 to 5 or 6 and B-C ratio can be increased from 1.08 to 1.29 as observed in various combinations.
- Micro irrigation introduction in phased manner annual irrigation will be doubled. Also B-C ration nearly increase 60% and IRR 45%.
- An introduction of micro irrigation in the command area by switching over from gravity flow irrigation increases the Benefit Cost ratio of the project considerably.
- The B C ratio goes on increasing with the increase in percentage of micro irrigation. While working out the same, the yield/benefits of the crops have been kept as per FR However, due to introduction of micro irrigation, the yield of

Analysis IV. Possibility of utilising unused storage of Ukai Dam:

S. No.	Quantum of additional water **(MCM)**	Command area (ha.)		Benefits (Rs. Million)		Cost (Rs. Million)		B-C Ratio	
		Original	Revised	Original	Revised	Original	Revised	Original	Revised
1.	50	169339	182497	5630	6111	5490	5553	1.025	1.101
2.	100	169339	195655	5630	6593	5490	5600	1.025	1.177
3.	150	169339	208813	5630	7074	5490	5648	1.025	1.252
4.	200	169339	221971	5630	7555	5490	5695	1.025	1.327
5.	250	169339	235128	5630	8036	5490	5743	1.025	1.399

Analysis V. Review of crop yield per ha. at FR stage

S. No.	% of increase in agricultural production	Net value of production (Millions)	Annual Cost		B. C. Ratio	
			With power component	Without power component	With power benefits	Without power benefits
1.	10%	8277	5220	5743	1.691	1.441
2.	20%	8518	5220	5743	1.737	1.483
3.	30%	8758	5220	5743	1.784	1.525
4.	36%	8897	5220	5743	1.810	1.549

crops will also increase.

- Possibility of increasing crop yield per hectare in Post Dam Scenario needs also to be explored.
- Utilizing unused storage of existing Ukai Reservoir also found useful for project economics.
- Based on above results It is evident that these kind interlinking projects will help to reduce the water scarcity and cost of maintenance of reservoir/dam will get reduced and also it help in increasing the irrigation intensity and effective water utilisation till the down reach also possible. So it clear from the outcome that interlinking of river is viable alternative to manage the water crisis.
- The outcome confirms that interlinking of river is viable alternative to manage the water crisis.

Suggestion for Further Work

Similar studies to analysis for other water resources ILR Projects.

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