

Chapter-II

Project Planning

This chapter deals with issues related to formulation of Saryu Nahar Pariyojana including surveys and investigations to assess the soundness of the project.

Audit objective: *Whether project was conceptualised after assessing the feasibility and viability of the project and taking into account the need of the command area?*

Brief snapshot of the Chapter

- The planning of the project was inadequate and deficient as necessary surveys and investigations to determine the alignment of the canals, area to be served with the project, suitability of construction sites, were not carried out sufficiently.
- The alignment of Rapti Main Canal (RMC) was along the foothills of the Himalayan Range like a contour canal. However, adequate arrangements were not made to protect the left embankment of the canal from getting damaged due to the strong water current coming from the hills during monsoon. This had made the RMC vulnerable.

2.1 Introduction

Comprehensive and in-depth planning is the backbone of success of a canal irrigation project. According to the Guidelines of Central Water Commission (CWC), surveys and investigations are carried out on various parameters of geographical, environmental, technical aspects to assess the feasibility of the project and Detailed Project Report (DPR) is prepared for the implementation of project.

2.2 Project formulation

As per the guidelines of CWC, DPR should be prepared after assessing the feasibility and soundness of the project on the basis of detailed surveys and investigations and by considering various issues, such as international/inter-state aspects, hydrology, irrigation planning, environmental aspects, intended benefits, *etc.* Significant audit observations regarding project formulation have been discussed in the succeeding paragraphs:

2.2.1 Surveys and investigations

Guidelines of CWC envisages for detailed surveys on the aspects such as topography, hydrology, geology, seismicity, foundation of structures and availability of construction material¹, both qualitative and quantitative, within economical reach.

¹ Availability of quarry area and suitability of available material to be used for the works of the project.

As per DPR² of the project, surveys *vis.*, topographical, meteorological, hydrological, hydrogeological, ecological, seismological and soil were carried out for preparation of DPR. It was observed that data of rainfall for sixteen rain gauge stations lying within the command area of the project and availability of rain water for field application was analysed in meteorological surveys. Water discharge of Ghaghara, Saryu and Rapti river was analysed under hydrological surveys and ground water resources in the command area of the project was determined and analysed through hydrogeology studies. Besides, quality of soil on the construction sites was assessed through soil testing.

Details of topographical surveys and seismological surveys were neither appended with the DPR nor the CEs, SNP and the test checked divisions provided these to Audit, though requisitioned. However, Audit noticed various issues indicating inadequacies in the topographical surveys and designing of Reinforced Cement Concrete (RCC)/Cement Concrete (CC) structures taking into account proper Indian Standard (IS) codes for seismic risk zone as discussed in the succeeding paragraphs.

2.2.1.1 Topographical surveys

Topographical survey of the command area is the most significant aspect of planning for the canal project. Inputs obtained from the topographical surveys are used to determine the Culturable Command Area (CCA) to be covered under the project and Longitudinal Section (L-section) of canals. L-section of canal *inter alia* depicts natural surface level, full supply level and broad details of hydraulic data of outlets, regulators, bridges, drainage crossings, off taking channels, *etc.*

As discussed above, in absence of details of topographical surveys, the adequacy of the survey could not be examined in Audit. However, Audit noticed following shortcomings in L-section and determination of command area:

(i) Deficiencies in Longitudinal section of canals

L-section of RMC was approved by CE, SNP in February 2013. However, RMC was not constructed as per the approved L-section, as it underwent multiple changes during the course of construction. As against 209 masonry structures approved (February 2013) in the L-section of RMC, 230 masonry structures were constructed during execution of the work due to inclusion of 45 new structures and exclusion of 24 approved structures³. These new masonry structures includes 11 structures⁴ added even after the last revision of DPR (December 2017). As a result of delay in finalisation of design even after approval of L-Section, timelines given to the contractors to complete the works could not be adhered to, as discussed in detail in Chapter III.

There was major deviation in L-section of RMC during execution of work due to inadequate topographical survey

² Detailed Project Report revised in 2017.

³ It included nine Head Regulators, two Escapes with Cross Regulators, three Canal Crossings and Aqueduct at Ban Ganga river, *etc.*

⁴ Three inlets, one syphon, three pipe syphons, two head regulators, one drainage crossing and one village road bridge.

In reply, the State Government stated (November 2023) that the L-section of RMC was approved in the year 2013 based on surveys conducted at that time. The State Government also stated that in the past years, urbanisation took place, the number of villages increased and roads were built, due to which, the location and capacity of some proposed canals and other structures were changed. In respect of unavailability of details of topographical surveys, the State Government added that detailed topographical survey in respect of command area of SNP was carried out, records of which were with the respective divisions of the project. The State Government also provided (January 2024) samples of topographic and contour sheets of the project in support of its reply.

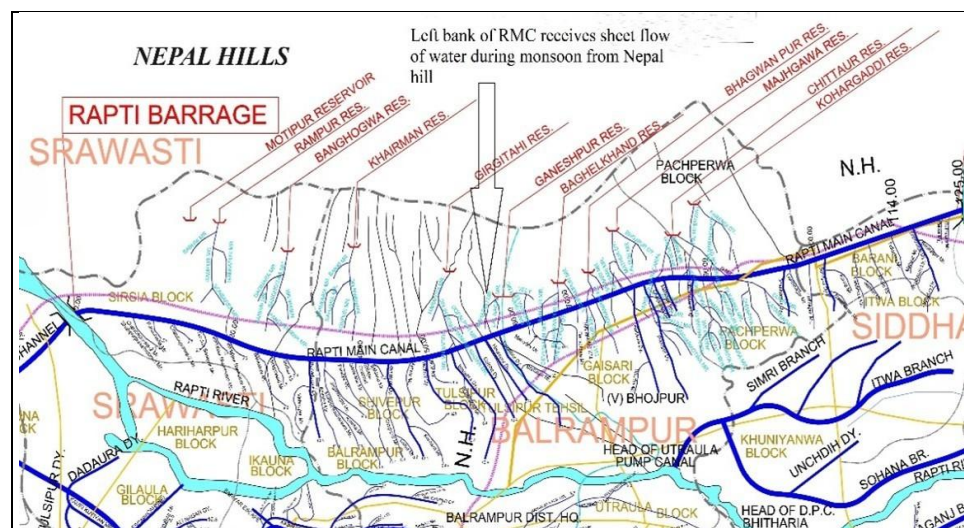
The reply of the State Government was not acceptable, as there were major deviations in L-section of RMC during the course of construction of canal, thereby, indicating that the inputs obtained/used from the topographical surveys were inadequate for determining canal structures (L-Section). Further, CEs as well as test checked divisions did not provide any document in respect of topographical surveys.

(ii) Inadequate technical measures for the safety of canals

Alignment of canal should be determined after assessing the geographical conditions of the area.

Audit observed that RMC was aligned to run across the natural drainage slope of the area and is almost parallel to the toe⁵ of Himalayan range. A sketch of route of RMC is depicted in **Figure 2.1**.

Figure 2.1: Rapti Main Canal



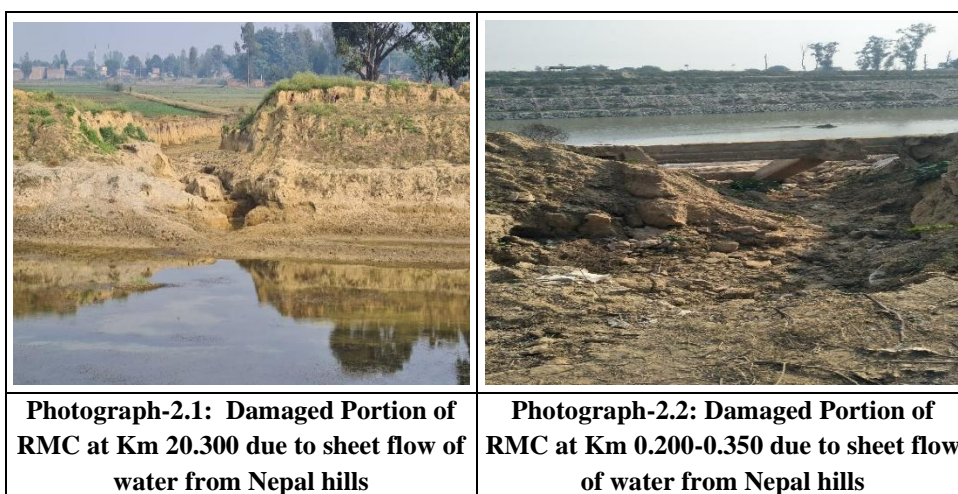
(Source: DPR 2017)

Audit examination of records disclosed that the expert committee of CWC visited the RMC in July 2018 and noticed that RMC got damaged at many places due to flood water as well as by the locals to pass accumulated flood

⁵ The junction of the face of a hill with the ground surface.

water into the canal as the canal has acted as obstruction to the natural flow of the streams coming from the nearby hills in the left side of RMC. Though several drainage crossings were made in the canal, the Cross Drainage (CD) system were not working effectively. The expert suggested measures which *inter alia* included channelisation of CD structures/drains by providing suitable toe drain along the left bank of RMC to protect the RMC from the sheet flow of water.

Audit examination of records disclosed that RMC was damaged in October 2022 from water flow of heavy rain. During joint physical verification (December 2022), Audit noticed severely damaged irrigation assets of RMC as depicted in the following photographs:



The above mentioned situations indicated that the left bank of RMC was not protected adequately from the flow of water, despite recommendations of CWC.

In reply, the State Government stated (November 2023) that all the main canals under the project were mainly conceived and constructed as contour canals. Contour canals are type of canals which are constructed depending on geographical condition and it is not possible to make technical changes in it. In respect of not providing safety to the left bank of RMC, the Government replied that on the basis of the suggestions of the Technical Experts Committee of CWC in July 2018, earth work was carried out to raise the embankment of Saryu Link Channel and Saryu Main Canal. Ditch drains in about 46.450 km length were constructed and the same was in progress at some other important places along RMC for providing proper drainage of water.

The fact remains that though the L-section of RMC was approved in 2013, the issue of receiving sheet flow of water from the nearby hills damaging the left bank of RMC was brought to the notice of the Department by CWC in July 2018. If the geographical conditions had been studied extensively for the construction of RMC by the Department, necessary provisions could have been made in L-section to protect the left embankment of RMC from the water flow coming from the hills.

(iii) Incorrect determination of CCA

Determination of CCA to be commanded by the canal project is a significant aspect of planning for a canal project. After deciding the head discharge of canal, the area to be irrigated by canal system is worked out by preparing land use maps and considering other factors, *vis.* area already under cultivation, soil types, habitations, roads, drainages, and contours of the area. On the basis of size of command area, the quantum of benefits from the project is determined.

A CCA of 12 lakh hectare area in the nine eastern districts of Uttar Pradesh was conceived for the project as per DPR of 1982. The Department revisited the CCA at the time of cost revision of the project in 2017 and CCA was reduced to 11.29 lakh hectare citing urbanisation during the period of 34 years and other factors affecting the quantum of CCA.

Proposed CCA of 11.29 lakh hectare in SNP was inflated as compared to actual CCA of operational canals

Audit examination of records, however, revealed that the quantum of re-determined CCA was inflated as compared to the actual CCA. Audit compared the combined list of 894 canals of the project maintained by CEs indicating proposed CCA of 11.29 lakh hectare *vis-a-vis* CCA actually created as per canal lists available in the test checked divisions. As per records of the three out of five test checked divisions⁶, CCA of 145 operational canals was found to be 1.25 lakh hectare as against proposed CCA of 2.36 lakh hectare for these 145 canals in the combined list maintained by CEs. Thus, the actual CCA created in respect of these 145 canals was only 53 *per cent* of the proposed CCA for these canals. This indicated that the proposed CCA of 11.29 lakh hectare as determined in the DPR was inflated.

In reply, the State Government provided (November 2023) the details of CCA in respect of 145 canals adding to 1.25 lakh hectare but did not furnish comment on the audit observation of showing more CCA under the coverage of project than the actual availability of CCA. The inflated command area of the project was indicative of inadequate topographical surveys.

2.2.1.2 Hydrological surveys

The upstream and downstream water availability at Ghaghara river and Saryu and Rapti barrages was analysed in the revised DPR 2017 of SNP after collecting data for the period from 1975 to 2016. The hydrological studies concluded that 76.20 to 359.42 cumec water during Kharif season (Irrigation potential: 9.24 lakh hectare) and 14.5 to 178.03 cumec water during Rabi season (Irrigation potential; 4.80 lakh hectare) was required for SNP. Month-wise details of requirement and availability of water for SNP as detailed in hydrological study were as given in **Table 2.1**.

⁶ Out of 17 test checked divisions, five divisions were involved in the operation of canals created under Phase I and II.

Table 2.1: Requirement and availability of water for SNP

(in cumec)

Month	Assessed requirement of water	Assessed average availability of water	Assessed 75 per cent average availability of water ⁷	Assessed shortage at average water availability	Assessed shortage at 75 per cent average water availability
January	173.98	102.26	50.48	71.72 (41)	123.50 (71)
February	178.03	74.76	32.40	103.27 (58)	145.63 (82)
March	14.50	83.23	32.45	Nil	Nil
April	0	248.60	169.33	Nil	Nil
May	76.20	327.65	281.96	Nil	Nil
June	359.42	360	360	Nil	Nil
July	162.04	360	360	Nil	Nil
August	208.99	360	360	Nil	Nil
September	334.38	360	360	Nil	Nil
October	273.47	360	360	Nil	Nil
November	149.13	342.08	280.79	Nil	Nil
December	146.25	137.03	77.52	9.22(6)	68.73 (47)

(Source: DPR 2017 of SNP)

In view of shortage of water during Rabi crops in December, January and February, the DPR 2017 of SNP proposed that Department would have to consider less water consuming crops and improved method of irrigation, such as sprinkler and drip alongwith implementation of conjunctive use of surface water and ground water after formation of water user association with participatory approach.

The State Government stated (November 2023) that Rabi crops are mainly dependent upon the winter rain and due to late sowing/cutting of Kharif crops, only one watering is required for the Rabi crops during December and January. The State Government added that adequate water was available for the Rabi crops during 2022-24. However, audit noticed inadequate supply of water in Saryu Main Canal during Rabi season 2022-23⁸ as detailed in **Paragraph 4.5.1.1**. Further, shortfall in achievement under Command Area Development and Water Management Programme (*Har Khet Ko Pani*) and Per Drop More Crop (PDMC) components under Pradhan Mantri Krishi Sinchayee Yojana (PMKSY) for promoting efficient water conveyance and for development of micro-irrigation infrastructure for facilitating use of devices like underground piping system, *etc.*, for sprinklers, drips, *etc.* are discussed under **Paragraphs 4.7** and **4.7.1**.

2.2.1.3 Seismology studies

Guidelines of CWC envisaged for seismic study and for determination of site specific design parameters for creation of structures in the seismic risk zones. Bureau of Indian Standard (BIS) prescribes codes in respect of reinforced concrete structures taking into account the accepted level of seismic risk, building typologies, and materials and methods used in construction. BIS in this respect prescribed codes *vis.* IS Code 1893-2002 (Criteria for earthquake resistant design of structures) and 13920-1993 (Ductile detailing of reinforced concrete structures subjected to seismic

⁷ 75 per cent average availability of water is the dependable flow using runoff series meaning by 75 per cent of time water shall be available.

⁸ State Government had provided data on water release only for the Kharif season in 2023-24.

forces) for designing the Reinforced Cement Concrete (RCC)/Cement Concrete (CC) structures. Therefore, it was imperative for the Department to prepare drawings and designs of the structures considering the risk of earthquake and IS codes.

As per DPR of 2017, out of nine districts covered in the project, seven districts are earthquake affected districts, *vis.*, Shravasti, Balrampur, Siddharthnagar, Maharajganj and a part of Bahraich, Basti and Gonda falls under high damage risk zone IV whereas some part of Bahraich, Gonda and Basti falls under moderate risk zone III. The RMC and its distribution system is lying within the territory of districts Shravasti, Balrampur, Siddharthnagar.

Audit examination of records revealed that in the terms of the six contracts related to the construction of RMC and its distribution system, it was mentioned that all works shall be carried out in accordance with the detailed specifications described in the contracts and in case specifications of any work are not given, the same shall be carried out in accordance with relevant Indian Standard (I.S.)/ Indian Roads Congress (I.R.C.) specifications. Qualifying the above mentioned terms in respect of technical specifications of the structures, it was also specified that the structures shall be built to the lines/grades and dimensions shown on the construction design as per requirements of IS 456:2000 (Plain and reinforced concrete).

Audit further test checked drawings of 270 structures out of 874 structures created in RMC and its distribution system and got confirmed that 98 drawings (36 *per cent*) were prepared by using the provisions of IS code 456:2000 and in the remaining 172 drawings, no mention was made regarding use of IS code or any other parameters for providing protection against earthquake hazards. Thus, IS Codes 1893-2002 and 13920-1993 prescribed for earthquake resistant design of structures and for ductile detailing of reinforced concrete structures subjected to seismic forces were not considered while preparing drawings of any of the 270 CC/RCC structures in RMC and its distribution system.

In reply, the State Government stated (January 2024) that provisions for earthquake force and requirements governing reinforcement and detailing earthquake resistant have been given in the clause 19.1, 19.4, 26.1 and 26.1.2 of IS code 456:2000. The State Government further stated that in the annexure B 2.3 of IS code 456:2000, provision for increase in permissible stress due to earthquake has also been made and have specifically been mentioned in all the drawings of RMC.

The reply of the State Government was not acceptable because the scope of IS code 456 says that this standard deals with the general structural use of plain and reinforced concrete. It further elaborates that special requirements of structures such as hydraulic structures and earthquake resistant structures covered in respective standards have not been covered in IS code 456 and these standards shall be used in conjunction with IS code 456. Therefore, IS codes 1893-2002 and 13920-1993 should have been applied in the designing of structures such as head regulators, cross regulators, canal road bridges,

drainage crossings, canal crossings, syphons, aqueducts, falls and super passages.

2.2.2 Time overrun and consequent cost overrun

As discussed in Paragraph 1.1, the project cost was revised from ₹ 299.20 crore in 1992 (price level 1978) to ₹ 696 crore in 1985 (price level 1985), ₹ 1,256 crore in 1992 (price level 1992), ₹ 2,522.02 crore in 2006 (price level 2004-05), ₹ 7,270.32 crore in 2010 (price level 2008) and ₹ 9,802.68 crore in 2017 (price level 2016). The cost revisions in the project were mainly due to time overrun in completing the project which led to increase in the cost of construction material, labour and land acquisition. Besides, the scope of work was not firmed up in the DPR due to which additional works were added at the time of subsequent revisions of the DPR, which shows inadequate planning for the project.

Delay in acquisition of land, tardy allocation of funds, changes in the scope of works, delayed approval of designs and drawings of the canal structures led to time overrun and consequent cost overrun in the project

Audit examination of DPR of project revised in 2017 disclosed that changes in the quantities of works were mainly in respect of construction of RMC as detailed in **Table 2.2**.

Table 2.2: Variation in the quantities in RMC during 2010-16

Item of work	Unit	DPR 2010		DPR 2017		Increase (+)/ Decrease in Quantity
		Quantity	Cost	Quantity	Cost	
(1)	(2)	(3)	(4)	(5)	(6)	(7) = (5)-(3)
A- Preliminary	Lumpsum	Lumpsum	3.29	Lumpsum	17.04	NA
B- Land (permanent acquisition)	Hectare	1,600.00	62.63	1,421.71	255.69	(-)178.29
C- Work (inlets)	Number	Nil	Nil	30	14.69	(+) 30
D- Regulators	Number	32	9.10	39	16.49	(+) 7
E- Fall	Number	10	6.86	12	18.51	(+) 2
F- Cross drain	Number	42	197.70	70	1,522.27	(+) 28
G- Bridges	Number	57	42.90	103	295.00	(+) 46
H- Escape	Number	06	10.50	03	36.37	(-) 3
K- Buildings	Number	775	20.26	150	18.29	(-) 625
L- Earthwork	Lakh cum	276.46	254.24	173.19	218.13	(-)103.27
M- Plantation	Km	125	1.12	Not mentioned	12.76	NA
O- Miscellaneous	Lumpsum	Lumpsum	1.59	Lumpsum	33.09	NA
P- Maintenance	Lumpsum	Lumpsum	5.48	Lumpsum	8.64	NA
R- Communication	Km	250	8.73	61.05	6.84	(-)188.95
X- Environment & Ecology	Lumpsum	Lumpsum	0.60	Lumpsum	0.99	NA

(Source: DPRs of SNP) (NA – Not applicable)

As detailed in Table 2.2, there were significant increase in masonry structures, *vis.* inlets (30 number), regulators (seven number), fall (two number), cross drainage (28 number) and bridges (46 numbers) in respect of construction of RMC and its distribution system in DPR 2017 as compared to 2010. Besides, there was decrease in provisions for earthwork, buildings and communication. No justification for these variations was found in records.

Audit noticed that the work of Phase III of the SNP, which included construction of Rapti main canal and its distribution system, was stopped midway by the Expenditure Finance Committee (EFC) in February 1999 with the direction to prepare DPR based on actual survey of Rapti canal system. Subsequently, EFC approved (March 2010) the construction work of Rapti canal system in the revised DPR 2010 which found construction of Rapti canal system feasible. However, major changes in DPR 2017 in respect of the work items determined in March 2010 indicates that the respective components of work were not determined on the basis of adequate surveys.

As discussed in Chapter III, the time overrun in the project was mainly due to delay in acquisition/purchase of land, tardy allocation of funds as against the requirement of funds assessed in annual work plans, changes in the scope of works due to not being able to estimate the quantum of works accurately, delayed approval of designs and drawings of the canals and structures by the departmental officers and slow progress of construction works by the contractors. These delays and revision in scope of the work led to cost overrun in the project.

In reply, the State Government stated (November 2023) that the project was originally started in 1982 at a cost of ₹ 299.20 crore and subsequently its cost was revised in the years 2002 (₹ 2,765.16 crore), 2010 (₹ 7,270.32 crore) and 2017 (₹ 9,802.68 crore). The State Government further stated that construction works were completed based on detailed survey according to conditions of the work site. In order to complete the works under the project, the project cost was revised from time to time due to the changes in circle rate of land and Schedule of Rates.

The fact remains that the survey carried out for preparing DPR 2010 in order to determine the scope of work of RMC proved to be inadequate and there were significant changes in the number of structures required to complete the project. This also led to delays in finalisation of designs and drawings of the canals and structures which further delayed the project. Besides, the delays in completion of project also led to increase in acquisition cost of land and price escalations.

To sum up, the project suffered due to inadequate surveys and investigations owing to which even the significant aspects of the project such as determination of command area to be benefited, longitudinal section of the canals to cover the proposed area, scope of project works including quantum of works' items could not be firmed even up to last revision of the DPR in 2017. This led to significant time overrun in the project and consequent cost overrun. The project could be commissioned only after about 40 years from the date of its commencement (1982).

Recommendation 1: *The State Government should investigate the reasons for incorrect assessment of the requirements of the project leading to significant variations in the scope of works during execution and consequential delays in the completion of project.*

Recommendation 2: *There is an urgent need of formulating effective mechanism for stringent monitoring of irrigation projects for timely completion.*

Recommendation 3: *The State Government should carry out comprehensive field surveys to determine the actual area covered with the Saryu Nahar Pariyojana for correct assessment of required development works and for effective irrigation planning.*