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IMPACT OF THE ANDHRA PRADESH STATE BIFURCATION (2014) ON THE IRRIGATION SECTOR – A CASE STUDY ON NANDIGAMA BRANCH CANAL OF NAGARJUNA SAGAR LEFT BANK CANAL (NSLBC) IN RESIDUAL ANDHRA PRADESH

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Abstract: The bifurcation of the erstwhile Andhra Pradesh in 2014 created several structural, administrative, and operational challenges—particularly in the irrigation sector. One of the most severely affected areas has been the Nandigama Branch Canal of Nagarjuna Sagar Left Bank Canal (NSLBC) system, a major irrigation infrastructure serving lakhs of farmers in the region. State bifurcation brought the head works and upper canal reaches into the control of Telangana State (TS), while tail-end command areas are under the control of Andhra Pradesh. As a result, AP has no control over water release from NSLBC head works, creating dependence and uncertainty. TS prioritize its own ayacut, leaving Andhra Pradesh's tail-end farmers with delayed or inadequate water supply. Only around 30% to 40% of the ayacut area in AP under the Nandigama Branch Canal received the required water. There was no formal inter-state water sharing agreement for managing NSLBC operation post bifurcation. Absence of joint monitoring, discharge auditing, or dispute resolution body leads to unilateral control by TS. Farmers in the tail-end areas have been severely affected, leading to reduced agricultural productivity, increased dependence on groundwater, and socio-economic stress. This study aims to analyze the institutional, technical, and inter-state coordination challenges in water distribution, to suggest innovative engineering, administrative, and policy solutions to convert the existing "curse" of bifurcation-induced water stress into a "boon" by improving water access for farmers in AP, to engage the intelligentsia of irrigation engineering, policy makers, and water management professionals in crafting a sustainable, cooperative framework for the equitable operation of the selected canal system. The insights generated from this report will serve as a vital input for future deliberations on inter-state water management, especially in shared canal systems like NSLBC, and could act as a model for resolving similar issues in other parts of India.

Key Words: Bifurcation effect, Irrigation Sector, Crafting of sustainable & Cooperative framework, equitable operation, intelligentsia of irrigation engineering, policy makers, and water management professionals

1. Introduction

The bifurcation of the erstwhile Andhra Pradesh into Telangana and residual Andhra Pradesh in 2014, under the Andhra Pradesh Reorganisation Act, brought with it several structural, administrative, and operational challenges—particularly in the irrigation sector. One of the most severely affected areas has been the Nandigama Branch Canal of Nagarjuna Sagar Left Bank Canal (NSLBC) system, a major irrigation infrastructure serving lakhs of farmers in the region.

The Nandigama Branch Canal of NSLBC system in erstwhile unified Andhra Pradesh state, originally designed to irrigate large tracts of fertile land in the Khamma & Krishna districts, now falls under the jurisdiction of two different states, with the head works and head reaches of canal infrastructure located in Telangana and the tail-end reaches command area (ayacut) predominantly in Andhra Pradesh. This division has created serious water delivery and governance issues, directly impacting the livelihoods of farmers in Andhra Pradesh.

2. Historical Significance of the Nagarjuna Sagar Project (NSP)

The Nagarjuna Sagar Project (NSP) stands as a monumental achievement in post-independence India's drive toward self-sufficiency in agriculture and infrastructure development. Envisioned in the context of nation-building, when dams and irrigation

projects were hailed as the "temples of modern India," NSP exemplified the strategic vision of using large-scale irrigation and hydroelectric power to transform rural economies and support national growth.

Initiated in 1955 and completed by 1967, the project was constructed across the Krishna River, straddling the Nalgonda district (Telangana) and Guntur district (Andhra Pradesh). Named after the Buddhist scholar Acharya Nagarjuna, the project reflects both India's cultural heritage and its engineering aspirations.

As one of the earliest and largest multipurpose river valley projects in India, NSP aimed to:

- Irrigate vast agricultural lands in the Krishna Basin,
- Generate hydroelectric power to meet growing energy demands,
- Control floods in the region,
- And stimulate rural development and economic activity.

NSP transformed the socio-economic landscape of united Andhra Pradesh, contributing significantly to:

- Agricultural productivity through assured irrigation,
- Rural employment and poverty reduction,
- And the growth of supporting infrastructure like roads, canals, and power grids.

By integrating technological innovation with regional development, the Nagarjuna Sagar Project became a symbol of self-reliance and modernization, embodying independent India's aspirations for inclusive and sustainable development.

3.Method of Study:

The present study employed a combination of data collection, fieldwork, and technical analysis to evaluate the irrigation performance and operational challenges of the Nagarjuna Sagar Project (NSP), with specific focus on the Nandigama Branch Canal of Left Bank Canal system in Andhra Pradesh. The methodology involved:

1. Data collection from the Water Resources Department, Government of Andhra Pradesh
2. Analysis of canal network lengths and distribution across both Andhra Pradesh and Telangana
3. Field surveys to capture feedback from farmers (ayacutdars) on irrigation performance
4. On-site inspections to identify water distribution bottlenecks and inter-state operational issues
5. Evaluation of cross-border canal flow disruptions, especially in the post-bifurcation context

4.Irrigation Sluices in Nagarjuna Sagar Project:

According to the Water Resources Department, Government of Andhra Pradesh, the Nagarjuna Sagar Project includes two major canal sluices as shown in Table-1:

Table 1: Details of Irrigation Sluices in Nagarjuna Sagar Project

Description	Jawahar Canal (NSRC)	Lal Bahadur Canal (NSLBC)
Number of Sluices	9	3
Size	3.05m X 4.57m (10 feet X 15 feet)	3.05 m X 7.62 m (10 feet X 25 feet)
Sill Level	+489.00ft (149.00 m)	+489.00 ft (149.00 m)
Top of Gate level	+504.00 ft	+514.00 ft
Discharge @ Head Sluice(all vents open) At + 500.00 ft	12,024 cusecs	2,901 cusecs
At + 510.00 ft	24,606 cusecs	7,899 cusecs
At + 520.00 ft	33,147 cusecs	12,774 cusecs
Design discharge of canal	11,000 cusecs	11,000 cusecs

5.Contemplated Ayacut under Nagarjuna Sagar Project:

The NSP was designed to irrigate a total of **8.73 lakh hectares** (21.57 lakh acres) through two major canals:

- Nagarjuna Sagar Jawahar Canal (NSJC) – Right Bank Canal
- Nagarjuna Sagar Lal Bahadur Canal (NSLBC) – Left Bank Canal

These canals collectively serve around six lakh farmers across both Andhra Pradesh and Telangana. The ayacut distribution is shown in Table-2

Table 2: Localized Ayacut under Nagarjuna Sagar Project (in Lakh Acres)

Nagarjuna Sagar Right Bank Canal or NS Jawahar Canal (NSJC)				
S.No	**Name of the District**	**Wet**	**ID**	**Total**
1	Guntur in AP	2.47	4.22	6.69
2	Prakasam in AP	1.90	2.59	4.49
	Total	**4.37**	**6.81**	**11.18**
Nagarjuna Sagar Left Bank Canal (NSLBC) or NS Lal Bahadur Canal.				
S.No	**Name of the District**	**Wet**	**ID**	**Total**
1	Nalgonda in TS	3.24	0.57	3.81
2	Khammam in TS	1.13	1.63	2.76
3	Krishna in AP	0.59	3.16	3.75
4	West Godavari in AP	0.00	0.07	0.07
	Total	4.96	5.43	10.39
	Grand Total	**9.33**	**12.24**	**21.57**

6. Zonal Distribution of Ayacut under NSLBC

1. Entire NSLBC ayacut is divided into three zones:
    - Zone-1 (in Telanga State only): Only wet crops (paddy) cultivated in both Kharif and Rabi.
    - Zone-2 (in both AP &TS)): Both wet and ID crops cultivated in both Kharif and Rabi.
    - Zone-3 (in AP only): Only ID crops, cultivated in Rabi only.

7. Water Release and Crop Calendar Issues

1. Water is released into NSLBC in the 1st week of August every year.
2. In Zone-1 (Telangana State only), paddy transplantation takes place in August, and no water is required in November.
3. In Zone-2 (Andhra Pradesh &Telangana State), continuous water supply is needed from August to April (for wet and ID crops).
4. In Zone-3 (Andhra Pradesh only), water is required from December to April (for ID crops only).
5. Before bifurcation of Andhra Pradesh in 2014, water release schedules considered the full ayacut including Zone-2 and Zone-3 in AP and accordingly water was released into NSLBC.
6. Even before bifurcation, tail-end areas in AP struggled to receive water due to deteriorated canal conditions, not due to insufficient discharge released at the head regulator.

8. Gap Ayacut in Nagarjuna Sagar Project:

Over the course of 50+ years, the NSP canal systems deteriorated structurally, resulting in a significant loss in discharge capacity. According to a study conducted during 1996–97, it was found that 25–30% of the total designed ayacut was not receiving irrigation water due to poor maintenance, creating a "gap ayacut". This unserved area severely impacted agricultural output, farmer incomes, and rural stability.

9. Rehabilitation & Modernization under APWSIP

To address the growing issue of the gap ayacut, the Government of the then united Andhra Pradesh launched the Andhra Pradesh Water Sector Improvement Project (APWSIP) with assistance from the World Bank. Completed by 2018, the project included:

- Re-sectioning of canals to restore design capacity
- Concrete lining of vulnerable reaches to reduce seepage
- Repair of CM & CD (cross masonry & cross drainage) works
- Mechanical repairs to all canal off-take sluice gates etc.,

These measures significantly improved the operational efficiency of the NSP canal systems. However, the bifurcation of Andhra Pradesh in 2014 once again disrupted water-sharing and management coordination. This especially impacted farmers under NSLBC in Andhra Pradesh, reigniting their concerns about assured water supply, particularly in tail-end regions.

10. Influence on irrigated area under Nandigama Branch Canal of NSLBC in residual AP during 2014–2024:

- Bifurcation of Andhra Pradesh in 2014 led the head works and upper canal reaches falling in Telangana, while tail-end command areas lie in Andhra Pradesh.
- Andhra Pradesh has no control over water release from NSLBC head works, creating dependence and uncertainty.
- Telangana prioritizes its own ayacut, leaving Andhra Pradesh's tail-end farmers with delayed or inadequate water supply.
- Water supply to the Nandigama Branch Canal of NSLBC ayacut in AP has been inadequate and inconsistent.
- Only around 30% to 40% of the ayacut area in AP under the Nandigama Branch Canal received the required water and that too with substantial administrative and technical effort put forth by the Water Resources Department of AP.
- No formal inter-state water sharing agreement for managing NSLBC operation post bifurcation.
- Absence of joint monitoring, discharge auditing, or dispute resolution body leads to unilateral control by Telangana.
- Farmers in the tail-end areas have been severely affected, leading to reduced agricultural productivity, increased dependence on groundwater, and socio-economic stress.

11. Objective of the Study: This study aims to:

1. Examine the operational issues affecting Nandigama Branch Canal of NSLBC in the post-bifurcation scenario.
2. Analyze the institutional, technical, and inter-state coordination challenges in water distribution.
3. Suggest innovative engineering, administrative, and policy solutions to convert the existing "curse" of bifurcation-induced water stress into a "boon" by improving water access for farmers in AP.
4. Engage the intelligentsia of irrigation engineering, policy makers, and water management professionals in crafting a sustainable, cooperative framework for the equitable operation of the NSLBC system.

The insights generated from this report will serve as a vital input for future deliberations on inter-state water management, especially in shared canal systems like NSLBC, and could act as a model for resolving similar issues in other parts of India.

12. Canal Network and Operational Challenges: The Nagarjuna Sagar Jawahar Canal (NSJC) originating from right bank of NSP entirely located in residual Andhra Pradesh only and total O&M is under the control of the Water Resources Department of AP. Hence, there were no bifurcation-related issues.

Total length of the Nagarjuna Sagar Left Bank Canal is 180 km and it serves exclusive Telangana ayacut up to km 154.593. Beyond this point, a complex web of canals crisscrosses state boundaries multiple times as shown in Table-3, resulting in serious operational inefficiencies and dependency conflicts as the AP authorities lack power over water release.

Table 3: Cross-Border Canals under NSLBC

S.No	Name of the Canal	Reach in TS	Reach in AP
1	16+17th Branch Canal (Off Takes from NSLBC at km 154.593)	Km 0.000 – km 12.400TE and at the tail end it feeds CM tank in TS.	----
1.1	Nandigama Branch Canal (Off Takes from CM Tank)	Km 0.000 –km 6.810	Km 6.810 – km 32.500 TE
2	Mangapuram Major (Off Takes from NSLBC at km 164.752)	Km 0.000 – km 31.518	Km 31.518 – km 37.057 TE
3	21st Main Branch Canal (Off Takes from TE of NSLBC at km 180.000)	Km 0. 000- km 101.360	Km101.360–km 117.007 TE
3.1	Bonakal Branch Canal-BBC-		

	(Off Takes from 21st MBC at km 14.030)	Km 0.000 – km 27.923	----
3.1.1	Polampally Major (Off takes @ Km		
3.1.1	Damuluru Major (Off takes from TE of BBC @ km 27.923	Km 27.923 - Km 33.771& Km 49.816 - Km 50.407	Km 33.771 - Km 49.816 Km 50.407 – Km 54.495 TE
3.2	Madhira Branch Canal off takes at Km 71.850 of 21st MBC	Km 0.000 – km 22.750	Km 22.750 –km 31.454
3.3	Tiruvuru Major (off takes @ Km 83.515 of 21st MBC)	Km 0.000 – km 6.500	Km 6.500 – km 17.250 TE
3.4	Kakarla Major (off takes @ Km 94.699 of 21st MBC)	Km 0.000 – km 8.450	Km 8.450 – km 19.210 TE
3.5	Nuzvedu Branch canal Off takes @ Km 117.007 TE of 21st MBC	Km 0.000 – Km 31.860	Km 31.860 – Km 52.400 TE
3.6	Mylavaram Branch Canal Off takes @ Km 117.007 TE of 21st MBC	Km 0.000 – km 27.300	Km 27.300 – Km 37.342

13. **Canal-Wise Operational Challenges under NSLBC System:** As per the information available from the Water Resources Department of Andhra Pradesh, the 16+17 Branch Canal off-takes from the NSLBC @ Km 154.593 and irrigates ayacuts located in both Andhra Pradesh and Telangana. This geographical and administrative overlap has led to several operational challenges, particularly concerning the equitable distribution of water, maintenance responsibilities, and timely release and regulation of irrigation supplies.

    To assess the situation on the ground, a walkthrough survey was conducted along the 16+17 Branch Canal (12.400 km), tank bund of CM tank, Nandigama Branch Canal (32.500 km) and its Major Distributaries expanded in 135.68 km.This survey focused on gathering inputs from the ayacutdars (beneficiary farmers) of Andhra Pradesh, especially those dependent on irrigation through the NSLBC network.

14. **Key Canals Selected for Operational Analysis:**

    14.1. 16+17th Branch Canal (Off Takes from NSLBC at km 154.593)

    It is a typical branch canal off-taking from the Nagarjuna Sagar Left Bank Canal (NSLBC) at Km 154.593. This canal has a designed discharge capacity of 965 Cusecs and a total length of 12.400 km.

14.1.1 Water Utilization and Flow Regulation in 16+ 17 branch canal:

i. In 16+17 branch canal, along its course, the water flow is interrupted and regulated by three mini hydroelectric power plants, located at Km 6.000, Km 9.000 and Km 12.000. These power plants modulate water releases based on electricity generation needs, often disregarding irrigation demand schedules, especially for areas downstream in Andhra Pradesh.

ii. This canal primarily caters to an ayacut of 6,070 acres (wet) in Khammam district in TS. For this purpose, it utilizes nearly 100 Cusecs irrespective of the discharge released into it from the NSLBC**.**

iii. After meeting the ayacut requirement, it feeds the Cheruvu Madhavaram Tank in Telangana State from its Tail End @ Km 12.400.

14.1.2 Operational Challenges Identified in 16 + 17 branch canal:

Based on feedback received during the walkthrough survey from ayacutdars at downstream of this canal in Andhra Pradesh, the following issues were observed:

1. Disproportionate and Inconsistent Water Releases
    - Design discharge of 965 Cusecs has never been achieved.
    - Maximum discharge recorded during Kharif season: 700–750 Cusecs
    - Minimum discharge during Rabi season: 150–450 Cusecs
    - These discharges are well below the designed capacity, and are regulated at the discretion of Telangana State authorities, depending on the water availability in NSLBC and their own internal requirements.
    - Consequently, the actual volume received by Cheruvu Madhavaram Tank ranges only between 300 and 650 Cusecs.

2. Inadequate and Unpredictable Water Releases
    - Water releases are often based on power generation needs (due to mini hydel plants at Km 6, 9, and 12) instead of irrigation requirements, causing erratic supply downstream.
3. Lack of Coordination and Transparency
    - As both the release and monitoring authorities for NSLBC and the 16+17th Branch Canal are under Telangana jurisdiction, there is limited consideration of the water needs of Andhra Pradesh ayacut located further downstream.
    - Water is released in an on/off system, without predictability or adherence to crop calendars, leading to acute shortages during peak demand.
4. Additional Limiting Factors:
    - Water level in NSLBC significantly affects the ability to release water into 16+ 17 branch canal.
5. Impact on Downstream Ayacut (Andhra Pradesh)
    - Inconsistent and inadequately timed releases result in:
        - Crop stress/failure
        - Inefficient water utilization
        - Dissatisfaction and grievances among farmers

14.1.3. Cheruvu Madhavaram Tank:

Cheruvu Madhavaram Tank is located in Telangana state at the Tail End of 16 + 17 branch canal and its Full Tank Level is (FTL) 7.5 feet. It acts as balancing reservoir receiving water from the 16+17th Branch Canal, and feeding the Nandigama Branch Canal

Observed Operational Issues in Cheruvu Madhavaram Tank:

Despite its strategic location and importance, the TS authorities of Cheruvu Madhavaram Tank often fail to maintain the required Full Tank Level. This directly affects the release of water into the Nandigama Branch Canal, thereby jeopardizing irrigation supply to large ayacut areas downstream, especially in Andhra Pradesh.

Primary Reasons for Failure to Maintain FTL in Cheruvu Madhavaram Tank:

1. Inadequate Inflows from 16+17th Branch Canal
    - Due to irregular and reduced discharges from NSLBC and upstream regulation by hydro power plants, the inflow to CM Tank is insufficient and erratic.
2. Diversion for Cheruvu Madhavaram Lift Irrigation Scheme
    - Significant volumes of water are drawn from the tank to supplement the ayacut under the 19th Mangapuram Major Canal, further reducing the water available for Nandigama Branch Canal.
3. Uncontrolled Pumping by Ayacutdars
    - Over 200 unauthorized pump sets have been reportedly installed along the peripheral bunds of the tank.
    - These drawls are unregulated and significantly contribute to the depletion of storage levels, even when inflows are received.
4. Uncontrolled leakage from dilapidated Off-Takes (OTs)
    - Regulating shutters of the two off-takes constructed for CM Tank ayacut need repairs, resulting in continuous leakage of water.

14.2. Nandigama Branch Canal: Its design discharge is 906 Cusecs. To get this discharge into canal, it is required to maintain water level in CM Tank at FTL (7.5 feet or above). But it has never been maintained due to the above factors and as a result

- Required discharge of 906 Cusecs has never been achieved or sustained into the Nandigama Branch Canal.

- This has critically impacted the irrigation potential of a large ayacut located in Andhra Pradesh.

Total contemplated Ayacut under Nandigama Branch Canal is 90,415 Acres as shown in table-4 and Majority of Ayacut (97%) lies in Andhra Pradesh, which is severely affected by the inadequate and irregular water releases.

Table-4: Ayacut Distribution under Nandigama Branch Canal

S.No	Canal reach	District	State	Ayacut in acres
1	From Km 0.000 – Km 6.810	Khammam	TS	2,510
2	From Km 6.810 – Km 32.500	Krishna	AP	87,905
	Total ayacut under Nandigama Branch Canal			**90,415**

The hydraulic particulars of Nandigama Branch Canal are shown in Table-5.

Table-5: Hydraulic Particulars of Nandigama Branch Canal

SI No	Reaches in Km		Bed Width (Mtrs)	FSD (Mtrs)	Bed Fall	Top Width of Banks (Mtrs)	Discharge in Cusecs	Free Board	Velocity m/s
	From	To							
1	0.000	6.810	14.320	2.040	1 in 5500	6.00/4.00	906.00	0.90	0.833
2	6.810	13.370	14.630	2.070	1 in 5600	6.00/4.00	964.00	0.90	0.843
3	13.370	21.100	13.410	1.980	1 in 5500	6.00/4.00	882.00	0.90	0.818
4	21.100	21.710	12.800	1.920	1 in 5400	6.00/4.00	807.00	0.90	0.809
5	21.710	23.380	11.890	1.860	1 in 5300	6.00/4.00	717.00	0.90	0.795
6	23.380	32.500	10.970	1.800	1 in 5200	6.00/4.00	588.00	0.90	0.777

The first reach of the canal (Km 0.000 to Km 6.810) lies in Khammam district (Telangana State) and irrigates 2,510 acres. This reach is adjacent to the Cheruvu Madhavaram Tank, resulting in continuous seepage into the canal bed.

14.2.1. Issues Identified in the 1st reach (Km 0.000 to Km 6.810) of Nandigama Branch Canal:

1. Persistent Seepage and Slushy Bed Conditions

- Due to continuous seepage from the nearby tank, the canal bed remains slushy, even during peak summer.
- These wet conditions promote the uncontrolled growth of aquatic vegetation, particularly tape grass, making maintenance and flow regulation difficult.

2. Aquatic Plant Infestation

- Growth of tape grass is a recurring and persistent problem, especially in the first reach.
- More broadly, aquatic weeds and algae thrive in the Nandigama Branch Canal due to damp conditions and it reduces the canal's natural self-cleansing capacity.

To mitigate seepage and control weed growth, modernization works were undertaken under the Andhra Pradesh Water Sector Improvement Project (APWSIP). Cement Concrete (CC) Lining of M15 grade, 75 mm thickness was proposed to execute along the first reach from Km 0.000 to Km 6.810.

Execution Status:

- Executed CC lining: From Km 1.400 to Km 6.810
- Unexecuted stretch: Km 0.000 to Km 1.400

- Reason: Unsuitable canal bed conditions in the initial stretch (Km 0.000 to Km 1.400) to execute CC lining work and lack of suitable components for execution in the slushy segment (as this reach requires special soil stabilization works before CC lining can be executed).
- However, necessary grant was not sanctioned by Telangana State, resulting in the work remaining incomplete.

Impact of Incomplete Lining:

- The unlined portion continues to suffer from seepage and weed growth, leading to:
  - Obstruction to flow
  - Reduced conveyance efficiency & considerable water losses.
- This has seriously affected water supply to the downstream ayacut in Andhra Pradesh, particularly during peak crop demand.
- Thousands of acres in AP have faced crop failure due to irregular and insufficient irrigation resulting from this issue.

14.2.2. Analysis of Discharge Deficiency in Nandigama Branch Canal

To understand the persistent failure in maintaining the required discharge in the Nandigama Branch Canal**,** it is essential to analyze the functioning and interconnectivity of the 16+17th Branch Canal and the Cheruvu Madhavaram Tank**,** which are critical upstream components in the water supply chain.

Designed to act as a balancing reservoir, the CM Tank frequently fails to maintain Full Tank Level (FTL) and reducing availability of water for Nandigama Branch Canal.

If the design discharge of 16 + 17 Branch canal (965 cusecs) is released at Km 154.593 of NSLBC, 865 Cusecs are expected to reach Cheruvu Madhavaram Tank **a**fter meeting local ayacut demand of 100 Cusecs.

Discharge Losses between CM Tank and AP Border

- From CM Tank (Km 0.000 of Nandigama Branch Canal) to TS-AP border (Km 6.810), discharge reduces by 100–150 cusecs due to:
  - Aquatic vegetation (e.g., tape grass) causing stagnation
  - Overuse by Telangana ayacutdars (drawing 50–100 cusecs extra)
  - Illusory readings caused by ponding effect near head of canal

After km 6.810, Nandigama Branch Canal has to serve an ayacut of 87,905 acres as shown in Table-6.

Table-6: Distributary wise ayacut particulars under Nandigama Branch Canal.

S.No	OT @ Km	Name of the Distributary	Total length in KM	Disharge in cusecs	Contemplated ayacut in acres		
					ID	Wet	Total
1	6.840	Gandrai Major	1.763	7.14	1011.88	0	1011.88
2	6.840	D.P. 4L	--	0.82	115.38	0	115.38
3	8.980	Indugapally Major-I	4.813	15.480	1346.15	309.28	1655.43
4	9.856	Indugapally Major-II	2.312	8.960	359.71	416.40	776.11
5	11.131	Ravikampadu - I Major	4.215	16.36	427.78	948.09	1375.87
6	11.265	Pedamodugapally Major	0.635	3.12	439.42	21.78	461.2
7	13.670	Penuganchiprolu Major	12.18	68.85	4414	2331	6745
8	15.386	Ravikampadu - II Major	3.443	30.98	1472.6	1041.53	2514.13
9	16.426	Jaggaiahpet Major	4.257	11.66	1286.83	158.03	1444.86
10	18.200	Bhimavaram Major I	0.68	3.59	170.09	247.30	417.39

11	18.249	Bhimavaram Major II	2.75	6.29	753.43	71.25	824.68
12	20.053	Chillakallu Major	7.071	9.7	653.09	160.66	813.75
13	21.700	Sanagapadu Major-I	16.733	83.59	6476.79	2288.53	8765.32
14	22.850	Sanagapadu Major-II	13.963	66.96	4182.6	2805.4	6988
		Up to NH Crossing	**74.815**	**333.50**	**23110**	**10799**	**33909**
15	24.495	Nawabpet Major-I	5.273	18.35	1012.08	706.02	1718.1
16	25.300	Pochampally Major-I	1.25	5.45	247.96	253.65	501.61
17	26.600	Pochampally Major-II	0.402	1.25	36.91	65.69	102.6
18	27.288	Bandipalem Major	2.614	3.5	567.79	0	567.79
19	31.200	Nawabpet Major-II	5.296	12.5	1166.5	197.08	1363.58
20	32.680	Eturu Major	23.737	432	26120.7	12481	38601.7
21	32.680	Kanchala Major	22.293	110	7245.3	3896	11141.3
		Up to TE	**135.68**	**906**	**59,507**	**28,398**	**87,905**

14.2.3. Field Observations and Key Findings on Nandigama Branch Canal of NSLBC:

The Nandigama Branch Canal runs in 32.500 km with a designed discharge of 906 cusecs, to irrigate 87,905 acres distributed along 21 major distributaries in a total length of 135.68 km (excluding minor and sub-minor channels) in Andhra Pradesh as shown in the Table-6.

Based on field inspections, discussions with ayacut farmers and discharge data obtained from the Water Resources Department of Andhra Pradesh, following key observations were made:

Record of Discharges in Nandigama Branch Canal:

1. Water released into the Nandigama Branch Canal in August typically records:
    - 650–700 cusecs on rainy days (August–October)
    - 450–500 cusecs on non-rainy days in khariff season
2. In rainy season TS authorities release water to Nandigama Branch Canal to safeguard CM Tank (fed by monsoon runoff), not for AP ayacut utilization.
3. During this period (Aug–Oct), almost no irrigation requirement exists for AP farmers in the branch canal zone, and whatever excess water released than the indented water is disposed of through canal escapes to protect canal banks.
4. Hence AP authorities submit that such non-indented flood releases should not be counted as part of the assured water supply.

Operational and Inter-State Coordination Challenges:

1. In its total length of 180 Kms, NSLBC serves Telangana ayacut only (Zone-1) up to Km 154.593.Paddy transplantation in this zone occurs in August, and water is not needed in November.
2. TS authorities unilaterally stop water supply to NSLBC after Zone-1 requirements are met, without informing AP, which contrasts with practices in united Andhra Pradesh.
3. In Zone-2 (AP), water is critically required in November to support ID crop establishment.
4. Despite multiple indents by AP authorities and pleas from farmers, TS releases water reluctantly and with delay.
5. If water is released exclusively for ayacut in Andhra Pradesh as per the indent of AP authorities, the discharge at head regulator must include water losses due to evaporation, unauthorized withdrawals, leakages from escapes and off-take sluices so as to deliver the indented discharge at border point to ensure tail-end supply in AP, but they are not adequately considered.

6. TS releases only 60–70% of the allocated quantity to Nandigama Branch Canal by showing 30 – 40% as water losses, causing severe shortfalls at the border point and non-delivery to tail-end farmers.
7. From December onwards, TS follows a Warabandi system (9 days ON, 6 days OFF), without notification to AP:
    - This intermittent supply fails to move water adequately to the tail-end zones in AP.
    - Water cannot reach the ayacut during the 9-day window due to travel time and systemic losses.
8. In united AP, inter-zonal coordination and discharge management were effective, as all zones were under a single administration.
9. Post-2014 bifurcation, the division of administrative control and differing priorities have led to lack of coordination, under-release of water and failure to meet crop water needs in Zones 2 & 3
10. To find the overall effect on the contemplated ayacut of Nandigama Branch Canal in 8 mandals and 200 villages in AP, detailed field survey is conducted and found distributary wise, OT wise, village wise and Mandal wise irrigated ayacut & non irrigated ayacut under Nandigama Branch Canal. .

15. Conclusion:

Based on the data and field observations presented, it is evident that during the critical period in any year (November to April), the Nandigama Branch Canal is effectively irrigating only 36,000 to 40,000 acres out of its contemplated ayacut of 87,905 acres. This leaves approximately 50,000 acres—nearly 57% of the intended command area—deprived of assured irrigation during the most critical agricultural season.

This persistent failure not only compromises agricultural productivity, but also severely affects the livelihoods of thousands of farmers. The situation underscores serious lapses in:

- Inter-state water coordination post-bifurcation,
- Canal system maintenance and modernization, and
- Operational management and responsiveness by both engineering and administrative authorities.

Such a scenario reflects a systemic breakdown in irrigation governance. In a country that regards irrigation projects as the "temples of modern India", allowing over 50,000 farmers to suffer due to preventable water management issues is a matter of grave concern. This not only brings disrepute to irrigation engineering as a discipline but also calls into question the accountability of institutional mechanisms meant to protect the interests of farming communities.

The failure of Nandigama Branch Canal of NSLBC to serve the tail-end ayacut in Andhra Pradesh is a result of institutional paralysis, infrastructure degradation, and governance gaps intensified by inter-state bifurcation. Despite design provisions for equitable distribution, absence of enforceable protocols and real-time coordination has rendered the system ineffective for AP farmers.

There is an urgent need for policy intervention, technical rectification, and transparent inter-state coordination to ensure equitable water distribution and fulfill the original vision of the Nagarjuna Sagar Project.

16. Recommendations:

1. Constitute a Joint NSLBC Water Management Authority with representation from both AP and TS.
2. Implement real-time discharge monitoring and telemetry from head to tail.
3. Complete pending modernization works, especially slushy reach lining and gate automation.
4. Strict regulation of unauthorized pumping and hydel power water modulation.
5. Formalize inter-state water release schedules based on crop calendars and reservoir availability.

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References

This is an original and innovative study based entirely on:

- Factual data obtained from the Water Resources Department, Government of Andhra Pradesh, and
- Primary field data collected through direct interaction with farmers across various mandals in NTR district.

To the best of our knowledge, no prior studies of this nature—combining field-level observations with official irrigation system data specific to the Nagarjuna Sagar Left Bank Canal and Nandigama Branch Canal in the post-bifurcation context—have been conducted or published. As such, no secondary references were used in this study.

Biography of the First Author

The first author completed his B.Tech in Civil Engineering with First Class and Distinction from JNTU College of Engineering, Kakinada in 1993. He secured an All India Rank of 352 in GATE-1994, placing in the 95.12 percentile. He went on to earn his M.Tech in Civil Engineering with a specialization in Environmental Engineering from Sri Venkateswara University College of Engineering, Tirupati, graduating with First Class and Distinction in 1996.

He was awarded the Senior Research Fellowship (SRF) by the Council of Scientific and Industrial Research (CSIR) for the period 1998–2001 to pursue research in the area of Industrial Noise Pollution Control.

From 2002 to 2005, he served as Lecturer and Assistant Professor in reputed institutions such as SASTRA University, Thanjavur (Tamil Nadu) and GMRIT, Rajam (Andhra Pradesh).

In 2005, he joined the Irrigation & Command Area Development (I&CAD) Department, Government of Andhra Pradesh, as an Assistant Executive Engineer. Over the years, he has executed several critical and technically challenging irrigation infrastructure works including:

- Tunnels and tunnel lining
- Aqueducts and super passages
- Drops, DLRBs, and SLRBs
- Cut & cover works in deep cut canal portions
- Box culverts and cross drainage structures

For his exemplary work, he was awarded a Certificate of Appreciation by the District Collector of East Godavari in 2011.

After his promotion to Deputy Executive Engineer in 2012, he successfully implemented Cement Concrete lining works in black cotton soils using CNS (Cohesive Non-Swelling Soil) treatment techniques, earning a Certificate of Appreciation from the Superintending Engineer, Pulichintala Project Circle in 2018.

In March 2023, he was deputed to the Vigilance & Enforcement Department, Government of Andhra Pradesh, where his services earned high recognition. He received:

- A Certificate of Appreciation from the then Hon’ble Minister Sri P. Viswaroop in August 2023
- Another from the District Collector of West Godavari in January 2025
- And a third from the Hon’ble Director General of Police, Andhra Pradesh, in February 2025, in acknowledgment of his dedicated and efficient service.