सत्यमेव जयते

Report of the Comptroller and Auditor General of India

लोकहितार्थ सत्यनिष्ठा
Dedicated to Truth in Public Interest

Performance Audit on Achievement of objectives of Sindh Project Phase-II

Government of Madhya Pradesh

Report No. 2 of the year 2022

Images in front page (From top, Left to right):
Atal Sagar Dam, Right Bank Canal,
Minor Canal, View of crop in command area of Sindh Project Phase-II, Unlined canal,
Samoha Pickup Weir, Lined field channel, Head regulator of main canal.
Distributary of Right Bank Canal, Crop in command area

Report of the
Comptroller and Auditor General of India
on
Performance Audit on
Achievement of objectives of Sindh Project Phase-II

for the year ended 31 March 2019

Government of Madhya Pradesh

Report No. 2 of the year 2022

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PREFACE

This Report of the Comptroller and Auditor General of India for the year ending 31st March 2019 has been prepared for submission to the Governor of Madhya Pradesh under Article 151 of the Constitution of India, for being laid before the Legislature of the State.

The Report contains significant results of Performance Audit of 'Achievement of objectives of Sindh Project Phase-II', covering the period 2014-15 to 2018-19.

The instances mentioned in this Report are among those which came to notice in the course of test audit.

The audit has been conducted in conformity with the Auditing Standards issued by the Comptroller and Auditor General of India.

Executive Summary

In order to provide irrigation to the areas of the drought-prone districts of Gwalior, Shivpuri, Bhind and Datia, the Sindh Project Phase-II was conceived as an extension to the then existing Sindh Project Phase-I. This Project was to create irrigation potential of 98,251 hectares and provide annual irrigation to 1.62 lakh hectares, across both *Rabi* and *Kharif* seasons.

The Project consisted of construction of Atal Sagar Dam on the Sindh River and creation of four canal systems, off-taking from various sources, including the Atal Sagar and pre-existing Harsi Dam. While providing irrigation was the primary objective of this Project, generation of power, increasing production of fish and domestic water supply to a part of Shivpuri town were also secondary aims of the Project.

The Performance Audit was conducted for period 2014-19 to seek an answer that the project achieved its outcomes. We found several deficiencies in achievement of the primary objective of the Project. While the irrigation potential was created, its utilisation could not exceed 64 *per cent*. One of the reasons is that the cropping pattern in command area did not adhere to the envisaged pattern.

Three of the four canal systems were completed by 2013-14 and in their command area Paddy, Wheat and Sugarcane are now cropped in more and more areas, instead of the earlier water-resistant crops, like Jowar, Maize, Soyabean, Gram and Barseam. The project was delayed for five years after all the canal systems upstream were put on operation. This caused a water deficiency, particularly in the Harsi High Level Canal completed later in June 2018 in the lower reaches and the largest canal system, which was to irrigate 64 *per cent* of the total command area under the project.

Harsi High Level Canal system suffered water shortage *ab-initio*, at the planning stage which was further exacerbated by the skewed water distribution caused by the delay in its construction. Water was diverted from the core reserve of this canal to provide drinking water to a part of Gwalior city, something which was not envisaged at the planning stage. Delays in execution and completion of certain individual works in this canal system further delayed and compromised the efficacy of this canal.

We also saw that adequate inspection and monitoring was not being done by the designated officers across the entire Project, which could potentially impact the performance and life of these canal systems as time passes.

With regard to secondary outcomes envisaged from this Project, the power generation was more than optimal in four out of the five years checked by us. Fish production also increased for three years, following which a significant dip was noticed in the overall volume. The providing of drinking water to Shivpuri town was also largely delayed and has not been achieved till date.

On the positive side, even though not initially planned, various efforts have been made to promote tourism at Atal Sagar Dam constructed under this Project.

Overall, the disproportionate concentration of available water in certain pockets, which are moving towards growing water-intensive cash crops and leaving other areas short of water, and shortfall of utilisation of irrigation potential created are the issues which appear to us to be of concern. These have significantly slowed the achievement of the outcomes of this Project and may continue to be a hindrance in equitable distribution of water to all in future years too.

Chapter 1

Introduction and Audit Approach

Chapter 1

Introduction and Audit Approach

1. Introduction

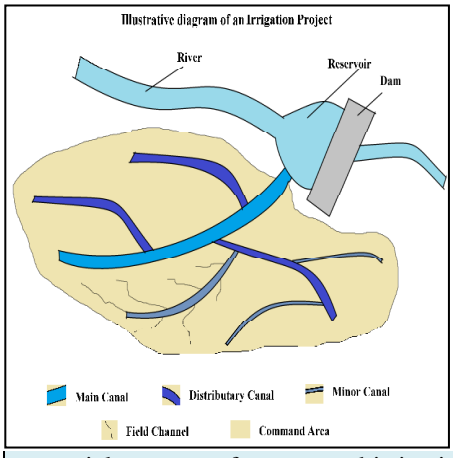
The State of Madhya Pradesh has a geographical area of 308 lakh hectares, out of which 153.3 lakh hectares is the cropped area. Sixty seven *per cent*[1] of the cropped area is devoted to food-grains and pulses and 30 *per cent* to oilseeds. The remaining three *per cent* area is used to grow sugarcane and cotton. Two main crops *i.e.* soyabean and wheat account for 25 *per cent* and 28 *per cent* of Gross Cropped Area[2] respectively.

Agriculture is the economic mainstay of the State with 70 *per cent* of working population engaged in it. Where agriculture is the economic backbone of the population, water is a critical input for agricultural production and plays an important role in food security. Since irrigated agriculture is, on an average, at least twice as productive per unit of land as rainfed agriculture, it allows for more production intensification and crop diversification.

Accordingly, the State has continued to increase its irrigation footprint over time – from 20.1 lakh hectares in 2000 to 28.01 lakh hectares in 2010, and currently, *i.e.* up to *Rabi* season of 2020-21, it is 38.10 lakh hectares. The proportion of irrigated land to the total agricultural land has also increased from 24 *per cent* in 2000 to 33.5 *per cent* in 2010 and was 49 *per cent* in March 2019. The project under review covered in this report *i.e.* Sindh Project Phase-II accounts for 2.6 *per cent* of total irrigation footprint of the State.

Box 1.1: What comprises a major irrigation project?

Irrigation project creates a storage facility (reservoir) by construction of dam on a river for impounding the water during monsoon season. Water is conveyed through a series of canals *i.e.* main canal, distributary canals and minor canals. Field channels carry water beyond minor canals to the fields under the command area.



The Irrigation Potential of an irrigation project is the area in which irrigation can be done through the waters of the project during two cropping seasons.

The two cropping seasons are (i) *Kharif* (July to October/ November), main crop sown in North Madhya Pradesh being Paddy[3], and (ii) *Rabi* (October/ November to March), main crop sown in North Madhya Pradesh being Wheat[4].

Irrigation Potential is said to be created on completion of the construction of irrigation project till minor canals. However, utilisation of irrigation potential may vary from created irrigation potential due to various reasons like, delayed/ non-construction of field channels; change in cropping pattern vis-á-vis cropping pattern envisaged at planning stage; non-availability of water; as well as seepage and evaporation losses in conveyance of the water.

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1 Data sourced from Agricultural Statistics at a Glance 2018 (for year 2016-17), published by Department of Agriculture, Cooperation & Farmers Welfare, Ministry of Agriculture & Farmers Welfare.

2 This is the sum total of the areas under all crops over the various seasons in a year.

3 Other Kharif crops: Soyabeen, Pulses, Groundnut, Jowar, Maize, *etc.*

4 Other Rabi crops: Mustard, Gram, Barseem, Moong, Sunflower, Vegetable, Summer vegetables, *etc.*

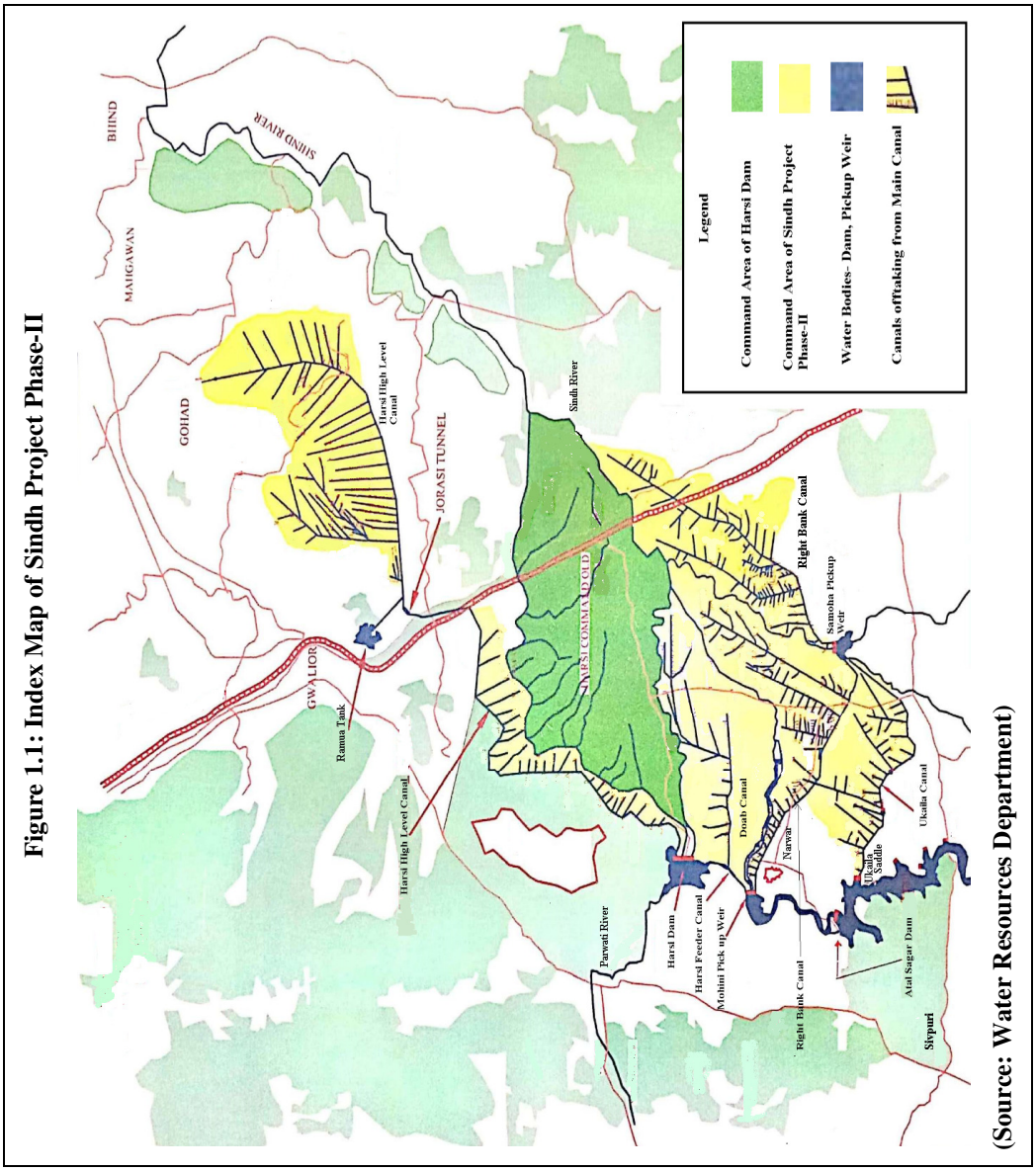

Figure 1.1: Index Map of Sindh Project Phase-II

(Source: Water Resources Department)

1.1 Genesis of the Sindh Project

The northern part of the State, comprising the current districts of Gwalior, Bhind, Morena, Shivpuri and Datia, have generally always remained drought prone. Harsi Dam was constructed around 1925 on the Parwati River, adjoining to Sindh River, major river of the Area. The Harsi System, which evolved around this Harsi Dam, is one of the oldest Major Irrigation Projects of Madhya Pradesh, designed to irrigate 7,085 hectares of *Kharif*, 20,243 hectares of *Rabi* and 3,036 hectares of sugarcane as a perennial crop. Once the Harsi System was completed in the year 1935 and started functioning, the Command Area developed fast and soon exceeded the designed irrigation area. This led to shortage of water in the Harsi Command and it became imperative to divert Sindh river water to Harsi Dam. The Sindh Project was conceived in two phases, to address this need.

1.2 Sindh Project Phase-I

The first phase of Sindh Project was taken up (1974-75) to augment the capacity of Harsi Dam through works of: (i) construction of a Pick-up Weir[5] on Sindh River near Mohini village, (ii) construction of a Feeder Canal from the Mohini Pick up weir to feed Harsi Dam, (iii) construction of the Doab Canal (19.98 kilometres) off-taking water from the Feeder Canal, and (iv) remodelling of the old Harsi System. Major portion of the Project was completed in 1980. Simultaneously, detailed survey for Phase-II was also taken up by the Department.

1.3 Sindh Project Phase-II

Corollaries of Sindh Project Phase-II, as defined in the Detailed Project Report, were expected to impound 1518.10[6] Million Cubic Metre water through:

i. Construction of Atal Sagar Dam on Sindh River near Madikheda village, 16 kilometres upstream of the existing Mohini Pick-up Weir to impound 1155.50 Million Cubic Metre of water;

ii. Erecting 23 large gates and two smaller gates on the crest of the existing Mohini Pick-up Weir, to impound additional storage of 109.85 Million Cubic Metre of water; and

iii. Construction of sluice gate in Harsi dam which impounds 253.30 Million Cubic Metre of water;

The impounded water was planned to be conveyed to fields through four canals, as detailed in **Table 1.1** below:

Table 1.1: Planned utilisation of impounded water

Name of Canal as per Detailed Project Report	Off-taking from	Length of Main Canal in kilometre	Irrigation Potential created	Water Requirement in Million Cubic Metre
Extension of Doab Canal	Harsi Feeder Canal	From 19.98 to 37.95	12,536	101.3
Ukaila High Level Canal	Atal Sagar Dam	42.00	10,115	77.3
Right Bank Canal	Mohini Pick-up Weir	70.20	30,355	242.2
Harsi High Level Canal	Old Harsi Dam	102.40	45,245	366.9
Sub Total			**98,251**	**787.7**
Water used in old Harsi plus existing Doab Canal				426.3
Drinking water supply to Shivpuri town				14.4
Losses (evaporation, enroute losses and losses in feeder canal)				289.7
Total water requirement				**1,518.10**

(Source: Information provided by the Water Resources Department and Detailed Project Report)

The old Harsi Canal system irrigates an area of 62,675 hectares in a year. Sindh Project Phase-II was to irrigate area of 1,62,100 hectare in a year, of which 46 *per cent* was to be through Harsi High Level Canal. The Index Map showing the coverage of Sindh Project Phase-II is placed in the facing page as

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5 Weir is a barrier across a River designed to alter the flow characteristics.

6 The actual figure as per the Detailed Project Report is 1518.65 Million Cubic Meter. However, while computing water requirement, 1518.10 Million Cubic Meter was reckoned in Detailed Project Report.

Figure 1.1. Additional water impounded at Atal Sagar Dam and Mohini Pick up weir was to be used in the three canals upstream and the excess water was to flow up to the Harsi Dam. Additional sluice gate, constructed in Harsi Dam 5.5 metre above the existing sluice gate of old Harsi Canal, was to allow additional areas to be irrigated through gravity (hence called Harsi High Level Canal).

As per Detailed Project Report, by creating additional irrigation potential of 1,62,100 hectares (*Kharif* 79,222 hectares + *Rabi* 80,760 hectares + Perennial 2,118 hectares), food production was to be increased by 5,76,860 Metric Tonne in the areas of four northern, drought-prone Districts of the State to be irrigated through the Sindh Project Phase-II.

The Project could deliver this designed benefit, only if the cropping pattern supporting the design was adhered to. The envisaged cropping pattern in the Detailed Project Report (2009) is at **Appendix 1.1**. Share of water utilisation was (with lower per Million Cubic Metre irrigation in hectares as given in **Appendix 1.1**) for paddy, wheat and sugarcane was to be rationalised at 14.3 *per cent*, 30 *per cent* and 5.2 *per cent* of total water available respectively.

In addition to agriculture, the Project envisaged following benefits:

i. Yearly fish production of 440 Metric Tonne.

ii. Industrial and domestic water supply of 14.40 Million Cubic Metre for Shivpuri town.

iii. Generation of 10 Megawatt of firm[7] power and 60 Megawatt of secondary[8] power.

The Energy Department, Municipal Councils and Nagar Panchayats, and Fisheries Department were the line Departments for the Project. However, anticipated roles of line Departments were not defined in the Detailed Project Report.

1.4 Status of Sindh Project Phase-II

Component-wise status of work under Sindh Project Phase-II is given in the **Table 1.2** below:

Table 1.2: Component-wise status of works

Sl. No.	Component of work	Status
1	Construction of Atal Sagar Dam	Completed in 2008
2	Erection of 25 gates on Mohini Pick-up Weir	Completed before 2011-12
3	Extension of Doab canal beyond 19.98 to 37.95 Kilometer	Completed in 2013-14
4	Construction of Ukaila High Level Canal	Completed in 2013-14
5	Construction of Right Bank Canal	Completed in 2013-14
6	Construction of Harsi High Level Canal	Completed in 2018
7	Construction of lined field channels under Command Area development work	77,267 hectares out of 98,251 hectares constructed (March 2020)

(Source: Information provided by Water Resources Department)

[7] The power which can be produced by a plant with no risk.

[8] All power available in excess of firm power.

1.5 Funding of the Sindh Project Phase-II

Administrative Approval of ₹ 607.67 crore was accorded for Sindh Project Phase-II in 1991, which was later (2012) revised to ₹ 2,033.92 crore.

An expenditure of ₹ 1,973.70 crore has been incurred on the construction of the Sindh Project Phase-II up to 2019-20. Out of that, ₹ 814.91 crore and ₹ 648.85 crore was met from National Bank for Agriculture and Rural Development and Accelerated Irrigation Benefits Programme respectively. The Project has also been financed (₹ 509.94 crore) from State Funds. Year-wise allotment and expenditure from the beginning of the Project, with year-wise details from 2014-15 to 2019-20, are given in **Table 1.3** below:

Table 1.3: Details of expenditure on Sindh Project Phase-II

(₹ in crore)

Year	Allotment	Expenditure	Savings
Up to 2013-14	1,404.16	1,404.16	Not Applicable
2014-15	125.94	125.01	0.93
2015-16	160.50	160.14	0.36
2016-17	134.02	133.32	0.70
2017-18	75.72	67.92	7.80
2018-19	46.44	43.20	3.24
2019-20	39.97	39.95	0.02
Total	**1,986.75**	**1,973.70**	**13.05**

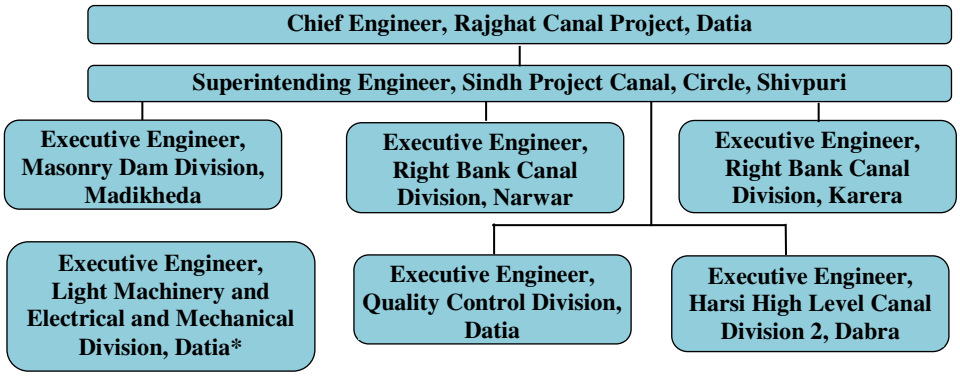
(Source: Information from Engineer-in-Chief office)

1.6 Organisational Setup

The Sindh Project Phase-II was executed by the Water Resources Department of Government of Madhya Pradesh. The Water Resources Department is headed by the Additional Chief Secretary, who is assisted by the Engineer-in-Chief. The latter is responsible for planning, execution and monitoring of the irrigation projects.

At the field level, the Chief Engineer, Rajghat Canal Project is responsible for overall execution of Sindh Project Phase-II. He is assisted by one Superintending Engineer and five Executive Engineers, as depicted in **Chart 1.1** below.

Chart 1.1: Field level organisation setup of Water Resources Department for execution of Sindh Project Phase-II



* Executive Engineer, Light Machinery and Electrical and Mechanical Division, Datia is under Superintending Engineer, Electrical and Mechanical Circle, Gwalior and Chief Engineer, Electrical and Mechanical, Bhopal.

2. Our Audit

The Performance Audit was conducted between August 2019 and September 2020. The period covered was 2014-15 to 2018-19. Audit was conducted to seek an answer that the Sindh Project Phase-II could achieve the outcomes set out in the Detailed Project Report.

Our audit findings are based on criteria derived from the following sources:

- Madhya Pradesh Works Department Manual;
- Specifications for Irrigation Works, Technical Circulars, and other orders issued by Water Resources Department of Government of Madhya Pradesh;
- Guidelines for Water Resources Projects issued by Government of India;
- Detailed Project Report of Sindh Project Phase-II; and,
- Terms and conditions of agreements with contractors.

We examined records and related information maintained by Engineer-in-Chief, Water Resources Department and the offices of Chief Engineer, Superintending Engineer and Executive Engineers concerned.

We also collected information from Revenue, Agriculture and Horticulture Departments. Information relating to power and fish production, as well as tourism activities, were also collected from the respective Departments. Wherever necessary, joint physical verifications were conducted by us in the company of officials from the Department.

We also used the assistance of Madhya Pradesh Agency for Promotion of Information Technology[9] (March 2020) for satellite mapping of villages falling under the Command Area of the Project.

The objectives, criteria, scope and methodology of Audit were discussed in the Entry Conference held on 24 December 2019, while the Exit Conference was held on 20 September 2021 with the Government. Responses of the Government have been suitably included in this report. Wherever possible, the figures have been updated up to 2019-20.

3. Acknowledgement

The Office of the Accountant General (Audit-II), Madhya Pradesh, Bhopal acknowledges the co-operation and assistance extended by the staff and offices of the Water Resources Department and the Commissioner of Land Records, Government of Madhya Pradesh during the course of conduct of this Performance Audit.

[9] Madhya Pradesh Agency for Promotion of Information Technology is a Government agency constituted (May 1999) under Society Registration Act, 1973, to propel the growth of Information Technology in the State.

Chapter 2

Outcomes in irrigation

Chapter 2

Outcomes in irrigation

Summary

With the availability of water on account of this Project in otherwise water-scarce, drought-prone Districts, the cropping pattern of this region has drastically altered. Less water consuming crops have often been substituted with more water intensive crops which bring better economic benefit to the farmers in the market. Disproportionate higher consumption in the upper reaches utilised by three of the four canals of this Project reduced the water availability at the largest canal system, the Harsi High Level Canal, which was to cater to 46 *per cent* of the area.

In addition to the skewed distribution in implementation, Harsi High Level Canal system also suffered from design flaws. Various reasons - from flawed planning, to unplanned diversion of water, to problems in scheduling and distribution of water, starved this canal system of water. As a result, it was not in a position to provide irrigation as planned.

2.1 Outcomes on irrigation

The project was completed in 2013-14 including all its major components except the last one *i.e.* Harsi High Level Canal, which was completed in June 2018. We assessed the achievement of the outcome in irrigation on the following parameters.

A. Food production:

The Detailed Project Report projected an additional food production from command area of the project to the extent of 5,76,860 Metric Tonne. However, the annual food production increased only by 2,45,205 Metric Tonne *i.e.* from annual production of 5,42,573 Metric Tonne in 2014-15 to 7,87,778 Metric Tonne in 2019-20. The details are given in **Appendix 2.1**.

B. Irrigation Potential created:

Sindh Project Phase-II was to create an additional irrigation potential of 1.62 lakh hectares in the drought-prone northern part of the State covering areas of Gwalior, Bhind, Datia and Shivpuri district. But the utilisation in 2019-20 was assessed at 64 *per cent* of the irrigation potential (**Table 2.1**).

Table 2.1: Details of Irrigation Potential of the Project

(In hectares)

Year	Irrigation Potential			Shortfall in utilisation	
	Developed	To be utilised	Actually utilised	Shortfall	Percentage of Shortfall
1	2	3	4	5= 4-3	6
2018-19	98,251	1,62,100	98,259	63,841	39.4
2019-20	98,251	1,62,100	1,03,575	58,525	36.1

(Source: Information provided by Superintending Engineer, Sindh Project Canal Circle, Shivpuri)

The Department stated (September 2021) that the utilisation was increased to 1,03,479 hectares. The shortfall of 36.1 *per cent* was because the farmers did not demand water for irrigation during *Kharif* season due to good rains, therefore irrigation as per provisions of Detailed Project Report for *Kharif* crops could not be done.

The reply is not acceptable as release of water in *Kharif* season itself indicates demand from farmers despite this irrigation potential was not achieved.

We also noted that the canal gauge registers maintained by the Department show a different picture. During *Kharif* seasons 2014-20 (except year 2017-18 which was a drought year), water released was higher than the requirement as per Detailed Project Report as given in the **Table 2.2** below. This belies the claim that the lower utilisation (in terms of hectares cropped) was because of lower demand from farmers during *Kharif*.

Table 2.2: Year-wise details of release of water during *Kharif* season

Name of canal	Requirement as per Detailed Project Report	Actual release of water in Million Cubic Metre					
		2014-15	2015-16	2016-17	2017-18	2018-19	2019-20
Left Bank (Doab) Canal	28.7	93.9	77.4	91.9	0	64.9	74.9
Ukaila Canal	19.5	34.3	29.1	30.9	0	23.6	33.6
Right Bank Canal	66.1	68.8	54.5	109.8	0	70.8	102.4
Harsi High Level Canal	112.2	0	0	25.0	0	21.0	75.3
Total for *kharif* crops	**226.5**	**197**	**161**	**257.6**	**0**	**180.3**	**286.2**

(Source: Information provided by Superintending Engineer, Sindh Project Canal Circle, Shivpuri)

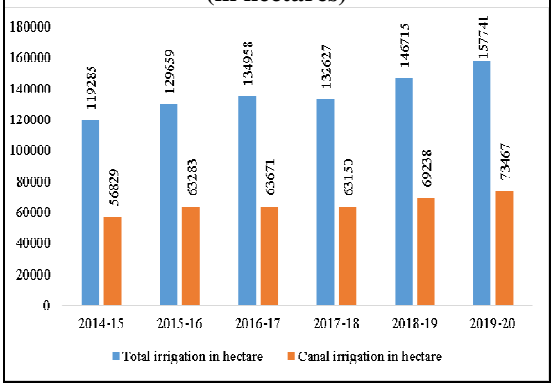
C. Irrigation intensity:

Irrigation intensity[10] captures the intensity of cropping, because irrigation allows farmers to grow more than one crop during the year.

The irrigation intensity projected in the Detailed Project Report was 165 *per cent*, against which the achievement in 2018-19 and 2019-20 (*i.e.* after completion of the project) was 100 *per cent* and 105 *per cent* only respectively.

D. Canal Irrigation:

Chart 2.1: Area covered through irrigation (in hectares)



While the area under the irrigation increased by 32.3 *per cent i.e.* up to 1.58 lakh hectare during 2014-20 in the four districts, the share of canal irrigation actually decreased from 47 *per cent* to 46 *per cent* after the Sindh Project Phase-II was completed (**Table 2.3**). The designed target for annual irrigation of the Sindh Project Phase-II through canals was 1.62 lakh hectares, but area irrigated through canals ranged between 56,829 hectares and 73,467 hectares, which also finds reflection in the low irrigation intensity (**Point C above**).

[10] It is the ratio of gross irrigated (total) area to the net irrigated area expressed as a percentage. In case of Sindh Project Phase-II, gross irrigated area was 1,62,100 hectares and net irrigated area (*i.e.* culturable command area) was 98,251 hectares.

Table 2.3: Source-wise details of irrigated area

Sources of water	2014-15		2019-20	
	Area in hectare	*Per cent* share	Area in hectare	*Per cent* share
Canals	56,828.5	47.6	73,466.5	46.6
Tanks	1,568.7	1.3	1,674.4	1.1
Tube wells	28,716.5	24.1	39,437.4	25.0
Wells	26,676.6	22.4	32,109.1	20.4
Other sources	5,494.8	4.6	11,053.1	7.0
Total	**1,19,285.1**		**1,57,740.5**	

(Source: Information provided by Superintendents of Land Records)

2.2. Disproportionate distribution of water supplied

Although all the four canal systems of Sindh Project Phase-II were taken up for construction, problems of contract management led to delays in construction of Harsi High Level Canal. The three canals upstream of Sindh River - the Ukaila Canal, the Right Bank Canal and extended Doab Canal - were completed by 2013-14 but the Harsi High Level Canal was completed only in June 2018.

Box 2.1: Contract issues delaying completion of Harsi High Level Canal

Contract of construction work of Harsi High Level Canal (excluding Tunnel) and its entire distribution network system, was awarded (December 2011) for completion within 24 months at contract amount of ₹ 124.43 crore. As of April 2015, the contractor had executed work worth ₹ 22.89 crore only. Due to slow progress, the work was terminated (April 2015) under debitable clause[11] of the agreement, leaving work of ₹ 108.78 crore (against Probable Amount of Contract) incomplete. Later on, the work was split up into five works and these were awarded to different contractors.

The work of tunnel between 73.160 to 75.845 kilometres of Harsi High Level Canal amounting to ₹ 31.19 crore was awarded in October 2011, to be completed within 12 months. It could however be completed only in June 2018, with a delay of more than five years and eight months.

As a result, the Harsi High Level Canal, which was to be completed by December 2013, was completed only by June 2018, with a delay of more than four years.

The Department stated (September 2021) that the work was delayed due to cases of land acquisition filed in Hon'ble Court, opposition of farmers, and geographical and technical problems at site.

Once the three upstream canals were completed in 2013-14, the demand in the command area grew rapidly exceeding the utilisation planned in the Detailed Project Report (**Table 2.4**).

[11] Under debitable clause of the contract, extra cost incurred by the Department on completion of the balance work is to be recovered from the defaulting contractor in case the original contractor lefts the work incomplete.

Table 2.4: Details of supply of water in main Canals of Project

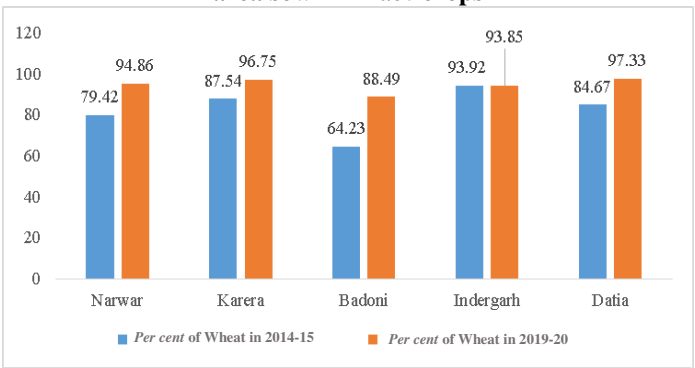
Sl. No.	Main Canal	Irrigation potential as per Detailed Project Report (in hectares)	Share of irrigation potential (in *per cent*)	Requirement of water per annum as per Detailed Project Report (in Million Cubic Metre)	Release of water in 2017-18		Release of water in 2018-19		Release of Water in 2019-20	
					(In Million Cubic Metre)	(In *per cent*)	(In Million Cubic Metre)	(In *per cent*)	(In Million Cubic Metre)	(In *per cent*)
1	Doab Canal	20,680	13	101.3	80.0	30.7	189.5	25	161.9	19.8
2	Ukaila Canal	16,690	10	77.3	46.0	17.6	98.9	13	103.9	12.7
3	Right Bank Canal	50,080	31	242.2	109.8	42.1	247.9	32.7	257.1	31.4
4	Harsi High Level Canal	74,650	46	366.9	24.9	9.5	222.1	29.3	295.4	36.1
	Total	**1,62,100**		**787.7**	**260.7**		**758.4**		**818.3**	

(Source: Data provided by the Water Resources Department)

The higher utilisation upstream led to low water availability at the Harsi High Level Canal downstream. After the completion of work in June 2018, the Harsi High Level Canal, which was to irrigate 46 *per cent* of the total area of the project, received only 36 *per cent* of the water available for whole project. On the other hand, the Doab Canal which was to irrigate only 13 *per cent* of total area of the Project, was fed with 20 *per cent* of total water.

The skewed water distribution was because while the Harsi High Level Canal was under construction, the farmers in the command area of the other three canals *i.e.* Doab, Ukaila and Right Bank canals shifted to water intensive crops. We conducted a detailed analysis of the area under these three canal systems, comprising of 223 villages in five Tehsils[12] of Datia and Shivpuri districts. It showed that share of wheat increased from 77 to 94 *per cent* during 2014-20 in these five Tehsils. Similarly, in four Tehsils[13] out of the same five Tehsils as above, another water intensive crop, sugarcane, was sown aggressively. Total area of sugarcane sown in just these four Tehsils increased from 4,148.04 hectares (2014-15) to 6,305.93 hectares (2019-20) against the total sugarcane crop in the entire Command Area of Sindh Project Phase-II of 6,839.11 hectares in 2019-20. In short, in five years, the coverage of sugarcane in these four Tehsils increased by 52 *per cent* in

Chart 2.2: Details of *per cent* share of wheat crops with total area sown in *Rabi* crops



(Source: Agriculture data from Superintendents of Land Records)

12 Narwar, Karera, Badoni, Indergarh and Datia.

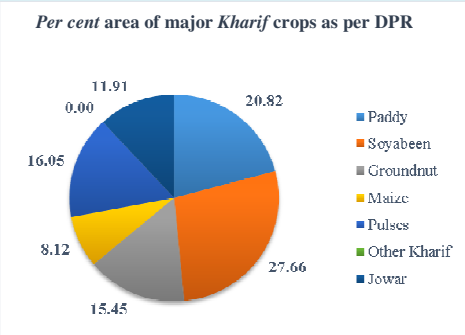
13 Karera, Badoni, Indergarh and Datia.

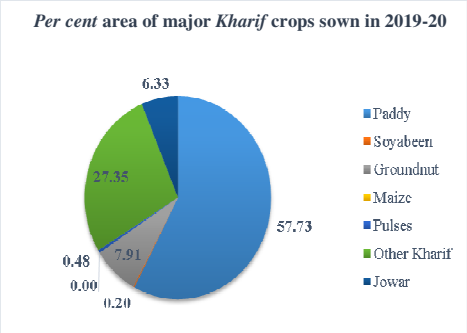
2019-20 over 2014-15, and now account for 92.2 *per cent* of the total sugarcane grown in the entire Command Area of this Project.

Given that these three canal systems got completed in 2013-14 and the fourth, *i.e.* Harsi High Level Canal, got completed only in June 2018, it is easy to understand how and why these three canal systems used up overall 64 *per cent* of the available water, while catering to only 54 *per cent* of irrigable area by 2019-20.

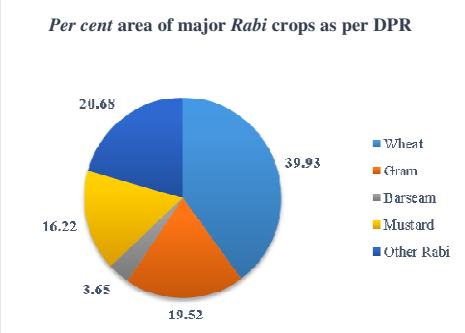
Since sowing of water intensive crops in the Command Area of these first three canal systems have now become the new normal, it will be difficult to significantly change the water release pattern or the quantum of water released annually for these areas now, without negatively impacting farmers' prospects and giving rise to dissatisfaction. Consequently, higher diversion of water to these three canals currently has, and will possibly continue to have, a very negative impact on the supply of water to the last canal, *i.e.* Harsi High Level Canal.

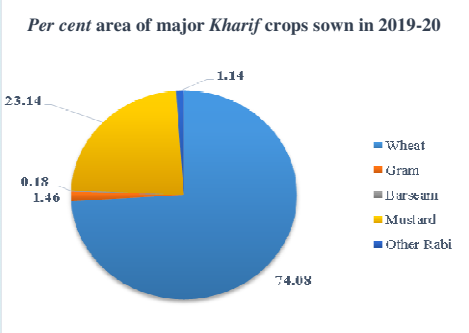
Box 2.2:
Crop-wise share of area for *Kharif* crops





Crop-wise share of area for *Rabi* crops





(Sources: Detailed Project Report and agriculture data given by Superintendents of Land Records)

The utilisation of the irrigation potential (and hence the benefit of envisaged food production) depends critically on adherence to the cropping pattern planned while designing the project. Charts above show that the actual cropping pattern varied substantially from the cropping pattern envisaged for the project for both *Kharif* and *Rabi* crops. Water used in paddy cultivation during *Kharif* season and in wheat cultivation during *Rabi* season is 278 *per cent* and 185 *per cent* of what the project was designed for (as detailed in **Appendix 2.2**).

A third party evaluation was also conducted by WALMI[14] in March 2019, who also reported that there was a distinct deviation in cropping pattern in the Command Area after the Project.

[14] Water and Land Management Institute, Bhopal.

The Department stated (September 2021) that Bhind district comes under the Command Area of Harsi High Level Canal, where mustard is sown abundantly in *Rabi* season. Mustard is not a water intensive crop. Therefore, due to lesser demand of water, less water was released in Harsi High Level Canal. Sugarcane is produced by farmers with their own irrigation facilities, as canal irrigation in the Command Area of the Project has increased the ground water level, and hence the increased sugarcane production.

We do not agree with the view that the reason for less supply of water to Harsi High Level Canal was lesser demand by farmers. The fact that the Department itself has begun construction of the Harsi High Level Feeder Canal to augment the supply of water to Harsi High Level Canal, indicates that there was unfulfilled demand of water in the command area of the Harsi High Level Canal. (discussed in **Box 2.3** below).

2.3 Deficiencies in Harsi High Level Canal System

In addition to the skewed water distribution to the Harsi High Level Canal, we found that *ab-initio,* the Harsi High Level Canal system suffered from shortfall in water availability.

Availability of water for Harsi High Level Canal depends on the excess water available for transferring to Harsi dam from Atal sagar dam and Mohini Pick up weir. Live storage capacity of reservoirs indicates usable volume of water available for irrigation during normal years. We found that Harsi High Level Canal as planned, would have water availability lower than the requirement, shortage being 69.6 Million Cubic Metre, a situation which the skewed distribution of water has only exacerbated (**Table 2.5**).

Table 2.5: Details of water availability for Harsi High Level Canal

Sl. No.	Details	Water in Million Cubic Metre
1	Live storage capacity of Atal Sagar Reservoir	834.8
2	Live storage capacity of Mohini Pick up weir	107.1
3	Sub-total for 1 and 2	941.9
4	Requirement for three canals of Sindh Phase-II	420.9
5	Remaining water available for transferring to Harsi Reservoir (3-4)	521.0
6	Live storage capacity of Harsi Reservoir	192.7
7	Total available through Harsi Reservoir (5+6)	713.7
8	Requirement of old Harsi System	402.0
9	Drinking water supply to Shivpuri	14.4
10	Remaining available water for Harsi High Level Canal (7-(8+9))	297.3
11	Requirement of Harsi High Level Canal	366.9
Deficiency of water for Harsi High Level Canal (11-10)		**69.6**

(Source: Detailed Project Report and web site of Water Resources Department)

From the above, it is evident that there was a shortfall of 69.6 Million Cubic Metre of water at planning stage, which would affect 11,832 hectares (170 × 69.6), *i.e.* 26.2[15] *per cent* of the total Command Area of *Rabi* season.

We also noted that the Chief Engineer, Rajghat Canal Circle had informed the Engineer-in-Chief (October 2010) of the possibility of water shortage at Harsi

[15] 11,832 /45,245(Command area of Harsi High Level Canal) × 100

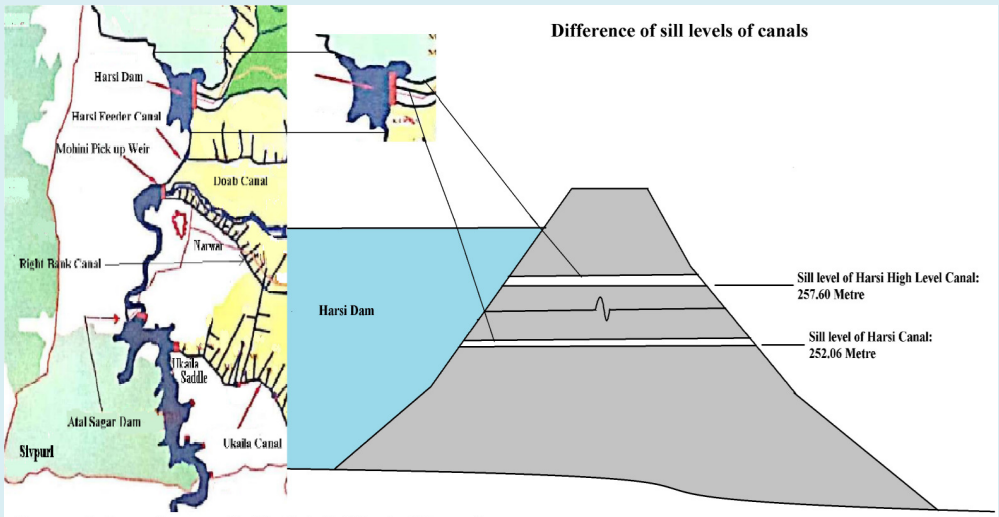
High Level Canal. But no action on these misgivings by the Engineer-in-Chief was found in the records of the Chief Engineer's office.

The Department stated (September 2021) that lining work was done in the Harsi High Level Canal system to provide 251.4 Million Cubic Metre water (*i.e.* reduce the losses by 251.4 Million Cubic Metre to irrigate 45,245 hectares at the rate of 180 hectares per Million Cubic Metre). *Kharif* irrigation is done by balance of the provisioned water and additional water available in dam in rainy season and water available from post monsoon flow. Hence, there was no shortage in water for irrigation. The Department further stated that after completion of Harsi High Level Canal, 28.86 cumec water was released during 2019-20. The Harsi High Level Feeder Canal is also being constructed as there is problem of availability of required head for operating both Harsi High Level Canal and Harsi Canal during the peak demand. Designed water would be released in Harsi High Level Canal after completion of the above work.

The reply is not acceptable due to several reasons. Firstly, the Harsi High Level Canal was already planned to be lined and the losses were provisioned in the Detailed Project Report after factoring the lining of the canal.

Secondly, the requirement of a Bypass Canal to fulfil the requirement of the Project, particularly when it was not initially included in the Detailed Project Report, also confirms our observation that the availability of water was less in the project (**Box 2.3** below). Thirdly, the records related to the audit period 2014-19 showed that the Harsi High Level Canal never ran with full discharge capacity. The maximum that it had run was 24.70 cumec with 2.7 metre supply depth on 10 September 2018. We were not provided any records to validate the claims of discharge of 28.86 cumec. There was a shortage of water for Harsi High Level Canal. Furthermore, the reply is also silent about less availability of water by 69.6 Million Cubic Metre in the design stage draft, for Harsi High Level Canal.

Box 2.3 Problems in scheduling and distribution of water



(Source: Information provided in Detailed Project Report)

The sluice gates of Harsi High Level Canal were constructed at 257.6 metre (figure above), *i.e.* 5.5 metre above to that of old Harsi Canal which was at 252.1 metre. The higher sill

level[16] of Harsi High Level Canal allows water to feed under gravity up to 102.40 kilometre of the Main Canal. A discharge of 87.2 cumecs[17] was needed to run both the Canal systems simultaneously.

Thus, water could be discharged from the higher level of Harsi High Level Canal only when there was enough water available in the Dam, to reach the desired operating head[18] for Harsi High Level Canal.

However, in actuality, water discharge was not being scheduled appropriately to allow for, first, enough accumulation for discharge through higher sill level of Harsi High Level Canal, and *then*, discharge through the old Harsi Canal. Water distribution scheduling of Harsi High Level Canal was not done till 2019-20 and water had been released to old Harsi Canal located at lower level of the Dam. Thus, due to non-scheduling of discharge of water, adequate water was not available for the entire period of requirement for Harsi High Level Canal, and most importantly, at the critical times when water is scarce and is required to be distributed to both canal systems.

In order to address this shortcoming, the Department took up (August 2018) the construction of a 7.35 kilometre long Harsi High Level Feeder Canal which would bypass the Harsi Dam and supply water directly to Harsi High Level Canal. The work envisaged to cost ₹ 65.40 crore was in progress (as of September 2021).

The Department admitted (September 2021) that the Harsi High Level Feeder Canal is being constructed as there is problem of availability of required head for operating both Harsi High Level Canal and old Harsi Canal during the peak demand for *Rabi* irrigation.

The reply confirms the fact that remedial action is now required to address the issue of the shortage of water for supply to Harsi High Level Canal, which stems from a wrong assessment of water requirement right at the beginning.

2.4 Diversion of water

As discussed above, Harsi High Level Canal already suffered *ab-initio* a water shortage of 69.6 Million Cubic Metre. In addition the skewed cropping pattern upstream of the Harsi High Level Canal has exacerbated this shortage of water. We found that an unplanned (not mentioned in the Detailed Project Report) diversion of water to Ramua tank will lead to an additional draw from already depleted water availability at the Harsi High Level Canal.

The Ramua Tank was constructed with a capacity of 13 Million Cubic Metre by the Water Resources Department, Division Gwalior in 1956. The tank was being filled only up to 10 *per cent* capacity from its natural resources of catchment area and since the last several years has had no water to fulfil its irrigation responsibility. Therefore, Government directed (January 2013) to fill the tank with excess rain water from Harsi High Level Canal to this tank. The provision of supply of 76.9 Million Cubic Metre water from the Harsi High Level Canal can lead to shortage of 146.5[19] Million Cubic Metre water in Harsi High Level Canal. The Executive Engineer confirmed to us (January 2020) that about 15.5 Million Cubic Metre water was released to Ramua Tank during 18 September 2019 to 17 October 2019 from the regular supply of Harsi High Level Canal.

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16 Lowest level of Canal.

17 Doab 14.3 cumecs, Harsi High Level Canal: 31.7 cumecs + 5 *per cent* enroute losses from lifting 4.1 cumecs and Harsi Canal (old Canal): 37.1 cumecs.

18 Water that is required to be available above the bottom level of the sluice gate, so that water can be supplied by opening the sluice gate.

19 Total shortage of 146.5 Million Cubic Metre water (69.6 Million Cubic Metre as per para 2.3 + 76.9 Million Cubic Metre for Ramua Tank).

Further, there was no provision of feeding any Tank from the core reserve through Harsi High Level Canal, which was anyway deficient with respect to its requirement. The Department nevertheless provided water to the Ramua Tank, not from excess rainwater as envisaged, but its core reserve. Such diversion of the core reserve of water elsewhere would lead to scarcity of water for irrigation at all tail levels of Harsi High Level Canal. Although this was for the benefit of people, yet such diversion was beyond the scope of projected objectives of the Harsi High Level Canal. Since there was scarcity of water in Ramua Tank since long, the Department should have provided for some mitigating action for the Ramua Tank in the Detailed Project Report itself, modified its expectation of Irrigation Potential from this canal accordingly, and thus avoided the extra stress on the core reserve of water of this Canal.

The Department stated (September 2021) that the Ramua Tank is filled with additional water available in the dam during rainy season and not from live storage capacity of dam.

The reply did not qualify to our observation, as water was released during off-monsoon season which *inter alia* indicates that the water was released from the live storage capacity of the dam.

2.5 Decrease in number of beneficiary villages due to reduction in length of Harsi High Level Canal

The Harsi High Level Canal was to create a command area of 45,245 hectares, and benefit a total of 238 villages, *i.e.* 166 villages of Gwalior District and 72 villages of Bhind District. Later (2011), the length of the Canal was reduced from 110 kilometre to 102.4 kilometre, but the command area of the Canal was not reduced. However, the number of beneficiary villages was reduced to 165 from the 238 as envisaged earlier.

The Executive Engineer, Harsi High Level Canal Division, Dabra confirmed (January 2020) that 165 villages come under Command through 102.4 kilometres of Harsi High Level Canal and 21 kilometres of Sitla Mata Branch Canal.

2.6 Command Area Development Works

Field channels convey water from the minor canals to the fields and ensures efficient utilisation of irrigation works. Field channels and other activities comes under Command Area Development which need to be taken up along with the construction of the project corollaries in an integrated, convergent and coordinated manner. The Detailed Project Report of the Command Area Development envisaged works of correction of system deficiency, construction of field channels, topographical survey and investigations, reclamation of water-logged areas, land levelling, micro irrigation, field drains, *warabandi*[20], *etc.* Properly planned, aligned and designed field channels were to be constructed from the outlet in such a manner that each and every field is connected by field channels.

[20] *Warabandi* is a rotational method for equitable distribution of the available water in an irrigation system by turns fixed.

The Sindh Project Phase-II was taken up in 2014-15 under Command Area Development and Water Management Programme of the Government of India. The activities under Command Area Development and Water Management included structural interventions, survey, planning, design, development works through construction of field channels, and one-time functional grants to Water User Associations and training demonstrations. The Government of Madhya Pradesh accorded (April 2016) separate Administrative Approval for Command Area Development and Water Management works at a cost of ₹ 394.09 crore. Three activities, *i.e.* construction of lined field channels, one-time functional grants[21] to Water User Associations[22] and training demonstrations were set to be taken up during 2014-19. But, one-time functional grant was not provided to Water User Associations.

The Department stated (September 2021) that beneficiary farmers did not deposit 10 *per cent* contribution and hence, the one-time functional grant was not distributed to Water User Associations. However, training programmes on efficient use of water conducted were with the help of the Water User Associations. The training programmes came to a halt since last two years because elections to Water User Associations could not be conducted.

Table 2.6: Targets and achievements under Command Area Development and Water Management

Year	Construction of lined field channels (in hectares)		Training demonstrations[23] (₹ in lakh)	
	Target	Achievement	Target	Achievement
2014-15	562	300	2	0
2015-16	7,386	7,386	4	0
2016-17	28,301	28,301	10	0
2017-18	33,253	29,265	10	3
2018-19	9,182	9,182	10	1
2019-20	6,095	2,833	15	0
Total	**84,779**	**77,267**	**51**	**4**

(Source: Information provided by Commissioner, Command Area Development Authority)

The Departmental authorities achieved 91 *per cent* of the targets (**Table 2.6**) under construction of lined field channels although the work slacked in 2019-20. However, information provided to us by the Water Resource Divisions showed a shortfall of 24.3 *per cent* in area brought under command area development. Though the Divisions reported coverage of entire Culturable Command Area of 98,251 hectares, but the field channels were constructed only in 76,636 hectares.

We noticed further deviations in Command Area Development Works, as discussed below:

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21 Purpose of one-time functional grant was to ensure commencement of their effective functioning of Water User Associations.

22 Water User Associations are formed by farmers. Their main function is to construct and maintain field channels in the command area of the project for which they are funded by the Government.

23 Crop Demonstration programmes are carried out on the farmers' field to show them practically how to adopt suitable cropping pattern and use of balanced dose of inputs with proper management of available water in the command area for active participation of farmers.

- Right Bank Canal Division, Karera constructed 819 outlets by July 2019 which cover only 19,707 out of 22,425 hectares leaving out 2,718 hectares. The Executive Engineer, Right Bank Canal Division, Karera stated (December 2019) that construction of field channels was done as per topography of the area. In case of outlets, it was stated that remaining outlets would be constructed. The reply is not acceptable as outlets were not constructed as per required coverage and the purpose of providing water to end users in 2,718 hectares seems defeated.
- Detailed Project Report of the Command Area Development had acknowledged that the fund provided to Water User Associations for operation and maintenance at the rate of ₹ 100 per hectares was insufficient. Accordingly, an additional provision of ₹ 8,000 per hectare was proposed to be used for activities such as correction of system deficiency, strengthening of embankment, protection of outer slopes, restoration of bed gradients and inner Canal section and lining to prevent heavy seepage losses. But, the Department did not make any request for release of funds for operation and maintenance. Executive Engineer, Right Bank Canal Division, Karera stated (December 2019) that action would be taken for compliance.
- The Engineer-in-Chief's office, vide a circular (November 2011), had clarified the repair works to be carried out in ordinary repair, annual repair and special repair. We conducted joint physical verification of Right Bank Canal, in which we found several defects/ breakages in panels of lining work in initial reaches. These defects are yet to be rectified.

View of breach of Right Bank Canal (Up to Mahuar river) before Samoha pickup weir. (Status: December 2019)

View of broken lining of Right Bank Canal (Beyond Mahuar River), near Samoha pickup weir. (Status: December 2019)

- Micro irrigation[24] was included in the Detailed Project Report of Command Area Development as a new component to promote water use efficiency in irrigation. Accordingly, a provision of ₹ 50,000 per hectare for 10 *per cent* area of Culturable Command Area, *i.e.* 9,825

[24] Objective of Micro Irrigation is to enhance water use efficiency in the agriculture sector by promoting appropriate technological interventions like drip & sprinkler irrigation technologies and encourage the farmers to use water saving and conservation technologies.

hectares was to be made. But micro irrigation was not adopted. Department assured (September 2021) that the activity would be taken up. Similarly, an amount of ₹ 24.56 crore was provisioned for the Project for land levelling for improving efficiency, water, labour and energy resources utilisation, which was not taken up.

2.7 Inadequate monitoring

With respect to monitoring of implementation of the project, we noted the following:

- Construction of field channels and running and maintenance work of Canals was entrusted to the Water Users Associations of the respective Command Area. The Executive Engineers were to conduct quarterly meetings with the Water User Associations. Construction of field channels was executed through agreements between the Executive Engineer and President of Water User Associations and funds were to be released to the respective Water User Associations. The Water User Associations were required to submit Utilisation Certificates against the funds received by them. In the Right Bank Canal Division, Karera, the Executive Engineer had released ₹ 1.50 crore to the Water User Associations during the period 2014-19 for maintenance works, against which Utilisation Certificates were not submitted (for verification that these funds were used on the intended purposes).

  Though the Executive Engineer assured us (December 2019) that Utilisation Certificates would be collected from the Water User Associations. We were not provided further updates on this matter till date (October 2021).

- As per para 8.016 of Madhya Pradesh Works Department Manual, canals having carrying capacity more than 30 cumec were to be inspected annually by Chief Engineer, and canals having 3 cumec to 10 cumec by Executive Engineer.

  In all 70 inspections of the Harsi High Level Canal were conducted, most of all at the level of Superintending Engineer. Chief Engineer did not conduct inspections for the years 2014-15, 2017-18 and 2018-19. The Executive Engineer, Karera inspected the project work regularly except during 2016-17. The Executive Engineer, Dabra inspected the project work only in 2015-16.

  Absence of this oversight leads to ineffective operation of canals and possible leakages and breaches.

Chapter 3

Other Outcomes

Chapter 3

Other Outcomes

Summary

The project, achieved its secondary outcome in power generation. Fish production could not meet targets and the production tapered off in the last three years. The objective of supply of drinking water to Shivpuri town was not achieved even after a lapse of ten years from the construction of the Atal Sagar dam. Although tourism activity was not planned, the Madhya Pradesh Tourism Development Corporation has taken some initiative in this regard.

3.1 Outcome of Power generation

The Detailed Project Report provided for generation of 10 Megawatt of firm power[25] and 60 Megawatt of secondary power[26] through three units of 20 Megawatt capacity each on the left flank periphery about 900 metre upstream of the Atal Sagar (Madikheda) Dam site.

All the three units of 20 Megawatt each of the Madikheda Hydel Power Station were commissioned during August 2006 to August 2007. Agreement[27] for supply of water to Power House was also made on 16 July 2012 for drawl of 11 Million Cubic Metre /hour of water per day maximum, subject to availability of water, for use in the Madikheda Hydel Power Station. Except 2017-18, the Power Generation always exceeded the target for the year (**Table 3.1**). The Superintending Engineer, Operations and Maintenance, Madikheda clarified (March 2020) that variations in production of power was due to variations in rainfall received.

Table 3.1: Targets and Achievements of Power Generation

Year	Target in Million Units	Production in Million Units
2014-15	90	97.1
2015-16	91	95.9
2016-17	91	146.4
2017-18	74	26.9
2018-19	74	95.2
2019-20	70	139.7

(Source: Superintending Engineer, Madikheda Hydel Power Station)

We noted with satisfaction that this outcome of the Project was achieved and in time.

3.2 Fish production

Fish production of 440 Metric Tonne annually was envisaged in the Detailed Project Report of the Project. Targets were set by the Matsya Mahasangh (functioning under Fisherman Welfare and Fisheries Development Department) (**Table 3.2**).

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25 The power, which can be produced by a plant with no risk is called as firm power.

26 All the power available in excess of firm power is known as secondary power.

27 202.81 Million Units (for three years from 2009 to 2012) production was considered for agreement between Water Resources Department and Madhya Pradesh Power Generating Company Limited indicates average power generation per year was 67.06 Million Units.

Our analysis showed that the targets were raised by 25 *per cent* in 2017-18, which could not be met and in fact, the production was on a declining trend since 2018-19.

Table 3.2: Targets and Achievements of Fish Production

Year	Target in Metric Tonne	Achievement in Metric Tonne	Amount realised in lakh
2014-15	50	132.4	54.1
2015-16	70	133.9	60.9
2016-17	100	106.1	67.7
2017-18	125	108.1	28.5
2018-19	125	101.4	39.9
2019-20	135	95.2	41.9

(Source: Madhya Pradesh Matsya Mahasangh (Maryadit))

(View of fishing at Atal Sagar Dam, Madikheda)

3.3 Supply of Drinking water

A provision of 14.4 Million Cubic Metre of water was made from Sindh Project Phase-II for industries and domestic water supply for Shivpuri town. The construction of the Dam was completed in 2008.

We found that the Division took up (August 2019) the matter of entering in to the agreement for supply of water with Nagar Palika, Shivpuri (Water supply begun from September 2017). The Nagar Palika, Shivpuri entered into agreement with the Department for consumption of water only in March 2020. But the supply was irregular because of the frequent leakages in the pipeline.

On enquiry, we were informed by the Chief Municipal Officer, Shivpuri (November 2019) that the water was not being supplied regularly from Atal Sagar Dam due to leakage in pipeline. The work awarded for laying the pipeline for carrying the water from Atal Sagar Dam to Shivpuri town had been rescinded earlier. However, the work was re-awarded in 2018 and was in progress, which affected the regular water supply. The agreement was not executed in due time because quantum of water required and supplied could not be ascertained. Thus, the objective of providing drinking water was delayed by 10 years.

3.4 Tourism

While the Detailed Project Report did not specifically provide for any tourism activity at Atal Sagar Dam site, it projected provision of ₹ 1.25 crore for recreation and refreshment centre and boating facility. The Water Resources

Department did not take any initiative in this regard. But Government of Madhya Pradesh sanctioned ₹ 77.19 lakh and Madhya Pradesh Tourism Development Corporation had sanctioned ₹ 3.23 crore for various works to promote tourism which were completed by August 2019. We were informed that the process of leasing out the unit was under progress (June 2021).

3.5 Ecological and Environment Preservation

The Detailed Project Report contained a provision for plantation of fruit-bearing trees on either side of the Canal, with tree guards which was to be executed simultaneously with works. But the activity was not taken up. The Department stated (September 2021) that land could not be acquired for plantation work due to opposition of farmers.

Chapter 4

Conclusion and Recommendations

Chapter 4

Conclusion and Recommendations

4.1 Conclusion

This Performance Audit on the achievement of outcomes of surface irrigation in the Sindh Project Phase-II during 2014-19 showed that the irrigation potential created was not fully utilised, mainly due to shortage of water in the largest canal system of the Project.

On one hand, three out of the four canal systems (Left Bank, Ukaila and Right Bank canal systems) under this Project, which created 54 *per cent* of the total irrigation potential ended up absorbing a disproportionate 64 *per cent* of the total water that was available (2019-20). The farmers under these three canal systems switched over to growing water-intensive cash crops in deviation of the cropping pattern which the project was designed for. On the other hand, in contrast, the fourth and largest canal system (Harsi High Level Canal system), having created 46 *per cent* of the total irrigation potential was getting only 36 *per cent* of the available water. Expectedly, the cropping pattern in the area under this canal system, though changing over time, was still primarily growing the water-resistant crops as in the past.

This actual allocation of less water than planned, and several other issues, like designing a canal system and projecting targets but without providing for adequate water at source, has adversely affected the area served by the Harsi High Level Canal System. Coupled with less receipt of water, designing and scheduling issues have led to part of the water due to the Harsi High Level Canal system actually getting utilised by the pre-existing Old Harsi Canal System. Delays in execution of certain individual works, and having to share water with Gwalior city for drinking purpose, have further added to the woes of the Harsi High Level Canal system. This shortfall is being addressed by an additional feeder canal at the cost of ₹ 65.4 crore.

The secondary objective of power generation and fish production were reasonably met in this Project. Additionally, attempts are also being made to project the Atal Sagar Dam constructed during this Project as a tourist destination, even though this had not been planned earlier.

To conclude, if the target of this Project was the equitable distribution of water across the entire drought-prone northern region of Madhya Pradesh comprising of Gwalior, Shivpuri, Bhind and Datia districts, then it has so far been achieved only to a limited extent and that too in specific areas only. Even with the successes in achieving the secondary objectives, this Project has given rise to a skewed developmental picture and raises concerns about its sustainability.

4.2 Recommendations

The Government may consider:

- Augmentation of the irrigation facilities may be made so that the water reaches the tail end beneficiaries as envisaged in the Project;
- Arranging effective concurrent, inter-departmental, coordination between Water Resources Department and Farmer Welfare and Agriculture Development Department, for implementation of designed cropping pattern for optimum use of water;
- Expediting completion of all components of Command Area Development and Water Management scheme to avoid shortfall in utilisation of irrigation potential;
- Formulating a mechanism to assess optimum executable sizes of agreement, to avoid unnecessary delays on account of termination and retendering of works;

- Formulating a mechanism for maintenance of the completed canal system of irrigation projects pending for entire completion for getting optimum results from incomplete projects.

Bhopal
The 02 March 2022

(BIJIT KUMAR MUKHERJEE)
Accountant General (Audit-II)
Madhya Pradesh

Countersigned

New Delhi
The 08 March 2022

(GIRISH CHANDRA MURMU)
Comptroller and Auditor General of India

Appendices

Appendix 1.1

Crop-wise details of area and water requirement as per the cropping pattern envisaged in the Detailed Project Report

(Reference: Paragraph No. 1.3, Page 4)

Crop	Area in hectare as per Detailed Project Report	Water in Million Cubic Metre	Per Million Cubic Metre irrigation in hectare
***Kharif* crops**			
Paddy	16,491	112.47	146.63
Soyabean	21,911	16.00	1,369.44
Pulses	12,714	37.00	343.62
Groundnut	12,238	21.17	578.08
Jowar	9,438	24.07	392.11
Maize	6,430	15.63	411.39
***Rabi* crops**			
Wheat	32,248	236.06	136.61
Mustard	13,099	85.01	154.09
Sunflower	4,912	37.18	132.11
Gram	15,765	76.70	205.54
Barseem	2,946	28.58	103.08
Moong	4,306	20.93	205.73
Vegetable	3,625	17.15	211.37
Summer Vegetables	3,859	18.76	205.7
Perennial Crops			
Sugarcane	2,118	40.92	51.76
Total	**1,62,100**	**787.63**[1]	

[1] Actual figure is 787.7 Million Cubic Metre. The difference is due to minor calculation error in the Detailed Project Report.

Appendix 2.1

Statement showing increase in food production with respect to provisions in the Detailed Project Report

(Reference: Paragraph No. 2.1, Page 7)

(Quantity in Metric Ton)

Season	Crop	2014-15	2019-20	Variation	*Per cent*
Kharif	Paddy	2,12,858.7	2,75,160	62,301.33	29.27
Kharif	Soyabean	390.981	375.457	-15.524	-3.97
Kharif	Pulses	824.78	69.415	-755.365	-91.58
Kharif	Groundnut	33,909.76	20,437.55	-13,472.2	-39.73
Kharif	Jowar	5,520.569	5,472.811	-47.7588	-0.87
Kharif	Maize	160.2791	150.603	-9.6761	-6.04
	Total *Kharif*	**2,53,665**	**3,01,665.8**		
Rabi	Wheat	2,35,068.8	4,34,293.5	1,99,224.7	84.75
Rabi	Mustard	43,758.83	47,673.63	3,914.798	8.95
Rabi	Sunflower	319.09	584.693	265.603	83.24
Rabi	Gram	9,313.483	2,482.116	-6,831.37	-73.35
Rabi	Barseem	383.2	740.895	357.695	93.34
Rabi	Moong	41.73	318	276.27	662.04
Rabi	Vegetables	17.8734	8.469	-9.4044	-52.62
Rabi	Summer Vegetables	4.5	10.72	6.22	138.22
	Total *Rabi*	**2,88,907.6**	**4,86,112.1**		
	Grand Total	**5,42,572.6**	**7,87,777.9**	**2,45,205.3**	

Appendix 2.2

Statement showing increase in crop water requirement of actual cropping pattern with respect to cropping pattern planned

(Reference: Paragraph No. 2.2, Page 11)

Crops	Delta in millimetres	Area as per Detailed Project Report (in hectare)	Crop Water requirement as per Detailed Project Report (in Million Cubic Metre)	Actual sown area of crops in 2019-20 (in heactare)	Cropping pattern (in *per cent*)	Sown area on basis of cropping pattern (in hectare)	Actual Crop water requirement (in Million Cubic Metre)	Increase in water requirement (in Million Cubic Metre)
1	**2**	**3**	**4**	**5**	**6=Col. 5 / Total of Col. 5**	**7= 6× Total of Col. 3 /100**	**8= (Col. 7/ Col. 3) × Col.4**	**9= (Col. 8- Col. 4)**
***Kharif* crops**								
Paddy	682	16,491	112.47	75,489.6	57.84	45,822	312.51	200.04
Soyabean	73	21,911	16.00	258.792	0.20	158	0.12	-15.88
Groundnut	173	12,238	21.17	10,340.8	7.92	6,274	10.85	-10.32
Maize	243	6,430	15.62	0.672	0.00	0	0	-15.62
Pulses	291	12,714	37.00	636.507	0.49	388	1.13	-35.87
Jowar	255	9,438	24.07	8,265.77	6.33	5,015	12.79	-11.28
Other *Kharif* crops	0	0	0.00	35,527.08	27.22	21,564	0	0
Total *Kharif* crops		**79,222**	**226.34**	**1,30,519.2**			**337.4**	**111.06**
***Rabi* crops**								
Wheat	732	32,248	236.06	1,18,986	74.10	59,843	438.06	202
Gram	487	15,765	76.78	2,340.08	1.46	1,179	5.74	-71.04
Barseem	970	2,946	28.58	285.335	0.18	145	1.41	-27.17
Mustard	649	13,099	85.01	37,171.9	23.15	18,696	121.33	36.32
Other *Rabi* crops	550.5	16,702	93.94	1,784.35	1.11	896	5.04	-88.9
Total *Rabi* crops		**80,760**	**520.37**	**1,60,567.7**			**571.58**	**51.1**

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