International Journal of Research in Engineering and Science (IJRES)
ISSN (Online): 2320-9364, ISSN (Print): 2320-9356
www.ijres.org Volume 9 Issue 5 ǁ 2021 ǁ PP. 01-13

Impact Assessment of Uttar Pradesh Water Sector Restructuring Project (UPWSRP) Phase -II in the project Area

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Abstract
Uttar Pradesh is the northern state of India. The major economic activity in the state is agriculture. The sector accounts for about 30 percent of the state GDP and 60 percent of the total employment. UPWSRP Phase -II was designed with the objective to enhance the agricultural productivity. Agricultural growth not only has a direct impact on the incomes of rural households but can stimulate growth in the nonagricultural sector through both demand and supply linkages and elevated rural wages. In addition, horticulture and cash crops such as sugarcane will grow in importance and have positive income impacts, especially in the eastern and central parts of the state. The objective of this paper is to assess the impact of UPWSRP project area in the state in relation to the targets was established during the project development phase in the project documents. The midterm impact of project interventions in terms of improvement in irrigation intensity has increased from 61% at baseline to 70% in PY 3 (Yr 2015-16) i.e. an increase of 9% which is the result of increasing discharge in the PLGC and Haidergarh 23 km DN canal system. In the Project area under UPWSRP Phase- II, Paddy Yield has increased from baseline by 15.2% in comparison to non-project area and Yield of Wheat, Pulses and Oilseeds increased w.r.t. baseline value. Value of Agriculture production was observed as increased w.r.t. baseline (9.3 Billion) by 18.27% (11.0 Billion) during the mid-term impact assessment.

Keywords: *Irrigation Intensity, Agricultural output, Crop yield, Irrigated area, Discharge*

Date of Submission: 12-05-2021 Date of acceptance: 25-05-2021

I. Introduction

Uttar Pradesh is the most populous state in India with a population of about 20 crore. Most of the state lies in the fertile Indo-Gangetic Plain endowed with its high natural soil fertility, abundant rainfall, rich surface water and almost universal availability of good quality groundwater. Despite these endowments, the state however is often characterized as a 'lagging state' with low per-capita annual income compared to the national average. State growth rates also lag national figures. The state has been endowed with large fertile Indo-Gangetic plains and a number of fresh water perennial rivers together with almost universally present and accessible fresh ground water reservoir. The well-defined three seasons of winter (Cold and Dry), summer (Hot and Dry) and monsoon (Hot and Humid) provide congenial environment for three crop seasons. The agriculture sector had been the biggest employment provider in the state.

After successful completion and lessons learned from handling Phase I project, Uttar Pradesh Irrigation Water Resource Department (UPIWRD)Phase II project has been initiated on 24.10.2013 with its targeted completion by 31.10.2020 at an estimated cost of Rs. 283500 Lac with World Bank assistance of Rs. 198450 Lac (70% of the total cost) and the remaining Rs. 85050 Lac (30% of the total cost) shall be contributed by the Government of Uttar Pradesh. The Uttar Pradesh Water Sector Restructuring Project (UPWSRP) Phase II is being implemented in the state since October 24, 2013. The UPWSRP Phase II is a multi-facet irrigation project taken up by the State of Uttar Pradesh with financial assistance of the World Bank. It is an Irrigation Development Project, designed and implemented by the Department of Irrigation and Water Resources Government of Uttar Pradesh. It is a multi-faceted innovative Project, being implemented in the state in phased manner. The project was designed with the objective to benefit several irrigation systems namely; Haidergarh Branch (HG) 23 KmDN of Sarda Sahayak (SSK) System, Lower Ganga Canal system/Parellel Lower Ganga Canal and Rohini, Jamni and Sajnam Dam canal systems in Bundelkhand area Canals System, together covering a total CCA of 0.60 million ha (M ha) for system rehabilitation, modernization, productivity and efficiency improvements in the entire state of UP. Agriculture sector growth has to increases significantly to alleviate poverty through rise in income and also contribute to national food security. Rehabilitated, modernized, well-functioning, and fiscally and environmentally sustainable irrigation and drainage systems duly integrated with

seeding of appropriate technology at farmers' level in agricultural inputs and practices was planned under UPWSRP Phase II project area for necessary agricultural and rural income growth. The State Water Policy broadens the Uttar Pradesh Irrigation and Water Resources Department (UPIWRD) mission to provide irrigation, drainage, and flood control services to its beneficiaries in a sustainable manner, to promote participatory irrigation management, and to deliver bulk water to other users as appropriate. Farmer and water users' associations' involvement in managing irrigation and drainage system at the local scale is considered critical for the sustainability of these systems.

The purpose of impact assessment study is to evaluate UPWSRP on the basis of Project Development Objective (PDO) Level Result Indicators, Component wise intermediate result indicators and progress of various works carried out / being carried out by various implementing agencies in the entire state and compiled the data in the impact assessment report by the WAPCOS Limited, a Monitoring Management Information and Evaluation Consultancy (MMISEC) for UPWSRP, author was a part of WAPCOS team for M&E of the project. Monitoring and Evaluation (M&E) is of critical importance for tracking the progress during implementation of various project components, identifying problems as they arise, guiding remedial actions to help and ensure that the project achieves its intended objectives, assessing the impact of the project and taking mid-course corrections. The Project has established a robust monitoring & evaluation system to track technical, institutional, environmental, social, economic, financial, procurement progress and evaluate progress in achieving project outputs as well as out comes as compared to the targets of the project.

Baseline data has been used to compare with mid-term (Project Year Third) results to assess the impact of canal and drainage rehabilitation works in terms of various developmental parameters such as engineering, agriculture, socio-economic, environmental parameters etc. In mid-term assessment, the status of agricultural practices has been assessed up to2015-16 from 2013-14 to 2015-16.

The Mid Term Impact Assessment Report is to explore the status of intended and unintended project impacts due to project interventions initiated and executed during implementation of UPWSRP Phase II activities on the given set of PDO Level Result Indicators and Intermediate Result Indicators. The Baseline was used which are already set out during the project development phase of UPWSRP Phase II activities by using primary and secondary data, as a bench marks for expressing achievements against various indicators.

II. Study Area

Most of the parts of the state lies in the fertile Indo-Gangetic Plain endowed with its high natural soil fertility, abundant rainfall, rich surface water and almost universal availability of good quality groundwater. Despite these endowments, the state however is often characterized as a 'lagging state' with low per-capita annual income compared to the national average. State growth rates also lag national figures. Agriculture sector growth has to increases significantly to alleviate poverty through rise in income and also contribute to national food security. Rehabilitated, modernized, well- functioning and fiscally and environmentally sustainable irrigation and drainage systems duly integrated with seeding of appropriate technology at farmers' level in agricultural inputs and practices are planned in UPWSRP Phase II project area for necessary agricultural and rural income growth.

The State Water Policy broadens the Uttar Pradesh Irrigation and Water Resources Department (UPIWRD)'s mission to provide irrigation, drainage, and flood control services to its beneficiaries in a sustainable manner, to promote participatory irrigation management, and to deliver bulk water to other users as appropriate. Farmer and water users' associations' involvement in managing irrigation and drainage system at the local scale is considered critical for the sustainability of these systems.

The Uttar Pradesh Water Sector Restructuring Project Phase II is a multi-facet irrigation project taken up by the State of Uttar Pradesh with financial assistance of the World Bank. It is an Irrigation Development Project, designed and implemented by the Department of Irrigation and Water Resources Government of Uttar Pradesh. It is a multi-faceted innovative Project, being implemented in the state in phased manner. The project was designed with the objective to benefit several irrigation systems namely; Haidergarh Branch (HG) 23 Km DN of Sarda Sahayak (SSK) System, Lower Ganga Canal system/Parellel Lower Ganga Canal and Rohini, Jamni and Sajnam Dam canal systems in Bundelkhand area Canals System, together covering a total CCA of 0.60 million ha (M ha) for system rehabilitation, modernization, productivity and efficiency improvements in the entire state of UP (Fig. 1).

Haidergarh Branch 23KmDN Command Area the project command is covered by 3 districts Amethi, Barabanki and Raebareily, out of which 7 blocks are fully or partially benefitted by the project (Fig. 2). Under the UPWSRP phase of the Haidargarh 23 KM DN total CCA is 73, 432 ha, 180 Canals including distributaries and total length of canal 685.570 km was considered. In Bundelkhand Command Area the project command area is spread in the district of Lalitpur covering 4 blocks, namely, Bar, Birdha, Mehroni and Mandwara (Fig. 3). Under the Bundelkhand Dam canal system 3 dams namely Rahinin Dam canal (CCA-2912 ha, 5 no. canals and 19.99 km canal length), Jamini Dam canal (CCA-41586 ha, 38 no.

canals and 199.06 km canal length), Sajnam Dam canal (CCA-15468 ha, 19 no. Canals and 105.25 km canal length) was considered under the project Phase II. In Lower Ganga Canal (LGC) Command Area the project is spread over 12 districts which are further divided into 85 blocks (Fig. 4). Under the UPWSRP phase - 2 project of LGC canal system 2 main canal and 5 branches and 2 branch including canal system of was considered. The details of canal command Area (CCA), Number and Length of Canals under the Project UPWSRP Phase II covered are given in table 1 and table 2.

Table1: CCA, Number and Length of Canals under the Project UPWSRP Phase II

Sl	Canal Systems	Project CCA (ha)	Canals(no)	Length(km)
(A)	**Haidergarh Branch 23 Km DN Command**			
	(i) Haidergarh Branch (Km.22.98 down to Tail)	880	1	8
	(ii) Distributaires and their System	72,552	179	677.57
	Subtotal (A)	**73,432**	**180**	**685.570**
(B)	**Bundelkhand Dam Canal System**			
	(i) Rohini Dam Canal	2,912	5	19.99
	(ii) Jamni Dam Canal	41,586	38	199.06
	(iii) Sajnam Dam Canal	15,468	19	105.25
	Subtotal (B)	**58,435**	**62**	**324.30**
(C)	**Lower Ganga Canal System**			
	(i)Lower Ganga Canal (Main Canal) (includes Bandi)	6,171	1	99.360
	(ii) Parallel Lower Ganga Canal (Main Canal)	0	1	89.140
	(iii) Farrukhabad Branch (Branch only)	76,599	1	98.050
	(iv) Bewar Branch (Branch only)	76,068	1	92.613
	(v) Kanpur Branch (Branch only)	1,43,981	1	211.350
	(vi) West Allahabad Branch (Branch only)	2,35,184	1	230.020
	(vii) Fatehpur Branch / Feeder (Branch + Feeder)	137454	2	167.80
	(viii) Etawah Branch system	2,75,029	1	2,083.127
	(ix) Bhognipur Branch System	1,57,566	1	1,043.833
	Subtotal (C)	**11,08,052 (4,65,296*)**	**10**	**4,115.293**
	TOTAL	**5,97,163**	**252**	**5,163.118**

** As per PAD Source: UPIWRD*

Table 2: UPWSRP Phase -II canal System in Project Area

Particulars	Haidergarh 23 Km DN	Bundelkhand	Lower Ganga	Total
Project CCA (ha)	73,432	58,435	4,65,296	5,97,163
Canals (No)	180	62	10	252
Canal Length (km)	686	362	4,115	5,163
Project Districts (No)	Barabanki, Amethi, Raebareli (03)	Lalitpur (01)	Etah,Kashganj,Firozabad, Mainpuri, Farrukhabad, Kannauj, Etawah, Auraiya, Kanpur Nagar, Kanpur Dehat,Fatehpur, Kaushambi (12)	16
Project Blocks (No)	7	4	85	96

** Source: PIP and DPR of UPWSRP Phase II*

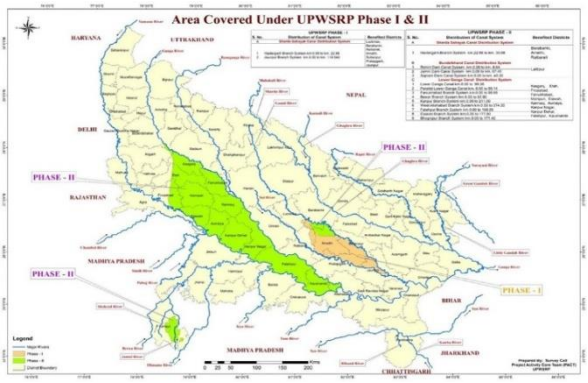

Figure 1: *UPWSRP Phase- II Project Area*

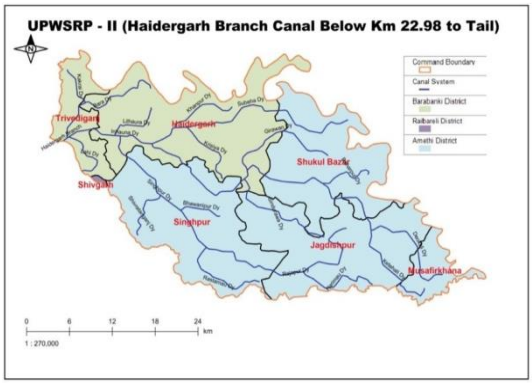

Figure 2: *Haidergarh Branch Canal System 23 Km DN Project Area under UPWSRP Phase- II*

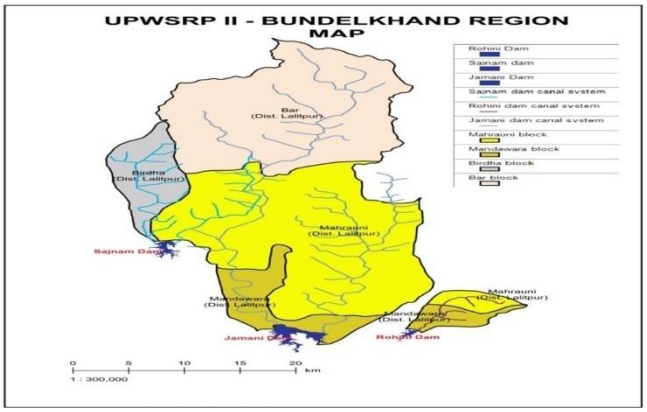

Figure 3: *Bundelkhand Canal System project Area Under UPWSRP Phase- II*

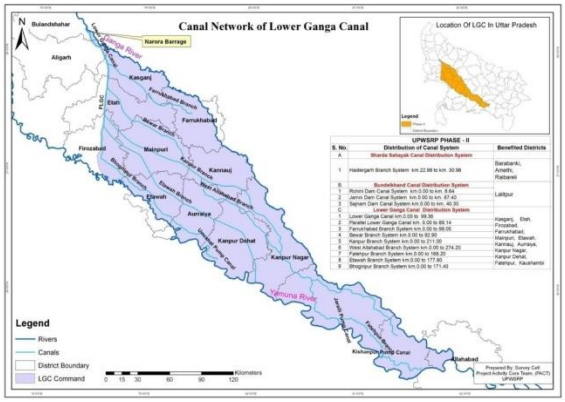

Figure 4: *Lower Ganga Canal Command project area under UPWSRP Phase- II*

Materials and Methods

In this context, the M&E frame work was prepared to cover the entire range of irrigation development and management activities carried out and planned to be carried out under the project that contribute to improve livelihoods and economic development by way of increased crop yields, greater levels of crop production and higher water productivity. The UPWSRP Phase II commenced from 24thOct. 2013 Mid-term impact assessment of activities done up to PY3 (2015-16) from 2013-14 and assess the outputs of various project development indicators delivered to date (October, 2016) have been carried out in this study. The compilation of MTIAR by the MMISEC, WAPCOS Limited, I was also a part of the team during the compilation of report.

Stock-taking of relevant external and internal factors have been done by way of consultation with stakeholders such as Project Activity Core Centre (PACT), State Water Resources Agency (SWARA), State Departments (Irrigation, Agriculture, Rural Development, Groundwater, Remote Sensing) etc., Data acquisition in respect of Irrigation, Agriculture, Meteorology, Remote sensing, Capacity building etc. Baseline data provided in the project document has been used to compare with mid-term results to assess the impact of canal and drainage rehabilitation works in terms of various developmental parameters such as engineering, agriculture, socio-economic, environmental parameters etc.

The project Impact Assessment have been exploring the status of intended and unintended project impacts due to project interventions initiated and executed during implementation of UPWSRP Phase II activities on the given set of PDO Level Result Indicators (set out during the project finalization) and Intermediate Result Indicators. The Baseline developed during the early stages of execution of UPWSRP Phase II activities based on primary and secondary data, which was used for establishing bench marks for expressing achievements against various indicators.

Project Impact Assessment has been carried out on the basis of current status obtained through mainly using secondary data of project area crop yields from Department of Agricultural Statistics and Crop Insurance (DOASCI), Irrigation data from Uttar Pradesh Irrigation and Water Resources Department (UPIWRD), Climate data from India Meteorological Department, (IMD) and crop coverage data from Remote Sensing Application Centre (RSAC). Irrigated Agriculture Improvement Programme is presently in its initial stage carried out by the Department of Agriculture, Uttar Pradesh. Client Surveys: Implementing Agencies, Water User's Associations and Farmers Consultations and Secondary Data collection work have been carried out with the following stakeholders:

In course of consultations, number of sessions were held with officers of various stakeholders which covering Project planning, executing agencies, targets and achievements, Development activities carried out for irrigation system improvement, farmers on efficient irrigation management practices, use of modern agricultural technologies for enhanced agricultural production, Interventions for agricultural production system management, Environmental and Social aspects. A wide range of secondary data and information was collected from Meteorological Data from IMD, Scheme level Distributary wise information on volume of water released (Discharge data) in Kharif and Rabi seasons, area irrigated, Canal rosters and running days from UPIWRD, Cropping pattern, crop yields season wise, application of manures and fertilizers, use of pesticides, from DOA/DOASCI, Data on environmental parameters such as, pre-monsoon and post-monsoon water table status, waterlogged areas etc. from Ground Water Department and Remote Sensing Application Centre. The secondary data statistics have been considered as a base for review, analysis and comparison. The required agricultural data based on crop estimation has been obtained from DOASCI, UP which is their routine practice for the entire state. The data sought from them has been derived as per the project area.

Cropping seasons was Kharif (June – Sept.) Rabi (Oct.- March) and Zaid (April – May) were considered for agriculture data analysis. The crop yields of Paddy, Wheat, Pulses and Oilseeds are targeted to increase with project implementation, Rabi area includes zaid crops also as per PAD. The crop yields are subjected to various agro-inputs and weather adversaries or favours as well. Data collected from the different departments like agriculture productivity, rainfall, discharge data (2011-12 to 2015 -2016), irrigated area, crop yield were segregated as per project command area from 2013-2014 to 215-2016 for all the canal system under the UPWSRP Phase- II. Cropping intensity refers to raising of a number of crops from the same field during on agriculture year. Crop Intensification implies increasing cropping frequency per unit land area by way of growing shorter duration crop varieties and thereby increasing the total crop areas across the three crop growing seasons in the command area in relation to the cultural command area (CCA). It is expressed as cropping intensity which is denoted by the following terms:

$$CroppingIntensity(inpercentage) = \frac{Cropareaofthecommand}{Culturalcommandarea} \times 100$$

Irrigation Intensity was calculated based on the designed irrigated area during the project development phase i.e.507589 h and achievement in the irrigation area under the UPWSRP Phase- II expressed in terms of percentage. Details of execution (engineering interventions) of works information from UPID and SMEC (Third Party Consultancy for Quality control of UPWSRP) were acquired. Project interventions carried out so far mainly pertain to de-siltation and rehabilitation works of canals/drains to enable them to accommodate design level discharge to ensure water reaching up to the tail. For Ground Truthing was ensured through Participating Rural Appraisal (PRA) and Focused Group Discussions with Project Farmers. Evaluation of agriculture related output like irrigated area; crop yield etc. has been done by comparing (i) Before and after project interventions (ii) Project Intervention area with non-project intervention area. Sincetheseasonalrainfallplaysanimportantroleinoverallagriculturalproductivity, the data on seasonal rainfall during the study years have been collated to get a view on variation from the normal and under pinits contribution in influencing the crop yields.

Consistency checks have been performed on the collected data by plotting double mass curves on irrigated area and discharge values for different branch canals (Double mass curves Manual of Hydrology: Part 1; General of Surface-Water Techniques, US Geological Survey water- supply paper 1541-B). The use of a double mass curve as described in this manual is a convenient way to check the consistency of record. Such a check is one of the first steps in the analysis of a long record.

Double mass curve analysis is a commonly used data analysis approach for investigating the behavior of records made of hydrological or meteorological data. It is used to determine whether there is a need for corrections to the data - to account for changes in data collection procedures or other local conditions. Such changes may result from a variety of things including changes in instrumentation, observation procedures, gauge location and surrounding conditions etc. Cumulative Kharif irrigated area plotted against cumulative Kharif Discharge for various branches of LGC and Sarda Sahayak canal system.

Project Performance Indicator

- ✓ Increase in Crop Yields in Project Area
- ✓ Percentage Increase of Agricultural Output in the Project Area
- ✓ Increase in Irrigation Intensity
- ✓ Area Provided with Improved Irrigation and Drainage Services

III. Results And Discussion

Monitoring and Evaluation (M&E) is of critical importance for tracking the progress during implementation of various project components, identifying problems as they arise, guiding remedial actions to help and ensure that the project achieves its intended objectives, assessing the impact of the project and taking mid-course corrections. The Project was established a robust monitoring & evaluation system to track technical, institutional, environmental, social, economic, financial, procurement progress and evaluate progress in achieving project outputs as well as out comes as compared to the targets of the project.

Enhancing Agricultural Productivity and On-Farm Management is designed to contribute to the development objectives of enabling farmers in targeted irrigated areas to increase their agricultural productivity and water use efficiency. In order to produce sustainable agricultural productivity gains, it shall been deavored to establish strong linkages amongst agriculture, irrigation, drainage and institutional strengthening both at the farmer and UPID levels. More productive use of water through new irrigation technologies is critical to the agricultural demand side management of irrigation water for which the establishment of Farmer Water Schools (FWS) is in the centre of the program focus. It is conceived that with enhanced availability of irrigation water

consequential to canal system improvement works and by evolving appropriate institution like farmer water schools, an environment for technology adoption and appropriate use of physical inputs in quality and quantity would be created leading to accelerated growth in agriculture productivity.

Enhancement in Agricultural Productivity is achievable through the Components of Crop Intensification, and irrigation intensification (increase in irrigated crop area) so as to obtain higher crop production and water productivity.

Uttar Pradesh, which is endowed with three distinct seasons – Kharif (hot and humid), Rabi (cool& dry) and Zaid (hot and dry) of diverse climates, improving dry-season irrigation performance through inter-seasonal balance in water supply is a much-needed strategy to propel agricultural productivity. It is anticipated in the Project Appraisal Document (PAD) that the overall cropping intensity in the project area will increase from 127% to 194% aided by improved irrigation services, increased irrigation coverage and significant increase in Zaid cropping.

For Enhancement in Crop Production and Water productivity, the first condition is the increase in irrigated crop area, which is to happen consequential to modernization and rehabilitation of irrigation and drainage system, and improvement in irrigation services to water users. However, in order to gain accelerated growth in agricultural productivity, significant enhancement of crop productivity (Increase in crop yield) is most crucial. Since it is mediated through adoption of improved agronomic technologies and appropriate use of physical inputs, which is a gradual process requiring continued and step-up agricultural extension effort, obviously, it is to happen in incremental manner and crop specific.

The engineering interventions have led to increasing coverage of irrigated area and setting thereby the foundation of increasing crop productivity and hence crop production. In the backdrop of the above contention, the present assessment examines the extent to which the impact on crop productivity enhancement has been realized in the command areas of Haidergarh 23Km DN, Lower Ganga Canal & Parallel Lower Ganga Canal (LGC & PLGC) and Bundelkhand (Rohini, Sajnam and Jamini Dam Canal Systems) by mid-term of the project. Such examination has been made by using project area yield data of various crops collected from the DOASCI, UPID project irrigated area data and discharge data collected from UPID.

3.1 Engineering Interventions

Engineering interventions was designed to enhance the water availability in the command area including rehabilitation and modernization works being carried out on the canal system such as earthwork, lining, structures and drainage works along with Supervisory Control and Data Acquisition (SCADA) and Hydrological Information System (HIS) etc. Haidergarh Branch 23KmDN Command Area the project command is covered by 3 districts Amethi, Barabanki and Raebareily, out of which 7 blocks are fully or partially benefitted by the project (Fig.2).Details of projects Interventions relevant to Agricultural Productivity.

The design discharge of Haidergarh Branch canal was 5850 cusec against which the existing head regulator was able to pass less discharge i.e. 5000 cusec which has been confirmed in IIT Model study report. Therefore, a supplementary head regulator was constructed at chainage 171.5 km in order to enable the Haidergarh branch canal to carry full discharge of 5850 cusec. Accordingly, Supplementary Head Regulator was constructed in June, 2014, which releases the additional discharge of 800 Cusec in Haidergarh Branch Canal which is partially available to Phase-1 Area (Jaunpur Branch) and partially to Phase-2 Area (Haidergarh Branch 23 KM DN).In the feeder canal, there was no requirement of increasing the carrying capacity as there is already a provision in roster for passing the above discharge. Canal re-sectioning works in Haidergarh Branch and its Distributary and Minors started in October, 2014 and likely to be completed by April 2017.Canal re-sectioning completed varies from 76% (in Shukul Bazar) to 89% (in Jagdishpur Block), with an overall achievement of 83.5% (table 3).

Table 3: Canal re-sectioning works in Haidergarh Branch and its Distributary and Minors

Block Details		**Engineering Interventions w.r.t. Canal Re-sectioning**		
Name	**CCA (ha)**	**Required Length (Km.)**	**Achieved PY3 (Km.)**	**% achieved**
Trivediganj	4,843	41.67	34.8	83.51
Haidergarh	19,247	182.41	154.39	84.64
Singhpur	21,613	204.88	171.53	83.72
Shukul bazar	13,108	121.99	93.79	76.89
Jagdishpur	12,773	115.63	103.01	89.08
MusafirKhana	1,848	13.67	10.7	78.27
Total	**73,432**	**680.25**	**568.21**	**83.53**

Source: UPIWRD

In Bundelkhand Command Area the project command area is spread in the district of Lalitpur covering 4 blocks, namely, Bar, Birdha, Mehroni and Mandwara. The engineering interventions relevant to agricultural productivity include canal re-sectioning which have been carried out to a limited extent in various blocks. Project work started in Jan. 2014 and work ranging between 10 to 30% has been completed till (2014-15), with an overall achievement of 16% (table 4).

Table 4: Canal re-sectioning works in Bundelkhand Project area

Block Details		Engineering Interventions w.r.t. Canal Re-sectioning		
Block Name	**CCA (ha)**	**Required Length (km)**	**Achieved (km)**	**% Achieved**
Bar	24998	57.52	6	10%
Birdha	5336	54.74	0	0%
Mehroni	24721	156.24	29.62	19%
Mandwara	3380	55.8	16.98	30%
Total	58435	324.3	52.6	16%

Source: UPIWRD

In Lower Ganga Canal (LGC) Command Area the project is spread over 12 districts which are further divided into 85 blocks. Project interventions include completion of earthwork pertaining to re-sectioning of PLGC in June, 2014 (Earth work completed – 83.13 Lac cum).

3.2 Increase Discharge of the canal systems

Supplementary Head Regulator was constructed in June, 2014, which releases the additional discharge of 800 Cusec in Haidergarh Branch Canal which is partially available to Phase-1 Area (Jaunpur Branch) and partially to Phase-2 Area (Haidergarh Branch 23 KM DN). In the feeder canal, there was no requirement of increasing the carrying capacity as there is already a provision in roster for passing the above discharge. Haidergarh 23 Km Down Command discharge have been observed to increased 3.5 % in 2014-15 and 1.9 % during 2015-16. Reduction in the kharif discharge during 2015-16 was recorded due to low rainfall in the canal command area (Fig.5).In SSC (Haidargarh Branch 23 Km DN) system, the average Kharif discharge at mid-term (Avg. 2014 & 2015) declined by **22.77%** over pre-project (Avg. 2012 & 2013) which is due to canal closures taken for the rehabilitation works during the year 2015-16, the canal running days were **68 days** only as compared to **114, 114** and **135,** days during the year 2012-13, 2013-14 and 2014-15 respectively.

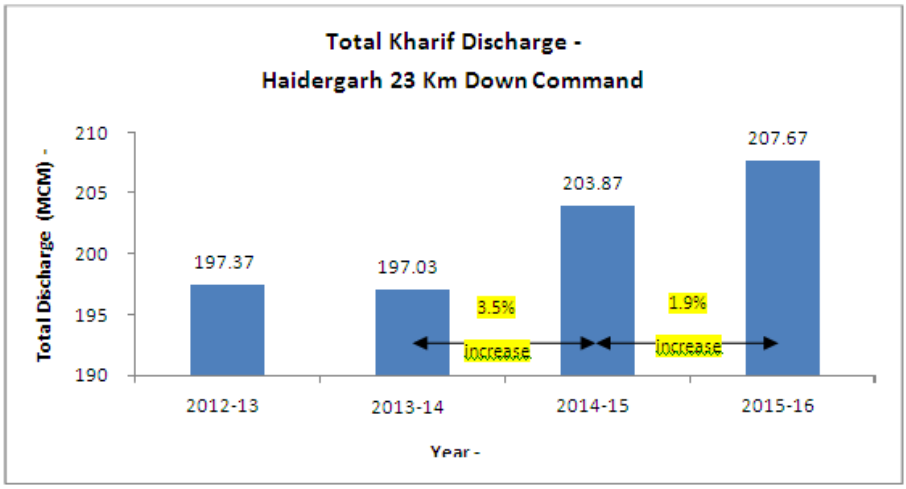

Figure 5: *Total Kharif Discharge in Haidergarh 23 Km DN*

Lower Ganga Canal Commandre-sectioning of PLGC was completed in June, 2014 resulting in increased water availability in LGC Canal System since Kharif 2014-15 and Kharif 2015-16 as indicated as table 5. It is evident from theTable-05 in LGC system average Kharif Discharge at midterm (Avg. of 2014-15 & 2015-16) has increased varying from 19.21 to 28.74 % over the Pre Project-Period (Avg. of 2012-13 & 2013-14) in the branches. The increase observed is due to enhanced carrying capacity through earth work in deepening & widening of PLGC which in turn enhanced the discharge from 4200 to 6480 cusec since June, 2014. The total discharges in LGC&PLGC system and respective branch canals in LGC command are as given below (table 5).

Table 5: Total Kharif Discharge of PLGC and Branches in LGC Command

Year	LGC& PLGC	Branches in LGC Command (MCM)**						
		Farrukhabad Branch	Bewar Branch	Kanpur Branch	Etawah Branch	Bhognipur Branch	West Allahabad Branch	Fatehpur Branch
2011-12 (Baseline)	3772	212	124	1196	836	475	509	273
2012-13	3422	244	201	1087	864	400	440	284
2013-14 (Pre intervention)	3412	239	237	961	782	420	451	280
2014-15	4186	291	225	1273	977	468	545	316
2015-16	4415	290	248	1252	1059	507	525	325
% Increase from 2015- 16 over 2013-14 (Pre intervention)	29	21	5	30	35	21	16	16

***Branch-wise Discharge data for LGC Command from UPIWRD,*

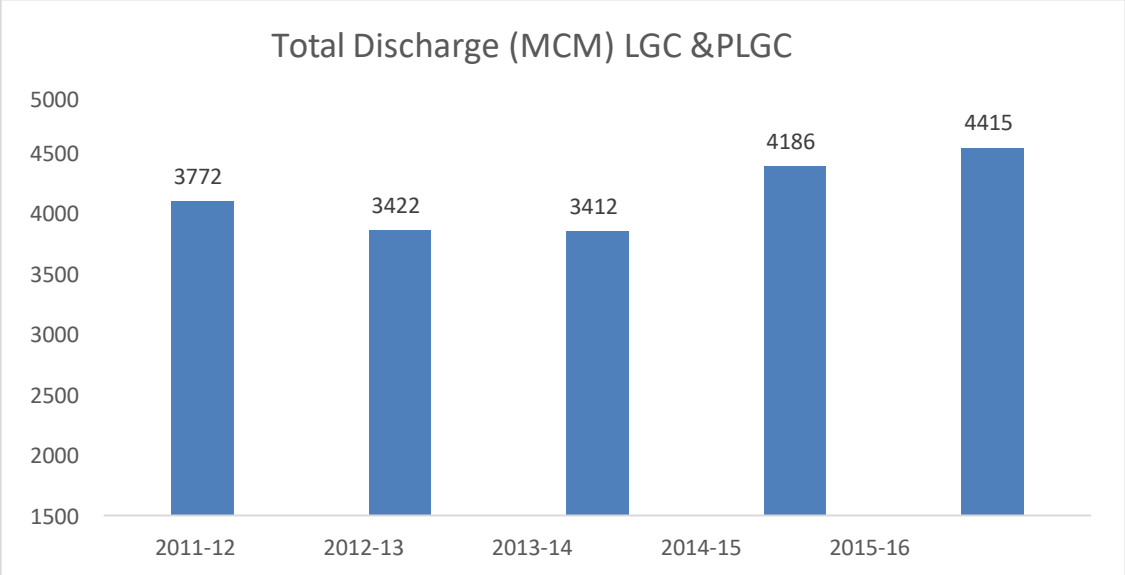

Figure 2: *Yearly Discharge of LGC/PLGC*

As a result of the increased capacity of PLGC since Kharif 2014-15, the total discharge in LGC&PLGC system has increased by 29% over 2013-14 (Pre intervention).The above improvement in branches discharge is attributed to increase in Kharif discharges in PLGC from 4200 to 6480 cusec. The discharges in the system are measured at head of the respective canals at Gauge sites of UPIWRD by department officials. Daily discharge data of PLGC&LGC and its branches has been collected from UPIWRD and compiled. The maximum daily discharge in PLGC (prior to the project interventions) during August/September, 2012 was 4036 Cusec and during June to October, 2013 was 3815 Cusec. Against this, after the project interventions, from July, 2014 onwards, the maximum daily discharge increased during monsoon season of 2014 as well as 2015 (table 5 and fig. 6). The maximum daily discharge released in PLGC during August and September, 2014 was of the order of 6486 Cusec and during September and October, 2015, 6340 Cusec. The comparison of Month-wise Maximum daily discharge during kharif from Year 2012 to Year 2015 is given below (table 6).

Table 6:Month-wise Maximum daily discharge during kharif from Year 2012 to Year 2015 in PLGC

Season	Maximum Daily Discharge (cusec)			
	June	July	August	September
Kharif 2012	3505	3740	4036	3706
Kharif 2013	3815	3815	3815	3815
Kharif 2014	4298	6014	6486	6486
Kharif 2015	5627	6340	6340	6050

Source: UPIWRD

The maximum daily discharges in PLGC vary amongst various Kharif Seasons, due to river run-off variations. Even though the rehabilitation works have not been carried out in branches so far, but the branches are able to carry this increased discharge as the branches were earlier running below their roster/design discharge.

3.3 Irrigated Area in Canal Command

The total irrigated area in 2015-16 (PY-3) in HG 23 DN project area increased by 23.3% over baseline in Kharif season, and 26.8% over baseline in Rabi season with an overall increase of 25.2% over baseline (table 7). Ground truthing/field verification exercises were carried out to ascertain the extent of water availability through canal irrigation throughout the command area. Site visits was organized on various minors along with the revenue staff of UPID. Formal group discussions were held on every minor with the concern farmers. The results observed are as Bara Distributary and Kakrai distributary serving Haidergarh and Trivediganj blocks benefitted from enhanced discharge due to project interventions up to the middle reaches. Site visit and focused group discussions carried out along with farmers on Thanpur Minor (RD 14 km) in the tail reaches revealed no enhanced water availability due to project interventions. In Singhpur block regions being served by minors off taking from Singhpur distributary reflected positive benefits due to re-sectioning works. The irrigated area on Bangra minor (RD 9.86 km) reported enhanced water availability and irrigated area increased on the minor from approx. 80 ha in 2013-14 to 115 rain 2015-16.The water availability from canal irrigation in the tail regions of Singhpur and Rastamau distributaries in Singhpur block was found to be low. This was observed from ground conditions at Paharpur Minor (RD 9.86 km) and focused group discussions with farmers in the tail regions. In Subeha Distributary, serving Shukl Bazar block, medium to low water availability was observed. Beyond the offtake point of Krisiya distributary (RD 5.28 km), no significant impact of project interventions could be observed. In Baharpur Distributary serving Shukl Bazar block, water availability was enhanced up to the minors in the tail regions. However, in the tail minors the benefit was confined to the head reaches only as noted during the field visits and focused group discussions at Chajjupur Minor (RD 4.8 Km), which is the extreme tail minor of the distributary. In Deokali and Katehali distributaries in the tail regions of the command, serving Jagdishpur and Musafirkhana blocks, there was no visible impact due to project interventions. In Musafirkhana block, there was virtually no irrigation. Visits conducted on Dichhauli minor (RD 8.09 km) on Deokali distributary and Emilgaon Minor (RD 6.9 km) revealed poor to no water availability. It is clear that the benefits of enhanced water availability due to project interventions were mainly observed up to the middle reaches of the distributaries and minors. The main reason for this was found to be siltation in the canals and distributaries not running at FSL in the tail regions.

Table 7:Total Irrigated Area in Command for all crops (ha)

Year	Bundelkhand	Haidergarh (HG) 23 Km DN			LGC Command (CCA – 465296 ha)			Grand Total Project Area
	Rabi	Kharif	Rabi	Total	Kharif	Rabi	Total	
Baseline*	37000	16439	19788	36227	1,07,707	1,27,151	2,34,858	**3,08,085**
2013-14					1,26,748	1,41,228	2,67,976	
2014-15		21175	23734	44909	1,29,110	1,46,399	2,75,509	
2015-16	37106	20268	25098	45366	1,32,109	1,40,121	2,72,230	**3,54,702**
% Increase in 2015-16 w.r.t. baseline	**0.29**	**23.29**	**26.83**	**25.23**	**23.7**	**10.2**	**15.9**	**15.9**

**Averaged over 2001/02 to 2011/12 (Ref: UPWSRP-II Project Implementation Plan and UPIWRD Data). This baseline is an average of the actual observed actual irrigated area (AIA) over a tenyear period. This number typically fluctuates year to year depending in the overall water availability and climate conditions.*

The increased capacity of PLGC since Kharif 2014-15, the total discharge in LGC&PLGC system has increased by 29% over 2013-14 (Pre intervention). The above improvement in branches discharge is attributed to increase in Kharif discharges in PLGC from 4200 to 6480 cusec. The discharges in the system are measured at head of the respective canals at Gauge sites of UPIWRD by department officials. Daily discharge data of PLGC&LGC and its branches has been collected from UPIWRD and compiled (table 8). The maximum daily discharge in PLGC (prior to the project interventions) during August/September, 2012 was 4036 Cusec and during June to October, 2013 was 3815 Cusec. Against this, after the project interventions from July, 2014 onwards, the maximum. As can be seen from above, the irrigated area during Kharif season in LGC/PLGC increased with respect to baseline by 23.7% (during which season discharge

was also enhanced by 29% as a result of project interventions) as compared to Rabi season, where the irrigated area increased by 10.2%.The increased discharge in LGC System had an impact over the irrigated area varying from **0.1%** to **25.63%** in various branches when average irrigated area at mid-term (Avg. of 2014-15& 2015-16) was compared with pre-project period average irrigated area (Avg. of 2012-13& 2013-14), whereas average irrigated area at mid-term (Avg. of 2014-15 & 2015-16) when compared with Baseline average irrigated area as per PAD/PIP (Avg. of 2001-02 to 2011-12) the increase varied from 21.97% to 38.75%.

Table 8: Details of Irrigated Area in Project Area (Command) for all Crops (Unit- Ha)

Year	Name of the canal system (ha)			Total (ha)
	LGC	HG 23 KM DN	BKD	
Baseline*	2,34,858	36,227	37,000	**3,08,085**
2015-16	2,72,230	45,366	37,106	**3,54,702**

Source: Block-wise data of Irrigated area for all crops obtained from UPIWRD
**Averaged over 2001/02 to 2011/12 (Ref: UPWSRP-II Project Implementation Plan and UPIWRD Data)*

Ground truthing/field verification exercises were carried out to ascertain the extent of water availability through canal irrigation in the command and project impact, if any. Various divisions of UPID were visited and site visits were organized to ascertain the overall situation in the command area. It was observed that in the 4 branches of LGC, viz. Bewar, Kanpur, Etawah and Bhognipur branches where discharge was enhanced as a result of project interventions, farmers in the middle reaches of the minors observed enhancement in water availability. In West Allahabad & Fatehpur branches, no impact of enhancement of water availability could be observed as these branches cover the tail areas.

The main reasons of poor water availability in the tail regions were the following: (i) Siltation in the branch canals, distributaries and minors, (ii) Channel damages and (iii) Unauthorized irrigation through illegal outlets.

The Project irrigated area is slightly higher than the baseline however there is no significant difference in Bundelkhand. It may be because of canal engineering re-sectioning and rehabilitation/modernization work just is in initial stage on 16% completed. Due to which initial stage of rehabilitation work no significant enhancement in the discharge in the canal command area.

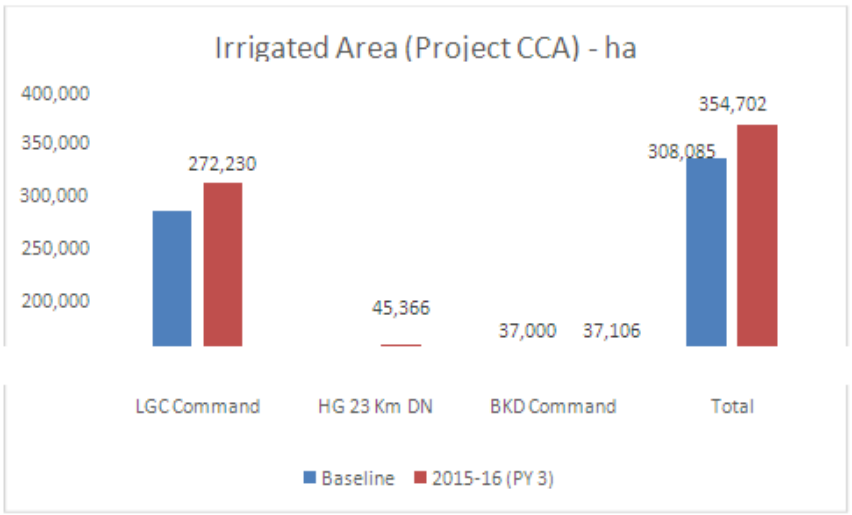

***Figure 7** Irrigated Area in the project command under UPWSRP Phase II*

3.4 Irrigation Intensity In Canal command Area

The impact of Project Interventions in terms of improvement in annual gross irrigated area indicates that the annual gross irrigated area has increased from 308085 ha at baseline to 354702 ha in PY 3 (Yr 2015-16) i.e. an increase of 15% with ultimate objective at the end of project i.e. PY 7 (Yr 2019-20) to reach upto the level of 32%. The impact of project interventions in terms of improvement in irrigation intensity calculated as percentage of annual gross irrigated area to the designed irrigated area indicates that the irrigation intensity has increased from 61% at baseline to 70% in PY 3 (Yr 2015-16) i.e. an increase of 9% which is the result of increasing discharge in the PLGC and Haidergardh 23 km DN canal system (table 9).

Table 9: Irrigation Intensity improvement in the project area

Project Schemes	Without Project/Baseline*		Status at Mid Term (2015-16)	Increase over Baseline
	Kharif	Rabi	Kharif	
Irrigated Area (ha)				
Haidergarh Br 23 Km Dn	16,439	19,788	20,268	
Bundelkhand	0	37,000		
LGC/PLGC	1,07,707	1,27,151	1,32,109	
Total Project Area	1,24,146	1,83,939	1,52,377	
Project Total (Kharif+Rabi)	3,08,085		3,54,702	15.9%
Irrigation Intensity (% of DIA i.e.507589 ha)	**61%**		**70%**	**9%**

**Averaged over 2001/02 to 2011/12 (Ref: UPWSRP-II Project Implementation Plan and UPIWRD Data), Source: UPIWRD*

3.5 Increase in crop yields in project areas

In Haidargarh 23 Km DN the Project area paddy Yield is higher than the non-project area however there is no significant difference. At present the rehabilitation works are in progress and the agricultural interventions are in preliminary stage. Therefore, the impact will be observed once the rehabilitations works are complete and agricultural interventions are in full swing. The above table shows increase in wheat yield within project area compared to non-project area in HG 23 Km DN. The increase is mainly attributed to the rehabilitation works carried out which increased the discharge during Rabi from 34,756 cusec days (Pre-rehabilitation period-2014-15) to 48,196 cusec days (During rehabilitation works 2015-16) i.e. 38.67% increase (table 10).

Paddy productivity increase in LGC is clearly showing the impact of increase in discharge as it is evident that the rainfall has been below normal in the region and in such condition it was the canal water availability due to which the command area farmers could sustain their crop productivity. Rehabilitation works were in progress up to midterm which has hindered the normal canal functioning due to which benefits of interventions were not apparent, once the works are complete and agricultural interventions are in vogue, better response could be observed. In the LGC project command area paddy Yield is higher than the non project area however there is no significant difference. At present the rehabilitation works are in progress and the agricultural interventions are in preliminary stage. Therefore, the impact will be observed once the rehabilitations works are complete and agricultural interventions are in full swing. Wheat in LGC The Project area Yield is higher than the non project area however there is no significant difference. Crop yields of pulses in Project and non- Project area followed approximately similar patterns in LGC system. The Project area Yield is higher than the non project area however there is no significant difference in LGC. Crop yields of wheat in Project and non- Project area followed approximately similar patterns in BKD. Pulses Yield is higher in the project area than the non project area; this increase is a marginal increase in Bundelkhand Canal system (table 10).

Table 10: Yield of all major crops in the project command and non-command project area PY3 (2015-16)

Name of the Canal System	Project Area	Non-Project Area
Paddy Yield (t/ha)		
Haidergarh 23 DN canal System	2.79	2.76
Lower Ganga Canal System	3.49	3.33
Wheat Yield (t/ha)		
Haidergarh 23 DN canal System	2.54	2.18
Lower Ganga Canal System	2.94	2.89
Bundelkhand Canal System	1.78	1.77
Pulses Yield (t/ha)		
Lower Ganga Canal System	0.41	0.41
Bundelkhand Canal System	0.55	0.43
Oilseeds Yield (t/ha)		
Lower Ganga Canal System	0.97	0.77

Ssource: Crop yield data from DoASCI

Crop yields in 2015-16 of all the major four crops in the project have increased vis-à-vis PAD baseline and remained slightly higher than non-project area. Crop yield data up to year 2015-16 as available has been used for impact analysis at mid-term stage. Paddy Yield has increased from baseline by 15.2% and Yield of Wheat, Pulses and Oilseeds increased w.r.t. baseline value (table 11). The crops in Rabi 2015 were affected due to calamitous weather during grain ripening stage.

Table 11: Over all Crops Yield improvement in the project command and non-command project area

Crop	Baseline as per PAD*	2015-16	
		Project Area	Non-Project Area
Paddy	2.9	3.35	3.30
Wheat	2.5	2.81	2.79
Pulses	0.5	0.53	0.42
Oilseeds	0.75	0.82	0.78

**Baseline was considered base on UPWSRP Phase 1 project (ICR report, 2012), As per PAD., Source: Crop yield data from DoASCI*

3.6 Percentage Increase of Agricultural Output in the Project Area

The baseline value of agricultural production in project area is assessed at Rs. 9.3 Billion on the basis of the economic and financial analysis of the project (as per PAD). Value of Agriculture production has increased in PY3 w.r.t. baseline by 18.27% (11.0 Billion). Crop yield data up to year 2015-16 as available has been used for impact analysis at mid-term stage. Paddy Yield has increased from baseline by 15.2% and Yield of Wheat, Pulses and Oilseeds increased w.r.t. baseline value.The crops in Rabi 2015 were affected due to calamitous weather during grain ripening stage.Year-wise values of Agricultural Output for all commands are as under (table 12 and table 13).

Table 12: Agricultural Output in the Project Area

Year	Sown Area of Entire System	Yield (t/ha)	Production (Tonne)	MSP* (Per Tonne)	Output (Billion)
Paddy					
2013-14	1,07,295	3.76	4,03,578	10,000	4.04
2014-15	1,13,810	3.56	4,05,477	10,000	4.05
2015-16	1,12,751	3.35	3,77,262	10,000	3.77
Wheat					
2013-14	1,87,535	3.39	6,35,772	11,700	7.44
2014-15	2,07,481	2	4,15,697	11,700	4.86
2015-16	2,03,537	2.81	5,70,976	11,700	6.68
Pulses					
2013-14	11,634	0.47	5,418	26,840	0.15
2014-15	25,688	0.61	15,722	26,840	0.42
2015-16	272,99	0.53	14,368	26,840	0.39
Oilseeds					
2013-14	9,011	0.74	6,706	18,633	0.12
2014-15	7,522	0.79	5,933	18,633	0.11
2015-16	9,745	0.82	8,025	18,633	0.15

**MSP as per Chapter-XII Economic Analysis (Annexure-19) of PIPDocument, Source: DOASCI*

Table 13: Details of Agricultural Output during 2015-16 of the project area

Crop	Yield (t/ha)	Sown Area (ha)	Production (Ton)	MSP * (Rs. Per Ton)	Agricultural Output (Rs. Billion)
Paddy	3.34	1,12,751	3,76,588	10,000	3.8
Wheat	2.81	2,03,537	5,71,939	11,700	6.7
Pulses	0.53	27,299	14,468	26,840	0.4
Oilseeds	0.82	9,745	7,991	18,633	0.1
Total		**3,53,332**	**9,70,987**		**11.0**

*MSP as per Chapter-XII Economic Analysis (Annexure-19) of PIPDocument, Source: DOASCI

Table 14: Status of rainfall (mm) in LGC and SSC Systems during the project assessment

Kharif	LGC	SSC
Normal	690.42	854.77
2013-14	689.04 (99.85%)	802.38 (93.87%)
2014-15	269.02 (38.96%)	455.82 (53.33%)
2015-16	282.44 (40.91%)	318.59 (37.27%)

Source: IMD, *(Data in parenthesis are percentage rainfall compared to normal rainfall)*

Since the seasonal rainfall plays an important role in overall agricultural productivity, the data on seasonal rainfall during the study years have been collated to get a view onvariation from the normal and underpin its contribution in influencing the crop yields.Though the average annual rainfall and discharge of the same periods have marginally increased, which shows positive impact of the drainage interventions in

the project area. The yearly fluctuations may be attributed to seasonal rainfall variations and farmer practices.

3.7 Policy Implications

One important policy implication is that these Water sectors projects may not be achieve the project outcomes within the schedule project timeline which were designed during the preparatory phase of the project. Another implication of this study is secondary data statistics have been considered as a base for review, analysis and comparison.

IV. Conclusion and Policy Implications

Uttar Pradesh Water Sector Restructuring Project Phase- II was especially designed for rehabilitation and modernization of canals through which increase the crop yields and ultimately goal of the project is to reduce the poverty in the state. It is concluded that the major impacts and achievements of the project as in Haidergarh (HG) 23 Km DN Command Release of additional discharge of 800 cusec water due to construction of supplementary head regulator in Haidergarh branch in 2014-15, so as to meet the designed discharge of 5850 cusec. Productivity of Wheat in Rabi (2015-16) increased compared to non-project area due to re-sectioning & ongoing rehabilitation works. In Bundelkhand Command Hydrological Information system (HIS) installed at Rohini, Jamini & Sajnam Dams. In Lower Ganga Command Discharge increased from 4200 cusec to 6480 cusec in PLGC, due to canal re-sectioning works completed in June 2014 (Earth work completed – 83.13 Lac cum). Due to increased discharge in PLGC, the discharge increased in all branches, resulting in 23.7% increase in irrigated area (Kharif) w.r.t. baseline. Area improved in irrigation services total CCA of the project is 597Thousand ha and at the end of the project the total irrigated area of 470 Thousand ha is envisaged to be achieved including the existing area under irrigation. Therefore, total area provided with improved irrigation and drainage services at the end of the project may not exceed 470 Th. ha. Achievements at Mid-term impact assessment in 2015-16 on the basis of weightages assigned to different civil works of rehabilitation/modernisation are SSK 33.295 Th. ha (against total 69Th ha) BKD0 Th. ha (against total 47Th ha) LGC 66.030 Th. ha (against total 354Th ha) 99.325 Th. ha (against PY7 revised Total 470Th ha Delay in achieving the Mid-term target is proposed to be made good by proposing a rescheduled plan. It needs to be pointed out that for enhancement of crop yields, besides water availability, other factors of production and improved agricultural.

Acknowledgements

I am thankful to the different stakeholders involved in the project implementation from various departments as well as World Bank for financial support to the Govt. of Uttar Pradesh. I would also like to show our gratitude to the Er. K.K. Jain, Chief Engineer, PACT, Er. Amitabh Kumar, Nodel Officer for M&E, PACT, UPIWRD for sharing their pearls of wisdom during the impact evaluation of the project. I am also immensely grateful to Dr. V.P. Singh (Team Leader), Dr. K.K. Gaur (Social Expert) and Mr. Rohit Mishra from Monitoring and Evaluation consultancy of the Project, WAPCOS Ltd for their valuable contribution in the impact assessment.

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