



Federal Project Management Unit (FPMU)
Ministry of National Food Security & Research, Islamabad

Monitoring, Evaluation and Impact Evaluation (ME&IE) Consultants

For

National Program for Improvement of Watercourses in Pakistan Phase-II (NPIWC-II)

MONITORING, EVALUATION, AND IMPACT ANALYSIS OF THE PROJECT “NATIONAL PROGRAM FOR IMPROVEMENT OF WATERCOURSES IN PAKISTAN PHASE-II (NPIWC-II)”

CONTENTS

| | |
|--|----|
| EXECUTIVE SUMMARY | 1 |
| 1. INTRODUCTION | 6 |
| 1.1 Project Components | 6 |
| 1.1.1 Organization of Water Users Association (WUAs)-Component C1: | 6 |
| 1.1.2 Watercourse (WC) Improvement-Component C2: | 6 |
| 1.1.3 Construction of Water Storage Tanks (WSTs)-Component C3: | 7 |
| 1.1.4 Provision of Laser Land Leveling (LLL) Units- Component C4: | 7 |
| 1.2 Project Territorial Coverage | 7 |
| 1.3 Zone-wise / Unit-wise Project Targets | 7 |
| 1.3.1 Organization of Water Users’ Associations (WUAs)-Component C1 | 7 |
| 1.3.2 Improvement of Watercourses (WCs)-Component C2 | 7 |
| 1.3.3 Construction of Water Storage Tanks (WSTs) - Component C3 | 8 |
| 1.3.4 Provision of Laser Land Leveling (LLL) Units- Component C4 | 8 |
| 1.4 Impacts of the Project (NPIWC-II) | 9 |
| 1.4.1 Project Direct Benefit under the Project | 9 |
| 1.4.2 Project indirect benefits to industry/economic activities | 9 |
| 1.4.3 Awareness support to farmers | 9 |
| 1.5 Project Beneficiaries | 9 |
| 1.6 Project Development Objectives | 9 |
| 2. PROJECT PROGRESS AND MONITORING | 10 |
| 2.1 Improvement of Watercourses | 10 |
| 2.2 Construction of Water Storage Tanks (WSTs) | 11 |
| 2.3 Delivery of Laser Land Leveling (LLL) Units | 12 |
| 3. MONITORING AND EVALUATION OF ORGANIZATION OF WATER USERS ASSOCIATIONS (C1) | 12 |
| 3.1 Impact and Evaluation of Improvement of Watercourses (C2) | 13 |
| 3.2 Impact and Evaluation of Construction of Water Storage Tanks (WSTs) - (C3) | 14 |
| 3.3 Impact and Evaluation of Laser Land Leveling (LLL) Units (C4) | 15 |

LIST OF TABLES

| | |
|--|----|
| Table 1: Increase in Cultivated / Cropped Area and Increase in Income (Gross/Net) Of the Farms from Completed Watercourses..... | 3 |
| Table 2: Increase in Area, and Income of the Farms from Completed Water Storage Tanks (WSTs)..... | 4 |
| Table 3: Zone-wise/ Unit-wise Targets of WUAs under NPIWC-II..... | 7 |
| Table 4: Improvement of Watercourses (WCs)..... | 8 |
| Table 5: Zone-wise / Unit-wise Water Storage Tanks to be constructed under NPIWC-II..... | 8 |
| Table 6: Zone-wise/Unit-wise Planned LLLs Units and Area coverage under NPIWC-II Project | 9 |
| Table 7: The Results Indicators of NPIWC-II, Project..... | 10 |
| Table 8: Watercourses Improvement, Achievement vs. Target up to June 2023 | 11 |
| Table 9: Construction of Water Storage Tanks (WSTs) vs. Target up to June 2023 | 11 |
| Table 10: Provision of PLL Units: Achievements versus Project Targets by the End of June 2023 | 12 |
| Table 11: Increase in Cultivated / Cropped Area and Increase in Income (Gross/Net) Of the Farms from Completed Watercourses..... | 14 |
| Table 12: Increase in Area, and Income of the Farms from Completed Water Storage Tanks (WSTs) | 15 |

EXECUTIVE SUMMARY

The Government of Pakistan is implementing a National Program for Improvement of Watercourses in Pakistan, Phase-II (NPIWC-II) funded by the Ministry of National Food Security and Research (MNFSR), Islamabad. The executing agencies (EAs) are the Federal Water Management Cell (FWMC), Provincial Directorates of OFWM, and respective departments of AJ&K, GB, and ICT and Water Users Association (WUAs). The Project Consultant (NESPAK & JV Partners) carries out the project supervision. The task of Monitoring Evaluation & Impact Evaluation has been entrusted to ME&IE Consultants. The coordination rests with the Federal Project Management Unit (FPMU) and Federal Water Management Cell (FWMC).

The Project comprises 4 Components: namely (1) Social Mobilization (Capacity building and establishment of Water Users Associations), (2) Reconstruction/renovation and remodeling of 47,278 watercourses, (3) Construction of 14,932 Water Storage Tanks, and (4) Provision of 11,610 Laser Land Levelers.

The Project Covers Punjab, Khyber Pakhtunkhwa (KP), Balochistan, Gilgit Baltistan (GB), Azad Jammu and Kashmir (AJ&K), and Islamabad Capital Territory (ICT).

Project Direct Benefit includes, a cropping intensity to increase by 5-20%, Crops yield to increase by 10-15%, Equity in water distribution to increase by about 30%, water disputes/thefts and litigation amongst the Farmers over water distribution to reduce by about 80%, Help poverty reduction through the generation of employment and Self-sufficiency in food through the utilization of water saved.

The total number of project beneficiaries is estimated at 1.668 million farmers (owners as well as tenants). Taking family size at five, the total net population benefitting is expected to be 8.34 million people.

In the middle of the assignment, ME&IE Consultants are required to submit a Midline Survey/ Mid-term Impact Evaluation report. Thus, in compliance with its contractual requirement, the ME&IE Consultants have prepared this report which evaluates the Project's mid-term Monitoring and Impact assessment results up to the end of June 2023 unless mentioned otherwise elsewhere. It is to be clarified here that these assessments are, however, not final. Rather these are interim and until all the surveys and studies are completed after the termination of all project activities, these will remain indicative. Thus, these assessments should be taken just as interim or indicative and not final for the time being. The main findings of the report are summarized below:

Progress and Monitoring of the Project (NPIWC-II):

During the Project period (4 years), a total number of 39,510 watercourses were targeted to be improved. By the end of June 2023 (during 4 years), 13,777 watercourses had been improved, showing only 35% achievement. As far as Zone-wise / unit-wise, in Punjab out of 7,600 watercourses, 4063 watercourses 53.5% (3,416 additional linings, 647 unimproved watercourses improved) were constructed.

During the Project period (4 years), a total number of 12,257 Water Storage Tanks were targeted to be constructed. By the end of June 2023, during 4 years, 5,390 WSTs were constructed, thus showing only 44% achievement. As far as zone-wise/unit-wise, in Punjab out of 2,300 WSTs 1,021 WSTs were constructed, showing 44.4% achievement.

During the Project period (4 years), a total number of 10,060 Precision Laser Land Leveling (LLL) Units were targeted to be delivered. By the end of June 2023 (during 4 years), 5,928 PLL Units were delivered showing a progress of 59% achievement. As far as zone-wise/unit-wise, in Punjab out of 8,100 LLLs, 5,844 LLL units were accomplished, which shows 72.1% achievement.

Evaluation of Organization of Water Users' Associations - Component C1

On an overall basis, 85% of farmers were aware of the existence/working of WUAs on their watercourses. About 94% of respondents informed that OFWM used to hold awareness meetings before the formation of the WUAs. About 74% of members had been participating in the meeting of WUAs and 98% of members reported that the WUAs were formed through a democratic process. On the whole, 92% of respondent farmers were found to be members of WUAs of which 42% were located at the head of WC reaches, 33% at middle reaches, and 25% at tail reaches and 88% of members were found water users of lined watercourses. About 94% of farmers reported that WUAs were functioning properly.

About half (49%) of the respondent farmers informed that meetings by WUAs were held, 27% informed that no meetings were held and 24% were of the view that these meetings were held to some extent. Moreover, 39% of respondents informed that they always participated in the meetings, 60% participated occasionally and one percent never participated.

Out of the total, 8% of respondents informed that the meetings were held every month, 6% said quarterly, 2% once a year and the remaining 84% informed that these meetings used to be held as and when need arose. About 85% of respondents informed the WUAs were established through a democratic process.

About 97% of member farmers responded that they faced no dispute. Only 3% faced disputes, out of which 50% always got their disputes resolved, 38% to some extent, and 12% never got their disputes resolved.

Out of 3% of respondents who faced disputes, 31% related to Land Acquisition, 59% on the distribution of Naccas, and 10% regarding funding for accounts. About 45% of disputes were solved by WUAs, 50% by OFWM department, and 5% by Irrigation Department.

Impact Evaluation of Watercourses (WCs) - Component C2

Land use intensity due to watercourse improvement on sample farms has increased by an average of 4.1%, meaning thereby an increase of 4.1% in cultivated areas. Cropping intensity has increased by 10.9%. These increases in land use and cropping intensities have resulted in about an 11.8% increase in cropped areas under various crops.

The Watercourse Improvement Impact on Crop Yields per acre varied from 4% to 49% averaging at 11.4% on an overall basis.

The cumulative impact of watercourse improvement is reflected in the total production of various crops. Production of various crops has increased at different rates varying from 11.6% in the case of peaches to 317.6% in the case of other vegetables. However, the weighted average impact is calculated at 23% (11.4% due to yield increase 11.8% due to area increase, and 1 percent due to interaction between the two).

Of the total completed watercourses up to June 2023, total increases in crop area have also been estimated. Of the total of 12,968 (excluding GB) improved watercourses, the increase in the crop area has been estimated at around 196 thousand acres.

The impact of watercourse Improvement on agriculture employment has also been significant. Labor man days at the farm have increased ranging from 2 percent to more than 100% after WC Improvement averaging at 15% due to an increase in crop area, crop yields, and crop production.

The impact of WC Improvement on per-acre net income varies from crop to crop. It varies from PKR 1,008 for cotton to PKR 37,950 for vegetables per acre averaging at PKR. 4,053 for all crops.

Water Conveyance Efficiency on 20% lined additional improved watercourses increased by 14%age point and on new 50% lined watercourses increased by 29%age point. On piped lined watercourses efficiency increases by 50%. Overall saving in water losses calculates to 30% of 154 AF per watercourse per annum. In total 2.0 MAF water saved from the improvement of watercourses, indicates \$800 million (Rs.224 billion) saved from these improved watercourses.

Spot Checking of Trees on Watercourses shows that 3,552 trees were cut down during the process of their improvement. As per the rule, at least three times (10,656) trees were required to be planted in place of 3,552 cut-down trees, however, during the spot check it was observed that only 5,259 saplings (49% of the required ones) were planted out of which, 2,731 (52%) were survived after one year of their plantation.

Spot-checking of Brick Lined Watercourses shows that the compliance of engineering parameters on Rectangular / Brick Lined Watercourses, on the whole, was satisfactory. However, lining length as per design was found on 76% of watercourses. Full-length improved water courses were extremely low; the Katcha portion of only 18% was fully improved. Katcha portions of the remaining 82% of watercourses remained unimproved.

Spot Checking of PCP Lining Watercourses: On Parabolic (PCPL) Watercourses, compliance with most of the parameters was found satisfactory. However, Lining length as per design was found on 73% of watercourses and full-length improved water courses were extremely low i.e., only 16%.

Spot Checking of Pipelined Watercourses: The quality of the pipe was found good in 51% of cases, satisfactory in 45% of cases, and poor in 4% of cases only. Pipeline length was as per design in 93% of cases, bends and flanges were as per design in 68% of cases, tees were as per design in 63% of cases and sockets were 56% as per design.

Due to 12,968 watercourse improvements (excluding GB), the cultivated area increased by 61,144 acres, the cropped area by 196,304 acres, gross income increased by Rs. 43,352 million, and net income by Rs. 19,414 million. Zone-wise/ Unit-wise detail may be seen in Table 1.

Table 1: Increase in Cultivated / Cropped Area and Increase in Income (Gross/Net) Of the Farms from Completed Watercourses

| S. No | Zone / Unit | Increased Cultivated Area (Acres) | Increased Cropped Area (Acres) | Increased Gross Income (Rs. in Million) | Increased Net Income (Rs. in Million) |
|-------|--------------|-----------------------------------|--------------------------------|---|---------------------------------------|
| 1 | Punjab | 18,624 | 86,615 | 29,209 | 12,530 |
| 2 | KP | 4,901 | 39,072 | 5,673 | 2,702 |
| 3 | Balochistan | 25,213 | 69,188 | 8,122 | 4,028 |
| 4 | AJ&K | 225 | 1,399 | 344 | 152 |
| 5 | ICT | 10 | 31 | 5 | 2 |
| | Total | 61,144 | 196,304 | 43,352 | 19,414 |

Impact Evaluation of Water Storage Tanks (WSTs) - Component C3

Land use intensity due to WSTs Construction on sample farms has increased on an average by 6.3%, meaning thereby an increase of 6.3% in cultivated area. Cropping intensity has increased by 15.4%. These increases in land use and cropping intensities have resulted in about a 22% increase in cropped area under various crops.

The WSTs construction Impact on Crop Yields per acre varied from 6.6% in the case of Rabi fodder to 16.7% in the case of pulses, averaging 10.2% on an overall basis.

The cumulative impact of WSTs is reflected in the total production of various crops. Production of various crops has increased at different rates varying from 20% in the case of cotton to 86% in the case of sugarcane. However, the weighted average impact is calculated at 35% (10% due to yield increase 22% due to area increase, and 3 percent due to interaction between the two).

Of a total of **5,062** completed WSTs (excluding GB) up to June 2023, total increases in the area have also been estimated at 10,604 acres.

The impact of WSTs on agriculture employment has also been significant. Labor man days at the farm have increased ranging from 10% to 69% after WSTs construction averaging at 22% due to an increase in crop area, crop yields, and crop production.

The impact of WSTs on per-acre net income varies from crop to crop. It varies from 1,008 PKR for cotton to 37,905 PKR for other vegetables per acre averaging at 22,262 PKR for all crops.

Before the construction of the tank, there was no such saving of water losses. The total water storage capacity from the sources mentioned above of the tank along with the reported filling-up frequency leads to calculating the water-saving impact. Overall, saving in water losses calculates to 7.31 acre-feet per Storage Tank per annum. It shows that on an overall basis, 39,401 acre-feet (0.0394 MAF) of water was saved. As per the

estimated economic value 1 MAF = \$ 400. It means due to Water Storage Tanks water savings the economic value becomes \$15.76 million (Rs. 4.41 billion)

On 222 spot-checked WSTs, 256 trees were reported to be cut down. In their place 922 (more than thrice as per requirement) Saplings were planted out of which 327 survived after one year. WST protection arrangements were about 84% satisfactory and 98% of WSTs were properly maintained.

Out of 222 spot-checked WSTs, satisfactory Excavation Certificates were issued by the Consultants to 192 (87%) WSTs.

About 171 (77%) WSTs were completed before receiving the subsidy amount. The rest 51 (23%) were completed after receiving the subsidy from the department.

Out of a total of 222 spot-checked WST, on an overall basis, 203 (91%) have been completed as per approved standards and specifications.

Due to 5,062 WSTs (excluding GB), the cultivated area increased by 3,460 acres, the cropped area by 10,604 acres, gross income increased by 3,275 million PKR, and net income by 1,780 million PKR. Zone-wise detail may be seen in Table 2.

Table 2: Increase in Area, and Income of the Farms from Completed Water Storage Tanks (WSTs)

| S. No | Zone/Unit | Increased Cultivated Area (Acres) | Increased Cropped Area (Acres) | Increased Gross Income (Rs. in Million) | Increased Net Income (Rs. in Million) |
|-------|--------------|-----------------------------------|--------------------------------|---|---------------------------------------|
| 1 | Punjab | 420 | 2,558 | 982 | 635 |
| 2 | KP | 793 | 2,955 | 878 | 477 |
| 3 | Balochistan | 1,781 | 3,862 | 1,097 | 596 |
| 4 | AJ&K | 466 | 1,229 | 318 | 173 |
| | Total | 3,460 | 10,604 | 3,275 | 1,780 |

Impact Evaluation of Provision of Laser Land Levelling (LLs) Units (Component C4)

Educational Profile of Sample Beneficiaries: Most of the beneficiaries (95%) were found literate. About 15% of beneficiaries are primary/middle level, 27% matric, 20% Intermediate, 25% Graduates, and 9% postgraduate.

Suppliers of Precision (Laser) Land levelers: In Total 160 Laser Land Leveling (LLs) sample units have been supplied, 148 were delivered in Punjab, 5 in KP and 7 in Balochistan. The Supply and Service Companies (SSCs), namely Crosfield Agro (21), Easy Farming (24), Modern Farming (14) and Ruba Digital Laser (21) and other SSCs (80).

About 56% of LLL drivers were fully trained for running LLLs in the field and got formal training. Around 41% were self-trained and the remaining 3% were found un-trained during the monitoring survey.

About 64% of respondents ranked these LLL units as good, 31% as satisfactory, and 4% as unsatisfactory. About 1 to 2 percent responded that they did not know. It means that 95% of beneficiaries regarded the quality/durability of the delivered LLL units as satisfactory at least.

Regarding after-sales service, 61% regarded it as good, 13% as poor, 6% as very poor, and 21% responded that they did not know.

About 53% of beneficiaries responded that the attended complaints by SSCs were prompt and 16% informed that the complaints were not being attended promptly.

As for the prices of LLL, 9% of respondent beneficiaries informed that the SSCs charged high prices, 54% informed that the prices were normal, and the remaining 37% responded that they did not know.

The respondents were also asked about the availability of spare parts by the SSCs. Out of a total of 160 respondents, 30% responded that spare parts were available with SSCs whenever required, 7% informed that it took a long time, whereas the remaining 63% informed that they did not need these spare parts as yet.

As for the prices of PLL spare parts charged by the SSCs, 8% of respondent beneficiaries informed that the SSCs charged high prices, 27% informed that the prices were normal, and the remaining 66% responded that they did not need these spare parts as yet.

The respondent beneficiaries were also asked about the availability of spare parts in the open market. About 36% of respondents informed that these spare parts are only available with the SSCs, 7% informed that the spare parts were also available in the market, while the rest 57% informed that they did not know.

While spot-checking, all 160 (100%) respondents were using PLL for agricultural purposes. No respondent was found using LLL for non-agricultural purposes.

The LLLs were also spot-checked concerning their working conditions. Out of the total, 60% were found in good condition and well-maintained. The condition of 35% was satisfactory and the remaining 5% were found in poor/unsatisfactory condition.

Record Keeping of Laser Land Leveling Services to Other Farmers: About 97% of PLL owners provide laser leveling servicing to the other fellow farmers. Out of these service providers, only 14% keep a complete or partial record of their lending services. Out of these 14 percent, 55% keep records on logbooks, 36% on loose papers.

Land Leveled during the last Rabi and Kharif cropping Seasons: The total laser land leveled by the 160 respondent PLL owners during the last Rabi and Kharif cropping seasons was 40,711 acres or 254 acres per LLL. Out of these total 40,711 acres, 4,092 acres (26 acres per equipment) were owned land, and 36,619 acres (228 acres per equipment) were laser leveled on rent of other fellow farmers.

LLL Beneficiaries: Total annual LLL beneficiaries calculated to 11,331 farmers including the owners themselves or 71 farmers per equipment.

Impact of LLL on Crop yields: The impact of LLL on crop yield was also assessed through the farmers' perception. The growers were of the view that laser leveling increases yields of various crops ranging from 8% to 14% averaging at 11% on the whole. The economics and economic benefits of PLL use were also estimated. The total number of delivered LLLs up to the end of June 2023 is 5,928. At the rate of 254 acres per PLL, the total area leveled by all the delivered LLLs is calculated as 1,506 thousand acres. Net benefits per LLL come to 521 thousand PKR per annum and for a total of 5,928 delivered LLLs, these calculate to 3,091 million PKR.

Water Saving Impact of LLL Units: Information was also asked from the growers regarding the saving of water due to Precision Land Leveling. On average 25% saving in water use has been reported.

Economic Analysis: The benefit-cost ratio at a 12% discount factor in the evaluation is calculated (B/C) at 2.5 and the Internal Rate of Return (IRR) is 50%.

INCOME FROM THE PROJECT INTERVENTIONS (30th June 2023)

WATERCOURSES (WCs)

| | |
|---|---------------------------|
| Water saved per watercourse per annum | 154 AF |
| Total Water saved from improved watercourses (12,968 WCs) | 2.0 MAF |
| The Total Value of water saved in US dollars | \$ 800 |
| The total value of water saved in Pak Rupees (Current) | Rs. 224.00 billion |
| Net income from increased cropped areas | Rs. 19.41 billion |
| Total estimated income from improved watercourses | Rs. 243.41 billion |

WATER STORAGE TANKS (WSTs)

| | |
|--|-------------------------|
| Water saved per water storage tank per annum | 7.31 AF |
| Total Water saved from water storage tanks (5,389 WSTs) | 0.0394 MAF |
| The Total Value of water saved in US dollars | \$ 15.76 million |
| The total value of water saved in Pak Rupees (Current) | Rs. 4.41 billion |
| Net income from increased cropped areas | Rs. 1.78 billion |
| Total estimated income from improved watercourses | Rs. 6.19 billion |

LASER LAND LEVELERS (LLs)

| | |
|--|-------------------------|
| Total Area leveled (5,928 LLs) | 1,506(000) Acres |
| Net benefits per LL per Annum | Rs. 5, 21,000 |
| Total benefits from Laser Land Leveling (LLs) Units | Rs. 3.09 billion |

On net and on an overall basis total estimated benefits of all three interventions is Rs. 252.69 billion (243.41 WCs + 6.19 WSTs + 3.09 LLs).

1. INTRODUCTION

The Government of Pakistan is implementing a National Program for Improvement of Watercourses in Pakistan, Phase-II (NPIWC-II) funded by the Ministry of National Food Security and Research (MNFSR), Islamabad. This Project covers Punjab, Khyber Pakhtunkhwa (KP), Balochistan, Gilgit Baltistan (GB), Azad Jammu & Kashmir (AJ&K) as well as Islamabad Capital Territory (ICT) at a total cost of PKR 154, 542.355 million (Umbrella PC-I) over five (05) years. The executing agencies (EAs) are the Federal Water Management Cell (FWMC), all provincial departments of agriculture (Provincial Directorates of OFWM) and respective departments of AJ&K, GB, and ICT, district Governments, and Farmers' Organizations (FOs) / Water Users Association (WUAs). For Monitoring, Evaluation, and Impact Evaluation, a joint venture of G3 Engineering Consultants Pvt. Ltd., Ease-Pak Engineering Services (Pvt.) Center for Social Research and Development (CSR) and ADA Incorporated, Canada has been selected through a competitive bidding process as ME&IE Consultants. The project supervision is carried out by the Project Consultant (NESPAC & JV Partners). The coordination rests with the Federal Project Management Unit (FPMU) and Federal Water Management Cell (FWMC).

1.1 Project Components

The following components are present in the Project

1.1.1 Organization of Water Users Association (WUAs)-Component C1:

The effective involvement and participation of the shareholders act as a catalyst for the successful implementation of any development undertaking. The Social Mobilization through capacity building of Water Users Associations / Farmers Organizations in improved water management techniques and their registration under On-Farm Water Management and Water User Associations Ordinance [Act] 1981 (Amended in 2001) and organization of 47,278 WUAs.

1.1.2 Watercourse (WC) Improvement-Component C2:

A total of 47,278 watercourses are planned to be improved/constructed under the project NPIWC-II. In the Punjab zone 10,000 watercourses (7,500 reconstructions of WCs and 2,500 new WCs), in KP 13,000 (3,000 reconstructions of WCs and 10,000 new WCs), in Balochistan 20,389 (3,589 reconstructions of WCs and 16,800 new watercourses) in GB 2,500 (2,500 new watercourses) in AJ&K 1,165 (1,165 new watercourses) and ICT 224 new watercourses.) It involved complete earthen renovation, 50% lining of the total watercourse length as decided in the high-level meeting, and installation of water control structures. It is expected to save annually a total of around 5.82 million acre-feet (MAF) water or 123 acre-feet (AF) per watercourse/annum.

1.1.3 Construction of Water Storage Tanks (WSTs)-Component C3:

Total Construction of 14,932 water storage tanks (Punjab 3,000; KP 5,000; Balochistan 5,507; GB 825; and AJ&K 600) with cost sharing of 60 percent by the project and 40 percent by the farmers. The subsidy for WSTs will be in both irrigated as well as in Barani areas where canal and rainwater are the sources of irrigation, and the tank is technically required for supplemental irrigation with flood irrigation or High-Efficiency Irrigation System (HEIS).

1.1.4 Provision of Laser Land Leveling (LLL) Units- Component C4:

Provision of 11,610 Laser Land Levelers (Punjab 9,500; KP 600; Balochistan 1,500; GB 5 and AJ&K 5) at 50% cost sharing, with the expectation to save about 50% irrigation water for wheat and about 68% of irrigation water for paddy. It is planned to provide one-time financial assistance of Rs. 250,000 per unit to the farmers/service providers while the beneficiary farmer would contribute the entire remaining cost of the equipment.

1.2 Project Territorial Coverage

The Project covers the following three Provinces and three Units

1. Punjab Zone
2. Khyber Pakhtunkhwa (KP) Zone
3. Balochistan Zone
4. Gilgit Baltistan (GB) Unit
5. Azad Jammu and Kashmir (AJ&K) Unit
6. Islamabad Capital Territory (ICT) Unit

1.3 Zone-wise / Unit-wise Project Targets

1.3.1 Organization of Water Users' Associations (WUAs)-Component C1

The key to the success of any OFWM program is the participation of the farmers/water users in the execution of envisaged interventions through a community-driven implementation approach. Under the NPIWC-II, the proposed works/activities are also to be carried out through the Water Users Associations (WUAs) to be registered under the "On Farm Water Management & Water Users Associations Ordinance [Act]-1981 amended in 2001". In this regard, the target of activating/ reactivating 47,278 WUAs, one at each target watercourse was envisaged. Zone-wise / Unit-wise detail is given in **Table 3**.

Table 3: Zone-wise/ Unit-wise Targets of WUAs under NPIWC-II

| S. No | Zone/Unit | Total WUAs to be Activated |
|-------|-------------------------|----------------------------|
| 1 | Punjab | 10,000 |
| 2 | Khyber Pakhtunkhwa (KP) | 13,000 |
| 3 | Balochistan | 20,389 |
| 4 | Gilgit Baltistan (GB) | 2,500 |
| 5 | AJ&K | 1,165 |
| 6 | ICT | 224 |
| | Total | 47,278 |

1.3.2 Improvement of Watercourses (WCs)-Component C2

A total of 47,278 watercourses are planned to be improved under NPIWC-II. These include 14,089 watercourses to be reconstructed (more than 20 years old / Additional lining up to 50%) and 33,189 new unimproved watercourses. Zone-wise / Unit-wise targets are detailed in **Table 4 below**.

Table 4: Improvement of Watercourses (WCs)

| S. No | Zone/Unit | Reconstruction of more than 20 years old WCs/ Additional lining 50% | New WCs (Unimproved) | Total WCs |
|-------|-------------------------|--|----------------------|---------------|
| 1 | Punjab | 7,500 | 2,500 | 10,000 |
| 2 | Khyber Pakhtunkhwa (KP) | 3,000 | 10,000 | 13,000 |
| 3 | Balochistan | 2,589 | 16,800 | 20,389 |
| 4 | Gilgit Baltistan (GB) | - | 2,500 | 2,500 |
| 5 | AJ&K | - | 1,165 | 1,165 |
| 6 | ICT | - | 224 | 224 |
| | Total | 14,089 | 33,189 | 47,278 |

1.3.3 Construction of Water Storage Tanks (WSTs) - Component C3

On-farm water storage tank is a structural best management practice that enables the capture and storage of canal water, surface water runoff during the rainy season, tail water from furrow irrigation, etc., so that it may be used subsequently at the required time of irrigation. A total of **14,932** water storage tanks are planned to be constructed under NPIWC-II. Zone / Unit wise detail is given in **Table 5** below:

Table 5: Zone-wise / Unit-wise Water Storage Tanks to be constructed under NPIWC-II

| S.No | Zone/Unit | WSTs (No) |
|------|-------------------------|---------------|
| 1 | Punjab | 3,000 |
| 2 | Khyber Pakhtunkhwa (KP) | 5,000 |
| 3 | Balochistan | 5,507 |
| 4 | Gilgit Baltistan (GB) | 825 |
| 5 | AJ&K | 600 |
| 6 | ICT | - |
| | Total | 14,932 |

1.3.4 Provision of Laser Land Leveling (LLL) Units- Component C4

Precision (laser) land leveling is the best option/solution for enhancing/improving water productivity by minimizing water application losses. Laser Land leveling technology is highly popular amongst farming communities, especially in the Punjab. Keeping in view its huge demand and its massive economic benefits/returns to the farmers, it has been planned to provide 11,610 laser land leveler equipment to the farmers/service providers under NPIWC-II. On average, laser land levelers have the capacity of laser leveling of about 300 acres per annum. Zone / Unit wise provision of PLL and annual area covered is given in **Table 6** below:

Table 6: Zone-wise/Unit-wise Planned LLLs Units and Area coverage under NPIWC-II Project

| S.No | Zone/Unit | Planned LLL (No) | Area to be covered (000 Acres) per Annum |
|------|-------------------------|------------------|--|
| 1 | Punjab | 9,500 | 2,850.0 |
| 2 | Khyber Pakhtunkhwa (KP) | 600 | 180.0 |
| 3 | Balochistan | 1,500 | 450.0 |
| 4 | Gilgit Baltistan (GB) | 5 | 1.5 |
| 5 | AJ&K | 5 | 1.5 |
| | Total | 11,610 | 3,483 |

1.4 Impacts of the Project (NPIWC-II)

1.4.1 Project Direct Benefit under the Project

- Reduction in Water Logging and salinity in project areas to the extent of 10%.
- Cropping intensity is expected to increase by 5-20%.
- Crops yield is estimated to increase by 10-15%.
- Equity in water distribution increases by about 30%.
- Reduction in water disputes/thefts and litigation amongst the Farmers over water Distribution by about 80%.
- Help poverty reduction through the generation of employment.
- Self-sufficiency in food through the utilization of water saved for edible oil seed Production.

1.4.2 Project indirect benefits to industry/economic activities

- The cement industry, bricks Killen, Precast Structures Industry, and other related industries Production will pick up.

1.4.3 Awareness support to farmers

- Motivating farmers through an awareness campaign for watercourse improvement.
- Providing technical material to farmers for optimal utilization of water resources in the shape of technical manuals and operational guidelines.

1.5 Project Beneficiaries

The majority of the direct project beneficiaries constitute the number of farmers (owners as well as tenants) growing crops and orchards on the watercourses improved under NPIWC-II. Assuming 35 beneficiaries on each watercourse, the total number of farmers benefiting from the activity comes to 1,654,730. The same number will benefit the Water Users' Associations (WUAs) in terms of cooperative management of irrigation water. Moreover, 14,932 will directly benefit from Water Storage Tanks, and 11,620 as recipients of Laser Land Leveling Units. Thus, total gross direct beneficiaries are expected to be around 3.336 million households. However, net beneficiaries are expected to be $1,654,730 + 1,654,730 \times 0.5 + 14,932 \times 0.5 + 11,620 \times 0.5 = 1,668,006$ or say 1.668 million if 100% WUAs, 50 % each of WST and PLL beneficiaries are already covered under Watercourse improvement beneficiaries. Taking family size at five, the total net population benefitting is expected to be 8.34 million people.

1.6 Project Development Objectives

The targets given in the Inception Report are summarized below in **Table 7**: The ME&IE Consultants are required to submit a Midline Survey/ Mid-term Impact and Final Evaluation report. Thus, in compliance with its contractual requirement, the ME&IE Consultants have prepared this report, which evaluates the Project's Monitoring and Impact assessment results up to the end of June 2023.

Table 7: The Results Indicators of NPIWC-II, Project

| S. No | Project Development Results Indicators | Unit | Baseline | Mid-Term | Final |
|-------|---|--------------------|----------|-----------|------------|
| 1 | Watercourses with an increase in watercourse conveyance efficiency of at least 15%. | Number | 0 | 27,871 | 47,278 |
| 2 | Direct project beneficiaries of watercourse improvements-households (number) ^(a) | Number | 0 | 975,485 | 1,654,730 |
| 3 | Construction of Water Storage Tanks | Number | 0 | 8,472 | 14,932 |
| 4 | Provision of Laser Land Leveling | Number | 0 | 7,460 | 11,610 |
| 5 | Increase in cropping intensity in Canal command areas (watercourses). | Percentage | 168% | 5 | 5 |
| 6 | Increase in Cropping Intensity in non-canal command areas | Percentage | 110% | 24 | 24 |
| 7 | Increase in Agriculture output per unit of water (watercourses) | PKR/M ³ | 8 | 3 | 3 |
| 8 | Reduction in water losses in project area due to watercourse lining | % age | 45% | 33 | 33 |
| 9 | Reduction in field application losses due to laser land leveling | % age | 30% | 33 | 33 |
| 10 | Increase in agriculture output per unit of water (laser leveling) | PKR/M ³ | 8 | 3 | 3 |
| 11 | The area benefited due to the improvement of watercourses ^(b) | Acres | 0 | 6,689,040 | 11,346,720 |
| 12 | Area leveled by laser Land Leveling units | Acres | 0 | 2,238,000 | 3,483,000 |
| 13 | Area served by Water Storage Tanks ^(c) | Acres | 0 | 69,894 | 95,782 |

(a) Assuming 35 beneficiaries per watercourse, (b) Assuming 240 acres benefitted per watercourse, (c) Assuming average area served by each WST at 8.25 acres

2. PROJECT PROGRESS AND MONITORING

2.1 Improvement of Watercourses

During the Project period up till now i.e., June 2023 (4 years), a total number of 39,510 watercourses were targeted to be improved. By the end of June 2023 (during 4 years), 13,777 watercourses had been improved, showing only **35% achievement**. As far as Zone-wise/ unit-wise, in Punjab out of 7,600 watercourses, 4063 watercourses **53.5%** (3,416 additional linings, 647 unimproved watercourses improved) were constructed. In the KP Zone out of 11,200 watercourses, 3,187 watercourses are 28.5%, in Balochistan out of 17,600 watercourses, 5,202 watercourses are 29.6%, in GB out of 1,998 watercourses, 809 watercourses are 40.50% and in AJ&K and ICT units, 57.44% and 19.7% watercourses completed (Table 8).

Table 8: Watercourses Improvement, Achievement vs. Target up to June 2023

| S. No | Zone/Unit | Project Target (June 2023) | Achievement up to June 2023 |
|-------|-------------------------|-------------------------------|--------------------------------|
| 1 | Punjab | 7,600 | 4,063 (53.5%) |
| 2 | Khyber Pakhtunkhwa (KP) | 11,200 | 3,187 (28.46%) |
| 3 | Balochistan | 17,600 | 5,202 (29.6%) |
| 4 | Gilgit Baltistan (GB) | 1,998 | 809 (40.50%) |
| 5 | AJ&K | 839 | 482 (57.44%) |
| 6 | ICT | 173 | 34 (19.7%) |
| | Total | 39,510 | 13,777 (35%) |

2.2 Construction of Water Storage Tanks (WSTs)

During the Project period (4 years), a total number of 12,257 Water Storage Tanks were targeted to be constructed. By the end of June 2023, 5,390 WSTs have been constructed which are 44% of the project's total 4-year targets. Thus, mid-term target achievement is behind the targets particularly in Khyber Pakhtunkhwa and in Punjab, where the achievement is only 27% and 44.4% of the Project targets. Further zone-wise / unit-wise detail target shortfalls may be seen in **Table 9**:

Table 9: Construction of Water Storage Tanks (WSTs) vs. Target up to June 2023

| S. No | Zone/Unit | Project Target (June 2023) | Achievement up to June 2023 |
|-------|-------------------------|-------------------------------|--------------------------------|
| 1 | Punjab | 2,300 | 1,021 (44.4%) |
| 2 | Khyber Pakhtunkhwa (KP) | 4,450 | 1,188 (26.7%) |
| 3 | Balochistan | 4,370 | 2,499 (57.2%) |
| 4 | Gilgit Baltistan (GB) | 657 | 328 (49.9%) |
| 5 | AJ&K | 480 | 354 (73.8%) |
| | Total | 12,257 | 5,390 (44%) |

2.3 Delivery of Laser Land Leveling (LLL) Units

During the Project period up to June 2023 (4 years), a total number of 10,060 Precision Laser Land Leveling (LLL) Units were targeted to be delivered. By the end of June 2023, 5,928 LLL Units have been delivered which are 59% of the project's 4-year targets. This shortfall is only 28% (100%-72%) in Punjab but 97.5% in Balochistan, 100% in GB and AJ&K, and 92% (100%-8%) in Khyber Pakhtunkhwa province. Further zone-wise / unit-wise detail target achievements may be seen in **Table 10**.

Table 10: Provision of PLL Units: Achievements versus Project Targets by the End of June 2023

| S. No | Zone/Unit | Target up to June 2023 | Achievement |
|-------|--------------|------------------------|------------------------|
| 1 | Punjab | 8,100 | 5,844 (72.1%) |
| 2 | KP | 600 | 50 (8.3%) |
| 3 | Balochistan | 1,350 | 34 (2.5%) |
| 4 | GB | 5 | 0 |
| 5 | AJ&K | 5 | 0 |
| | Total | 10,060 | 5,928 (59%) |

3. MONITORING AND EVALUATION OF ORGANIZATION OF WATER USERS ASSOCIATIONS (C1)

On an overall basis, 85% of farmers were aware of the existence/working of WUAs on their watercourses. About 94% of respondents informed that OFWM used to hold awareness meetings before the formation of the WUAs. About 74% of members had been participating in the meeting of WUAs and 98% of members reported that the WUAs were formed through a democratic process. On the whole, 92% of respondent farmers were found to be members of WUAs of which 42% were located at the head of WC reaches, 33% at middle reaches, and 25% at tail reaches and 88% of members were found water users of lined watercourses. About 94% of farmers reported that WUAs were functioning properly.

About half (49%) of the respondent farmers informed that meetings by WUAs were held, 27% informed that no meetings were held and 24% were of the view that these meetings were held to some extent. Moreover, 39% of respondents informed that they always participated in the meetings, 60% participated occasionally and one percent never participated.

Out of the total, 8% of respondents informed that the meetings were held every month, 6% said quarterly, 2% once a year and the remaining 84% informed that these meetings used to be held as and when need arose. About 85% of respondents informed the WUAs were established through a democratic process.

About 97% of member farmers responded that they faced no dispute. Only 3% faced disputes, out of which 50% always got their disputes resolved, 38% to some extent, and 12% never got their disputes resolved.

Out of 3% of respondents who faced disputes, 31% related to Land Acquisition, 59% to the distribution of Naccas, and 10% regarding funding for accounts. About 45% of disputes were solved by WUAs, 50% by OFWM department, and 5% by Irrigation Department.

3.1 Impact and Evaluation of Improvement of Watercourses (C2)

Land use intensity due to watercourse improvement on sample farms has increased by an average of 4.1%, meaning thereby an increase of 4.1% in cultivated areas. Cropping intensity has increased by 10.9%. These increases in land use and cropping intensities have resulted in about an 11.8% increase in cropped areas under various crops.

The Watercourse Improvement Impact on Crop Yields per acre varied from 4% to 49% averaging at 11.4% on an overall basis.

The cumulative impact of watercourse improvement is reflected in the total production of various crops. Production of various crops has increased at different rates varying from 11.6% in the case of peaches to 317.6% in the case of other vegetables. However, the weighted average impact is calculated at 23% (11.4% due to yield increase 11.8% due to area increase, and 1 percent due to interaction between the two).

On total completed watercourses up to June 2023, total increases in crop area have also been estimated. In total 12,968 (excluding GB) improved watercourses, increase in the crop area has been estimated at around 196 thousand acres.

The impact of watercourse Improvement on agriculture employment has also been significant. Labor man days at the farm have increased ranging from 2 percent to more than 100% after WC Improvement averaging at 15% due to an increase in crop area, crop yields, and crop production.

The impact of WC Improvement on per-acre net income varies from crop to crop. It varies from Rs.1, 008 for cotton to Rs. 37,950 for vegetables per acre averaging at Rs. 4,053 for all crops.

Water Conveyance Efficiency on 20% lined additional improved watercourses increased by 14 %age points and on new 50% lined watercourses increased by 29% age points. On piped lined watercourses efficiency increases by 50%. On an overall basis saving in water losses calculates to 30% of 154 AF per watercourse per annum.

Spot Checking of Trees on Watercourses shows that 3,552 trees were cut down during the process of their improvement. As per the rule, at least three times (10,656) trees were required to be planted in place of 3,552 cut-down trees, however, during the spot check it was observed that only 5,259 saplings (49% of the required ones) were planted out of which, 2,731 were survived after one year of their plantation.

Spot-checking of Brick Lined Watercourses shows that the compliance of engineering parameters on Rectangular / Brick Lined Watercourses, on the whole, was satisfactory. However, lining length as per design was found on 76% of watercourses. Full-length improved water courses were extremely low i.e., The Katcha portion of only 18% was fully improved. Katcha portions of the remaining 82% watercourses remained unimproved.

Spot Checking of PCP Lining Watercourses: On Parabolic (PCPL) Watercourses, compliance with most of the parameters was found satisfactory. However, Lining length as per design was found on 73% of watercourses and full-length improved water courses were extremely low i.e., only 16%.

Spot Checking of Pipelined Watercourses: The quality of the pipe was found good in 51% of cases, satisfactory in 45% of cases, and poor in 4% of cases only. Pipeline length was as per design in 93% of cases, bends and flanges were as per design in 68% of cases, tees were as per design in 63% of cases and sockets were 56% as per design.

Due to 12,968 watercourse improvements (excluding GB), the cultivated area increased by 61,144 acres, the cropped area by 196,304 acres, gross income increased by Rs. 43,352 million and net income by Rs. 19,414 million. Zone-wise detail may be seen in **Table 11**.

Table 11: Increase in Cultivated / Cropped Area and Increase in Income (Gross/Net) Of the Farms from Completed Watercourses

| S. No | Zone/Unit | Increased Cultivated Area (Acres) | Increased Cropped Area (Acres) | Increased Gross Income (Rs. in Million) | Increased Net Income (Rs. in Million) |
|-------|--------------|-----------------------------------|--------------------------------|---|---------------------------------------|
| 1 | Punjab | 18,624 | 86,615 | 29,209 | 12,530 |
| 2 | KP | 4,901 | 39,072 | 5,673 | 2,702 |
| 3 | Balochistan | 25,213 | 69,188 | 8,122 | 4,028 |
| 4 | AJ&K | 225 | 1,399 | 344 | 152 |
| 5 | ICT | 10 | 31 | 5 | 2 |
| | Total | 61,144 | 196,304 | 43,352 | 19,414 |

3.2 Impact and Evaluation of Construction of Water Storage Tanks (WSTs) - (C3)

Land use intensity due to WSTs Construction on sample farms has increased on an average by 6.3%, meaning thereby an increase of 6.3% in cultivated area. Cropping intensity has increased by 15.4%. These increases in land use and cropping intensities have resulted in about a 22% increase in cropped area under various crops.

The WSTs construction Impact on Crop Yields per acre varied from 6.6% in the case of Rabi fodder to 16.7% in the case of pulses, averaging 10.2% on an overall basis.

The cumulative impact of WSTs is reflected in the total production of various crops. Production of various crops has increased at different rates varying from 20% in the case of cotton to 86% in the case of sugarcane. However, the weighted average impact is calculated at 35% (10% due to yield increase 22% due to area increase, and 3 percent due to interaction between the two).

Of the total 5,062 completed WSTs (excluding GB) up to June 2023, total increases in area have also been estimated at 10,604 acres.

The impact of WSTs on agriculture employment has also been significant. Labor man days at the farm have increased ranging from 10% to 69% after WSTs construction averaging at 22% due to an increase in crop area, crop yields, and crop production.

The impact of WSTs on per-acre net income varies from crop to crop. It varies from Rs. 1,008 for cotton to Rs. 37,905 for other vegetables per acre averaging at Rs. 22,262 for all crops.

Before the construction of the tank, there was no such saving of water losses. The total water storage capacity from the above-mentioned sources of the tank along with the reported filing up frequency leads to calculating the water saving impact. On an overall basis, saving in water losses calculates to 7.31 AF per Storage Tank per annum.

On 222 spot-checked WSTs, 256 trees were reported to be cut down. In their place 922 (more than thrice as per requirement) Saplings were planted out of which 327 survived after one year. WST protection arrangements were about 84% satisfactory and 98% of WSTs were properly maintained.

Out of 222 spot-checked WSTs, satisfactory Excavation Certificates were issued by the Consultants to 192 (87%) WSTs.

About 171 (77%) WSTs were completed before receiving the subsidy amount. The rest 51 (23%) were completed after receiving the subsidy from the department.

Out of a total of 222 spot-checked WST, on an overall basis, 203 (91%) have been completed as per approved standards and specifications.

Due to 5,062 WSTs (excluding GB), the cultivated area increased by 3,460 acres, the cropped area by 10,604 acres, gross income increased by 3,275 million PKR, and net income by 1,780 million PKR. Zone-wise detail may be seen in **Table 12**.

Table 12: Increase in Area, and Income of the Farms from Completed Water Storage Tanks (WSTs)

| S. No | Zone/Unit | Increased Cultivated Area (Acres) | Increased Cropped Area (Acres) | Increased Gross Income (Rs. in Million) | Increased Net Income (Rs. in Million) |
|-------|--------------|-----------------------------------|--------------------------------|---|---------------------------------------|
| 1 | Punjab | 420 | 2,558 | 982 | 635 |
| 2 | KP | 793 | 2,955 | 878 | 477 |
| 3 | Balochistan | 1,781 | 3,862 | 1,097 | 596 |
| 4 | AJ&K | 466 | 1,229 | 318 | 173 |
| | Total | 3,460 | 10,604 | 3,275 | 1,780 |

3.3 Impact and Evaluation of Laser Land Leveling (LLL) Units (C4)

Educational Profile of Sample Beneficiaries: Most of the beneficiaries (95%) were found literate. About 15% of beneficiaries are primary/middle level, 27% matric, 20% Intermediate, 25% Graduates, and 9% postgraduate.

Suppliers of Precision (Laser) Land levelers: About 50% i.e., 80 PLL sample units have been supplied by 4 Supply and Service Companies (SSCs), namely Crosfield Agro (21), Easy Farming (24), Modern Farming (14) and Ruba Digital Laser. Out of these 80 PLL units, 79 were delivered by these companies in the Punjab. In KP, 3 LLLs were delivered by Cross Field Agro, one by Modern Farming PLL Services, and one by Ruba Digital Laser. In Balochistan, all seven PLL units were delivered by Amjad Brothers Zarai Industries.

About 56% of PLL drivers were fully trained for running PLLs in the field and got formal training for this purpose. Around 41% were self-trained and the rest 3% were found un-trained during the monitoring survey.

About 64% of respondents ranked these PLL units as good, 31% as satisfactory and 4% as not satisfactory. About 1 to 2 percent responded that they did not know. It means that 95% of beneficiaries regarded the quality/durability of the delivered PLL units as satisfactory at least.

Regarding after-sales service, 61% regarded it as good, 13% as poor, 6% as very poor, and 21% responded that they did not know.

About 53% of beneficiaries responded that the attended complaints by SSCs were prompt and 16% informed that the complaints were not being attended promptly.

As for the prices of PLL, 9% of respondent beneficiaries informed that the SSCs charged high prices, 54% informed that the prices were normal, while the rest 37% responded that they did not know.

The respondents were also asked about the availability of spare parts by the SSCs. Out of 160 respondents, 30% responded that spare parts were available with SSCs whenever required, 7% informed that it took along time, whereas the remaining 63% informed that they did not need these spare parts as yet.

As for the prices of LLL spare parts charged by the SSCs, 8% of respondent beneficiaries informed that the SSCs charged high prices, 27% informed that the prices were normal, and the remaining 66% responded that they did not need these spare parts as yet.

The respondent beneficiaries were also asked about the availability of spare parts in the open market. About 36% of respondents informed that these spare parts are only available with the SSCs, 7% informed that the spare parts were also available in the market, while the rest 57% informed that they did not know.

While spot-checking, all 160 (100%) respondents were using LLL for agricultural purposes. No respondent was found using LLL for non-agricultural purposes.

The LLLs were also spot-checked for their working conditions. Out of the total, 60% were found industries in good condition and well maintained. The condition of 35% was satisfactory and the remaining 5% were found in poor / unsatisfactory condition.

Record Keeping of Laser Land Leveling Services to Other Farmers: About 97% of LLL owners provide laser leveling servicing to the other fellow farmers. Out of these service providers, only 14% keep a complete or partial record of their lending services. Out of these 14 percent, 55% keep records on logbooks, 36% on loose papers.

Land Levelled during the last Rabi and Kharif cropping Seasons: The total laser land leveled by the 160 respondent PLL owners during the last Rabi and Kharif cropping seasons was **40,711** acres or 254 acres per PLL. Out of these total **40,711** acres, **4,092** acres (26 acres per equipment) were owned land, and **36,619** acres (228 acres per equipment) were laser leveled on rent of other fellow farmers.

LLL Beneficiaries: Total annual LLL beneficiaries calculate to 11,331 farmers including the owners themselves or 71 farmers per equipment.

Impact of LLL on Crop yields: The impact of PLL on crop yield was also assessed through the farmers' perception. The growers were of the view that laser leveling increases yields of various crops ranging from 8% to 14% averaging at 11% on the whole. The economics and economic benefits of PLL use were also estimated. Total number of delivered LLLs up to the end of June 2023 is 5,928. At the rate of 254 acres per LLL, the total area leveled by all the delivered LLLs is calculated as 1,506 thousand acres. Net benefits per LLL come to 521 thousand Rs. per annum and for a total of 5,928 delivered LLL, these calculate to Rs. 3,091 million.

Water Saving Impact of LLL Units: Information was also asked from the growers regarding the saving of water due to Precision Land Leveling. On average 25% saving in water use has been reported.

Economic Analysis: The benefit-cost ratio at a 12% discount factor in the midterm evaluation is calculated at 2.5 and the Internal Rate of Return is 50%.