



FEDERAL PROJECT MANAGEMENT UNIT
FEDERAL WATER MANAGEMENT CELL
MINISTRY OF NATIONAL
FOOD SECURITY & RESEARCH
ISLAMABAD - PAKISTAN

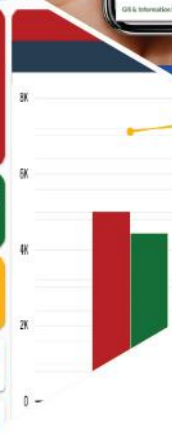
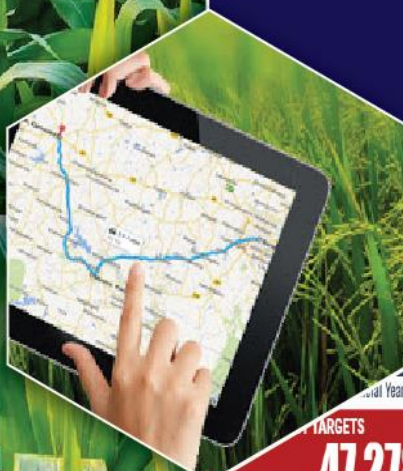
NATIONAL PROGRAM FOR IMPROVEMENT OF WATERCOURSES IN PAKISTAN PHASE-II: (NPIWC-II)

MONITORING, EVALUATION AND IMPACT EVALUATION CONSULTANTS



MID-TERM MONITORING AND IMPACT EVALUATION REPORT - (DRAFT)

OCTOBER 2023



A Joint Venture of
G3 Engineering Consultants (Pvt.) Ltd.



In Association with S&S Associates

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Federal Project Management Unit (FPMU)
Federal Water Management Cell (FWMC)
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)

SPECIAL REPORT ON MONITORING AND IMPACT EVALUATION OF PRECISION (LASER) LAND LEVELLING

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ACRONYMS

ADA	ADA Incorporated, Canada
AOSM	Adjustable Orifice Semi-Module
AF	Acre-Feet
AJ&K	Azad Jammu & Kashmir
BCR	Benefit Cost Ratio
CCA	Culturable Command Area
CSRD	Center for Social Research and Development
EAs	Executing Agencies
FPMU	Federal Project Management Unit
GB	Gilgit Baltistan
GIS	Geographic Information System
HDPE Pipe	High Density Polyethylene Pipe
IAs	Implementing Agencies
ICR	Intermediate Completion Report
ICT	Islamabad Capital Territory
ICT	Information & Communication Technology
Kgs	Kilograms
KPK or KP	Khyber Pakhtunkhwa
LOG Frame	Logical Framework
LPS	Liter Per Second
M&E	Monitoring and Evaluation
MAF	Million Acre Feet
ME&IE	Monitoring, Evaluation, and Impact Evaluation
MIS	Management Information System
MNFSR	Ministry of National Food Security and Research
MT	Monitoring Template
MTE	Mid-Term Evaluation
NESPAK	National Engineering Services of Pakistan
NPC	National Project Coordinator
NPIWC	National Program for Improvement of Watercourses
NPV	Net Present Value
OFWM	On Farm Water Management
PC	Project Consultants
PCC Pipe	Plain Cement Concrete Pipes
PCP	Parabolic Cement Precast
PCPL	Parabolic Cement Precast Lining
PVC Pipe	Polyvinyl Chloride Pipe
PC-1	Planning Commission-(Form-One)
PDO	Project Development Objectives
PIC	Project Implementation Committee
PLL	Precision Laser Land Leveler
PIES	Project Impact Evaluation Study
PKR	Pakistan Rupees
PQC	Pre-Qualification Committee
RCC Pipe	Reinforced Cement Concrete Pipes
SOPs	Standardized Operating Procedures
SPSS	Statistical Package for Social Sciences (Software)
SSCs	Supply and Service Companies
TABs	Tablets
TOR	Terms of Reference
TS	Technical Sanction
TWRD	Tail-Water Recovery Ditch
WC	Watercourse

WCE	Watercourse Conveyance Efficiency
WCL	Watercourse Conveyance Losses
WFM	Water Flow Measurement
WG	Women Group
WST	Water Storage Tank
WUAs	Water Users Associations

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 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 (NESPAC & 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. This part of the special report is only discussing about the monitoring and impact evaluation of precision (Laser) land levelling (PLL) in three zones viz., Punjab, Khyber Pakhtunkhwa (KP) and Balochistan.

Project's Direct Benefit includes, increase in cropping intensity & Crops yield, saving in water. The total number of project beneficiaries from all the interventions including watercourses improvement, construction of water storage tanks and provision of PLL are estimated 1.668 million farmers (owners as well as tenants). Taking family size at five, 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 Midline Survey/ Mid-term Impact Evaluation report. Thus, in compliance with its contractual requirement, the ME&IE Consultants have also prepared some special reports (i.e., one of these, the monitoring and impact evaluation of PLL) in addition to the report which evaluates Project's mid-term Monitoring and Impact assessment results up to end of October 2023 until 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 Monitoring:

During the Project period (5 years), a total number of 11,610 Precision Laser Land Leveling (PLL) 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 51% achievement.

Impact Evaluation of Component C4 (Provision of PLL)

Educational Profile of Sample Beneficiaries: Most of the beneficiaries (95%) found literate. About 15% 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 Cross Field 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 PLL were delivered by Cross Field Agro, one by Modern Farming PLL Services and one by Ruba Digital Laser. In Balochistan, all the 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 do 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 facility provision status, 60% regarded it as good, 13% as poor, 6% as very poor and 21% responded that they do not know.

About 53% of beneficiaries responded that the complaints attended by SSCs were prompt and 16% informed that the complaints were not being attended promptly, and rest of the respondents didn't yet need arose.

As for the prices of PLL concerned status by the respondents, 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 total 160 respondents, 30% responded that spare parts were available with SSCs whenever required, 7% informed that it took long time, whereas the rest 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, while the rest 65% 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 PLL for non-agricultural purposes.

The PLLs were also spot checked with respect to 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 status of Laser Land Leveling Services to Other Farmer: About 97% PLL owners provided 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 record on logbooks, 36% on loose papers and rest were not keeping record in writing.

Land Leveled during last Rabi and Kharif cropping Seasons: Total laser land levelled by the 160 respondent PLL owners during 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) was owned land, and **36,619** acres (228 acres per equipment) were laser levelled on rent of other fellow farmers.

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

Impact of PLL on Crop yields: 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. Economics and economic benefits of PLL use were also estimated. Total number of delivered PLL up to end of June 2023 is 5,928. At the rate of 254 acres per PLL, total area levelled by all the delivered PLL calculates as 1,506 thousand acres. Net benefits per PLL comes to 521 thousand PKR per annum and for total 5,928 delivered PLL these calculate to 3,091 million PKR.

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

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 a period of five (05) years. The executing agencies (EAs) are 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). The project supervision is carried out by the Project Consultant (NESPAC & JV Partners). The task of Monitoring Evaluation & Impact Evaluation (ME&IE) has been entrusted to ME&IE Consultants: A Joint Venture of G-3 Engineering (Lead Firm) Consultants (Pvt.) Ltd., CSRD, EASE PAK and ADA in association with S&S Associates. The coordination rests with the Federal Project Management Unit (FPMU) and Federal Water Management Cell (FWMC).

1.1 Background:

The history of precision (laser) land leveler (PLL) goes back dates to 1960s when the researchers first demonstrated their ability to project a focused Laser beam on the surface of ground to measure its height. The first endeavor of practical development of PLL was materialized in the world during the era of mid 1980s. Theodore Harold Maiman, an Engineer and Physicist innovated and developed the first laser land leveler implement on 16 May 1960 at Huges Research Laboratory in California, USA by employing the high-powered flash lamp on a ruby rod with silver coated surface. Presently, the application of PLL is being commonly practiced in developed and developing countries including Japan, USA, Australia, India, Pakistan, etc. The concept of PLL application had been around globally since the early 1970s, but recently its use introduced in subcontinent, India and Pakistan during 1985s (Website of Nature and Akmal et al. (2020).

1.2 USE of LASER Technology in Pakistan and Other Regions

Government of Pakistan has sanctioned a project entitled "NATIONAL PROGRAM FOR IMPROVEMENT OF WATER COURSES, PHASE-II". The objective of the project was to provide the facility of improvement of the Watercourses (WCs) and construction of Water Storage Tanks (WSTs) and provision of Precision (Laser) Land Levelers (PLL) on the arrangement of subsidized programs between the government and farmers (beneficiaries). It was initiated in July 2019 and will be ended June 2024 with the operational collaboration of provincial On Farm Water Management (OFWM) Departments. Improvement in the water management system yielding reduction of conveyance losses that would be resulted into the more area under cultivation with improved cropping intensity as well as improving the quality of agricultural commodities creating the opportunity of earning increased profits through trading competitively in the national/ international markets.

On Farm Water Management (OFWM) Departments in Pakistan are providing laser-guided PLL technology to the farmers for attaining higher accuracy in leveling the fields. However, there have been some questions about the effectiveness of this technology, such as, whether leveling, really saves significant amount of irrigation water, improves crop yields and water use efficiency (WUE)? How much does it cost to level the fields and whether leveling also helps to increase the net income of the farmers? Despite PLL introduced in Pakistan in 80'S but there is limited documented evidence of adoption and impacts in Pakistan. Few studies have focused on the impact of PLL in Pakistan, but none has considered potential sample selection size to get better feedback. The objective of the present study is to assess the adoption of laser-land leveling in Pakistan and specifically its impact on water use, household income and crop yields.

In recent years, modern farming technologies are prerequisite for agricultural growth and development in the country. Any technology which can increase crop production and household incomes, improve rural livelihoods. The adoption of agricultural technologies differs in developed and developing countries, affected by climatic condition, and socioeconomic conditions. Generally, agricultural growth is expected through the use of improved seed, fertilizer and improved irrigation practices. Now despite having boom in agriculture production, water availability indeed plays a critical role in agricultural production and food security in developed and

developing countries. This water issue forced to scientist/planners to develop new techniques to conserve moisture and utilize it efficiently. In Pakistan, the irrigated agriculture is the backbone of our economy which utilize over 93% of the available water resources. The existing reservoirs of Pakistan have lost almost 35% of their capacity due to sedimentation and unfortunately there is very little chance to add more water in the near future. In this situation the crop production can be achieved by using efficient use of the available water resources. In Pakistan, the main method of irrigation is based on traditional flood irrigation system on undulating fields which reduced the water productivity.

Pakistan is an agricultural country spreading over an area of about 79.6 million hectares (Mha) with an arid and semi-arid climate. Of 79.6 Mha, about 23 Mha is suitable for crop production and nearly 25 percent of the total cultivated area is suitable for rainfed agriculture. In Pakistan, water is becoming an absolute limiting factor due to reduction in rainfall and persistence drought which has serious social and economic repercussions. The lack of stability between water availability and its consumption that can weaken if specific conservational actions fail to follow. Pakistan's water related challenges stem from several factors such as its relations with neighboring upper riparian's whose activities upstream are threatening the flow of water downstream, lack of adequate storage options as the available water flows into the sea, limited reservoir capacity due to high rates of sedimentation, receding ground water due to excessive use of tube wells and the contamination of fresh water because of wrongful waste water disposal.

The burgeoning population trend of Pakistan is exerting a considerable additional demand for food and therefore, much of the additional food production is expected to come from irrigated land. In this situation, cost effective options are required to increase water use efficiency. It is shown that better timing of irrigation and controlling amount of water applies can improve irrigation efficiency and water productivity with little additional cost. Land leveling is required for taking up good agronomic, soil and crop management practices. Land leveling saves irrigation water, facilitates field operations and increases yield and quality of the produce. Leveled land also helps in mechanization of various field operations. It is presumed that on an average 51% water is saved under leveled fields in a cropping year (Rabi plus Kharif). The saving was due to the fact that laser-land leveling reduces undulations in the fields. Few studies have shown impact of laser-land leveling that 34 to 37% water saving could be attained. In Tajikistan, Abdullaev et al., (2007) concluded that laser leveled field can save 81 mm of water and 22% more net income compared to non levelled fields.

In Agriculture production operations, regular ploughing, planking, ridging and particularly puddling (ploughing of land for rice cultivation with a tractor in the standing water) disturb the leveling of the paddy fields. These factors raise some questions that levelling is required every time before plantation of new crop and if PLL has lot of benefits than why it is not adopted on large scale by the farmers. It is observed that our farmers think that it is necessary that every year the field must be levelled putting extra burden on cost of production. In recent studies it is observed that there is misconception among farmers that laser leveling increases the soil salinity and reduces the soil fertility. Ashraf (2017) found that after Land leveling, no need to level the fields at least up to three years. However, there is not significant effect of PLL on the soil salinity and fertility. Rather laser leveling helps uniform application of water thereby reducing the risk of salinity on rest of the fields where relatively less amount of water is applied as compared to the fields where PLL used. At the time of fertilizer application with irrigation, therefore uniform application of water helps equitable distribution of fertilizers. Farmers have been practicing since long the traditional land leveling techniques through tillage followed with planking to level the unlevelled fields during land preparation before cultivation of any crop. Laser land leveling provides a more precise and rigorous land leveling using a laser-equipped drag bucket. PLL can remarkably reduce irrigation water use and save energy through the reduced duration of irrigation (Jat et al., 2009). Uniform fields enhance irrigation efficiency through a better water distribution and diminish nutrient loss through enhanced runoff control, resulting in higher efficiency of fertilizer use and higher yields (Jat et al., 2011). PLL can also increase yields through better crop germination and crop stands.

The use of LASER technology in the precision land leveling was introduced in the Punjab during 1985. Punjab Government initiated "Irrigated-Agriculture Productivity Improvement Project (PIPIP)" with the financial support of World Bank, since July 2012 in the entire province. Its duration spanned over a period of five years (2012--17) with a total cost of Rs. 36,000 million and the main objective was to install high efficiency irrigation

systems (HEISs) on 120,000 acres, along with the provision of 3,000 LASER units to the farmers/ service providers. In 2015-2017, Government of the Punjab has launched ADP funded project” Provision of Laser Land levelers to Farmers/ Service Providers on Subsidized Cost” having a cost of Rs. 1,350 million for provision of 6,000 Laser land levelers to the farmers/service providers on cost sharing basis. It has been approved to provide one-time financial assistance of Rs. 450,000 per LASER unit from the financial support of WB and ADP. The main objective was that farmers benefiting from the subsidy will be required to assist other farmers by helping to level 300 acres of land annually. The Punjab government is offering a subsidy of Rs 250,000 against each laser land leveler in 13 districts with arid areas in the province. This subsidy worth Rs 300 billion was given under PM’s Agriculture Emergency Program. The subsidy would be given to the farmers having tractors and holding land less than twelve and half acres. Similarly, the holder of the subsidy would be bound to provide services for 300 acres annually (ADB, 2012). The same information for other provinces is not known.

1.3 Need of PLL

Since it is a general saying that ‘need is the mother of invention’. Looking at the supply and demand status of the quality water resources available at the farm gate for meeting dynamic agricultural husbandry requirements in the subcontinent, especially Pakistan. The available water resources from canal, rainfalls and ground water are continuously shrinking to meet the current as well as upcoming needs of the crops & livestock and industrial entrepreneurs. There is an urgent need to conserve irrigation water by arresting and testing the feasible alternatives techniques. Traditionally, the land levelling practice used to be employed through the tools of scrapers or levelling board (‘sohagha’) drawn by draft animals/ tractors as well as through bulldozers, especially in case of highly undulated lands/ sand dunes. This practice was not plausible as well as inefficient in terms of precise land levelling and even distribution of irrigation water to the targeted crops. However, the traditional methods of levelling land are not only more cumbersome and time consuming but also more expensive as well. Crop fields which are unlevelled yielding asymmetry crop stands, germination of dense populated weed load and uneven maturing of crops. All these factors are contributing to reduce the crop yield coupled with the deteriorated grain quality which induces to reduce the potential farm household income. Hence, the effective land levelling is contributing towards optimisation of water-use efficiency, strengthen crop stand establishment, save time to irrigate the crop fields for fetching the bumper crop yields. It is the farmers’ common practice of flooding the irrigating water to the crop fields until all the parcels are fully wetted and covered with a thin layer of water. It is also observed that improvement in water productivity through the adoption of different Resource Conservation Technologies (RCTs). Among various RCTs, Precision Land Leveling (PLL), and different types of water lining and water storage tanks have proven their applicability globally to reduce water application losses and improve yield and, hence, water productivity. PLL, or more commonly known as LASER land leveling, ensures the reduction in deep percolation and evaporation losses due to uneven fields having depressions and undulations. However, there may be a number of socio-economic, environmental, and technical factors, which may hamper the successful promotion and sustainable adoption of any of these RCTs in a region. The adoption of these RCTs for improving water productivity is in dire need in Pakistan too, where a lot of research and promotional work has already been performed on these RCTs (ADB., 2012).

Under the prevalent status quo, the need of proven technology like PLL was proved to be highly useful in conserving the irrigation water. It is a recognized fact that unevenness of the soil surface has been severely impacting on delays tillage, proper seed germination and subsequently to the crop stand establishment that lead to downward yield trends of targeted crops through the action of nutrient water interaction and soil moisture distribution pattern available for the crops to uptake, accordingly. The use of PLL for the levelling of the agricultural fields in South Asia was practiced over 1.5 million hectares in 2012 year. However, the PLL implement is proved to be more efficient technically as well as economically towards levelling of land and efficient utilization of scarce water resources by removing unessential depression and raised contours. (Website of Nature; Akmal et al., 2020; (Bhatt and Sharma, undated Indian Extension Bulletin)

The present special report scope is mainly limited on monitoring and impact evaluation of precision (laser) land levelling in the project areas of, Balochiston, Khyber Pakhtunkhwa and Punjab zones.

1.4 Project Component Facilities

Component 4 (Provision of Precision (Laser) Land Levelling): According to the sanctioned facilities in the Pc-1, the provision of 11,610 Precision (Laser) Land Levelers is spelled out across the Zonal/ Unit wise that includes Punjab 9,500; KP 600; Balochistan 1,500; GB 5 and AJ&K 5 at 50% cost sharing basis 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.

1.5 Project Territorial Coverage

The present scope of the project is only covering the following three Provinces due to the availability of the ready information by October 2023:

1. Balochistan Zone
2. Khyber Pakhtunkhwa and
3. Punjab.

But this special report about the precision (Laser) land levelling (PLL) will be discussed based on the selected data gathered through conducting the impact evaluation survey out of the above mentioned zones.

1.6 Zone-wise / Unit-wise Output

1.6.1 Component C4: Provision of Precision (Laser) Land Leveling Units (PLL)

Precision (laser) land leveling is the best option / solution for enhancing / improving water productivity through 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 leveler has 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 1** below:

Table-1: Zone /Unit wise PPL Units Planned and Area Coverage under NPIWC-II

Zone Unit	Number of PLL Planned	Total Area to be Covered Annually (000 acres)
Punjab	9,500	2,850.0
Khyber Pakhtunkhwa	600	180.0
Balochistan	1,500	450.0
Gilgit Baltistan	5	1.5
AJ&K	5	1.5
Total	11,610	3,483.0

1.6.2 Project Direct Benefit

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

1.6.3 Project indirect benefits to industry/economic activities

- viii) Cement industry, bricks Killen, Precast Structures Industry and other related industries' production will pick up.

1.6.4 Awareness support to farmers

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

1.7 Project Impacts

Past studies have indicated that a significant (20-25%) amount of irrigation water is lost during its application only at the farm level due to poor farm designing and unevenness of the fields. This problem is more pronounced in case of high delta of water consumptive use crops like rice, maize, cotton, sugarcane, etc. Laser Land Levelling seeks to explain the benefits of land levelling in fields, particularly rice fields, and help develop skills of farmers and operators in using laser technology to achieve a level field surface. (Bhatt and Sharma, undated Indian Extension Bulletin)

A series of studies on laser levelling in rice-wheat systems of the Indo-Gangetic Plains have found 10-30% irrigation water savings, 3-6% effective increase in farming area, 6-7% increase in fertilizer use efficiency and 3-19% increase in yield (Jat et al., 2009, Akmal et al., 2020). Bhatt and Sharma (2009) estimated that around 25 to 30% of irrigation water could be saved through employing this technique without leaving any harmful effects on the crop yield. It also resulted in a reduction in labor use for weeding by 75%. A considerable increase in the yield of various crops can be realized by using the PLL technology where a strong correlation manifested between the levelness of the fields and crop yield (Rickman, 2002). Moreover, it results in the even distribution of moisture, encourages uniform germination, efficient use of nutrients and improves crop stand. Thus, in brief, the technology saves valuable inputs like water, chemicals including fertilizers, herbicides & pesticides and labor that tend to improve crop growth leading towards higher productivity and resource use efficiency (El-Beheri and El-Khatib, 2001).

1.7.1 Benefits of laser land leveling over conventional land leveling:

The key benefits of PLL includes reduction in time and water for irrigation; uniform distribution of water; less water consumption in land preparation; precise level and smoother soil surface; uniform moisture environment for crops; lesser weeds in the field; good germination and growth of crop; uniformity in crop maturity; reduced seed rate, fertilizers, chemicals and fuel requirements. It takes about 4-5 hours to laser level a hectare of land. The farmer needs to do it once in 3 years. Laser Land leveling is essentially a water saving technology as it uses scares ground water optimally. Use of this technology increase yield, income and reduces environmental footprints. Studies show that there would be at least a 10 percent increase in irrigation water demand with 1 °C raise in temperature in arid semi-arid regions. Laser leveling considerably lowers irrigation time for rice by 47-69 hours per hectare per season. The use of PLL increases yield by about 8 percent for both crops viz., rice and wheat. It

saves electricity about 755 Kwh per hectare per year in rice-wheat cropping systems. (TIME IS. Technology Innovation Management & Entrepreneurship Information Services. Department of Science & Technology Government of India) Leveled fields through LASER technology help to improve the water application efficiency and enhance crop yields due to uniform water distribution. Johnson (1977) examined the physical and economic benefits of precision land leveling in Pakistan by comparing two sets of fields, i.e., precision-leveled and those leveled using traditional techniques. Overall, a 35% improvement in yield was reported under a LASER-leveled field over a conventionally leveled field. The water saving was 16% under precision land leveling compared with a conventionally leveled field. That is why LASER land leveling has been a success story in Pakistan as with many other countries.

Rizwan (2018) reported that PLL was performed at six sites (Khurrianwala, Killianwala, Mungi, Dijkot, Khikhi, and Shahkot) in the command area of the Lower Chenab Canal system. It was reported that water savings under PLL were 18.7% for wheat, 19.9% for cotton, and 22.4% for rice as compared to that under conventional leveling. The average water saving under PLL was recorded as 20.3%.

1.8 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. Moreover, 11,620 recipients of precision (Laser) Land Leveling Units. Thus, total gross direct beneficiaries are expected to be around 3.336 million households including WCs, WSTs and PLL. Taking family size at five, total net population benefitting is expected to be 8.34 million people.

1.9 Project Development Objectives (PDO)

Mid-term and Final PDO targets given in Inception Report are summarized below in **Table 2**:

Table-2: PDO Level Results Indicators under NPIWC-II

Sr. No.	PDO Level 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	Area benefited due to 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

1.10 Monitoring Evaluation and Impact Evaluation

Under the Project, activities are planned and implemented by the executing agencies (EAs) and supervised by Project Consultant. The Monitoring, Evaluation and Impact Evaluation of these completed activities are assessed by the ME&IE Consultants, normally through conducting periodic surveys and studies. The following deliverables (**Table 3**) are to be prepared and submitted from time to time by the ME&IE Consultants during the targeted course of the consultancy period.

Table-3: Deliverables / Reporting Requirement by ME&IE Consultants

Sr. #	Documents	Copies	Due
1.	Draft Inception Report	8	45 days after the effectiveness of the Consulting Services Agreement
2.	Final Inception Report	15	One week after the issuance of Comments by the Client on Draft Inception Report
3	Monthly Progress Report	10	10 th of the following month
4	Baseline Survey Report	10	4 months after start of the Assignment
5	Midline Survey Report	10	In the Middle of the assignment
6	End line Survey Report	10	At the End of the assignment
7	Quarterly Monitoring and Evaluation Report	10	10 th of the following quarter
8	Annual Monitoring and Evaluation Report	10	4 months after start of the assignment
9	Draft Assignment Completion Report	5	At Completion of Physical works/ activities
10	Final Assignment Completion Report	25	At completion of Physical and financial activities
11	Special Reports	10	As and when required

In the middle of the assignment, ME&IE Consultants are required to submit Midline Survey/ Mid-term Impact Evaluation report. Thus, in compliance with its contractual requirement, the ME&IE Consultants have prepared Project's mid-term Monitoring and Impact assessment results up to end October 2023 until unless mentioned otherwise elsewhere, as well as, the special report on the impact through PLL is being prepared. 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 are just as interim or indicative and not final for the time being.

The report contains the following sections, annexes, and appendices:

EXECUTIVE SUMMARY

1. INTRODUCTION
2. MATERIAL AND METHODS
3. PROGRESS MONITORING
4. IMPACT EVALUATION OF PRECISION LAND LEVELLING (COMPONENT C4)
5. BIBLIOGRAPHY

ANNEX-A: MONITORING LOG-FRAME

ANNEX-B: FIELD SURVEY SCHEDULE - ZONE/UNIT WISE

ANNEX-C: MONITORING TOOLS FOR PLL

2 MATERIAL AND METHODOS

2.1 Sample Size for Impact Evaluation

The Monitoring and Evaluation Log Frame for all the components with the focus of **PLL** (highlighted in bold ink) of the Project is placed at **ANNEX-A**. Impact assessment was to be carried out on a 2-20% random sample basis under the original methodology. For small sampling frames, 5% sample was to be taken, for very small sampling frames, 20% sample was to be taken, while for large sampling frames 2% sample was to be selected at random. However, under the revised methodology it was agreed that sample would be drawn randomly @ 5% cross the board, of the completed schemes or achieved targets, irrespective of small or large sampling frames. Samples calculated for total targets (sampling frames) under original methodology and for the completed schemes or achieved targets under revised methodology for PLL delivery components are given in **Table 4**.

Table- 4: Sample Size for PLL Delivery Component

Zone / Unit	Original Methodology			Revised Methodology		
	Activity Targets	Sample %age	Sample Size	Completed Schemes	Sample %age	Sample Size
Punjab	9,500	2%	190	5,844	5%	292
KP	600	5%	30	50	5%	3
Balochistan	1,500	2%	30	34	5%	2
Gilgit Baltistan	5	20%	1	0	5%	0
AJ&K	5	20%	1	0	5%	0
Total	11,610	2.17%	252	5,928	5%	296

2.2 Surveys for Impact Evaluation

Impact Surveys of PLL delivery are conducted after one year of their delivery to the farmers / service providers to determine the impact of the interventions on various agricultural, social and economic indicators such as cropping intensities, cropped area under various crops, crop yields per acre, crop production, farmers' income and employment, etc.

Baseline and impact surveys are carried out, the beneficiaries of project activities are interviewed and data from them are collected by field teams on pre-designed data collection tools through an android-based application on TABs. For each survey, data collection teams are arranged and their composition, data collection program as well as data collection templates are shared with NPC before sending the teams in the field. Baseline and Impact surveys are carried out in phases as targeted PLLs delivery are not pre-selected. Baseline surveys are carried out before the intervention but after the issuance of technical sanctions and the impact surveys are carried out after one year (two crop seasons) of the completion of the intervention. The information is collected by recall method from the beneficiaries. The mid-term study reviews the project progress in the middle of the project implementation. The end line study will assess the impact of the project interventions at the end of the Project. For PLL Impact Surveys, however, separate teams are formed to collect the required information.

2.3 Sampling Procedure for Monitoring & Impact Evaluation

2.3.1 Impact Surveys for Precision Land Leveling

For conducting impact surveys for Precision Laser Land Leveling, sample farmers are directly selected at random from the sampling frame or from the completed schemes as explained in earlier sections.

2.4 Water Saving Estimation

2.4.1 Water savings due to Precision Laser Land Leveling

Water savings at field level are assessed through Impact surveys on the basis of farmers' perception interviews. The impact survey form includes questions to be asked from the farmers who got their land leveled: (a) In how much time an acre was irrigated before land leveling (b) In how much time an acre is irrigated after land leveling. The difference is water saving due to laser land leveling. Based on water savings on the sampled PLL units, total water savings are estimated for all project's PLL units. The savings are reported per PLL unit, per annum and aggregate for the project in LPS and in Acre feet.

2.5 Economic Benefits Assessment for Agriculture

Agriculture data is collected before levelling of fields (baseline) and after levelling of fields (impact) by employing the PLL. In administering before and after surveys, the same forms are used with the same sampled farmers for seeking their views on recall basis. Data on variables such as crop yields, irrigated area, cropping pattern, cropping intensity, farm areas covered, farm income and employment are collected and analyzed. The difference between before and after situations is assumed as economic benefits to agriculture. These benefits are assessed using constant prices of the commodities i.e., same (base year) prices for before and after situations to nullify the impact of general inflation in the economy.

2.6 Impact Evaluation on the Economy

The results of the baseline and impact surveys inclusive all interventions viz., WC, WST and delivery of PLL are used to quantify the impact on the economy. Additional food produced due to the project is estimated. It is benefit towards food security. Project costs and benefits from all the interventions are compared in economic and financial terms to carry out economic and financial analysis. Project Economic Evaluation Tools including Internal Rate of Return (IRR), Net Present Value (NPV) and Benefit Cost Ratios (BCR) are also estimated.

2.7 Impact Evaluation on the Stakeholders

Impact Evaluation Analysis is also carried out with reference to targeted interventions for various stakeholders, like community, government, farmers, etc.

2.8 Spot checking

During the field visits for WUAs baselines impacts of Watercourses, WSTs and provision of PLL units, the interventions are spot checked for quality of construction, material, functioning and beneficiaries' satisfaction etc.

2.9 Process monitoring

The process data for all the interventions are fed to the MIS/GIS database. Clients' field staff and field teams of consultants furnish data of their activities. The ME&IE consultants have also assisted in developing an android based mobile application for this purpose. From this data, reports are generated for process monitoring. All interventions are fully (100%) covered with special reference to PLL.

2.10 Precision land leveler Material and Scope

Laser land leveler is a machine equipped with a laser guided drag bucket. This device emits light through a process of optical amplification based on the stimulate emission of electromagnetic radiation to project one or more fixed lines or dots along with horizontal or vertical axis (see parts in **Figure 1**). As discussed earlier, the scope of the invention of this instrument manifold such as uneven soil surface has a major impact on the germination, stand, and yield of crops due to inhomogeneous water distribution and soil moisture across the cultivated crop fields. Therefore, land levelling is a precursor to good agronomic, soil, and crop management practices. Traditionally farmers level their fields using animal drawn or tractor-drawn levelers. These levelers are implements consisting of a blade acting as a small bucket for shifting the soil from higher to the low-lying positions. It is seen that even the best leveled fields using traditional land leveling practices are not precisely leveled and this leads to uneven distribution of irrigation water.

The advanced method to level or grade the field is to use laser-guided leveling equipment. Laser land leveling is leveling the field within certain degree of desired slope using a guided laser beam throughout the field. Components of Laser Leveling System:

2.10.1 Precision Land Leveling Technology:

Precision land leveling (PLL) is a mechanical process of grading and smoothing the land to a precise and uniform plane surface at grade or no grade (zero slope) with variation of less than ± 20 mm (2cm). Generally, traditional method is used for PLL that involves earth movement with bucket type soil scrapers and tractor mounted rear blades but it is very laborious and too expensive to finish the land surface to exact grade.

The LASER controlled land leveling system consists of a LASER transmitter, a signal receiver, an electrical control panel, and a solenoid hydraulic control valve. The LASER transmitter transmits a LASER beam, which is intercepted by the signal receiver mounted on a leveling blade attached to the tractor. The control panel mounted on the tractor interprets the signal from the receiver and opens or closes the hydraulic control valve

that raises or lowers the leveling blade. The same has proved to be highly beneficial because it minimizes the cost of operation, ensures better degree of accuracy in much lesser time, saves irrigation water, ascertains uniform seed germination, increases fertilizer use efficiency, and resultantly enhances crop yields.

A laser-controlled land leveling system consists of the following five major components (See in **Figure 1-3**):

(i) Drag Scraper/bucket:

The drag bucket can be either 3-point linkage mounted on or pulled by a tractor. This system is preferred as it is easier to connect the tractor's hydraulic system to an external hydraulic by the 3-point-linkage system.

(ii) Laser transmitter:

The laser transmitter mounts on a tripod, which allows the laser beam to sweep above the field.

(iii) Laser receiver:

The laser receiver is a multi-directional receiver that detects the position of the laser reference plane and transmits this signal to the control box.

(iv) Control box:

The control box accepts and processes signals from the machine mounted receiver. It displays these signals to indicate the drag buckets position relative to the finished grade.

(v) Hydraulic system:

The hydraulic system of the tractor is used to supply oil to raise and lower the leveling bucket. The system includes a laser-transmitting unit that emits an infrared beam of light that can travel up to 700m in a perfectly straight line. The second part of the laser system is a receiver that senses the infrared beam of light and converts it to an electrical signal. The electrical signal is directed by a control box to activate an electric hydraulic valve. Several times a second, this hydraulic valve raises and lowers the blade of a grader to keep it following the infrared beam. Laser leveling of a field is accomplished with a dual slope laser that automatically controls the blade of the land leveler to precisely grade the surface to eliminate all undulations tending to hold water. Laser transmitters create a reference plane over the work area by rotating the laser beam 360 degrees. The receiving system detects the beam and automatically guides the machine to maintain proper grade. The laser can be level or sloped in two directions. This is all accomplished automatically without the operator touching the hydraulic controls.



Figure 1: Specifications of the Precision (Laser) Land Leveler

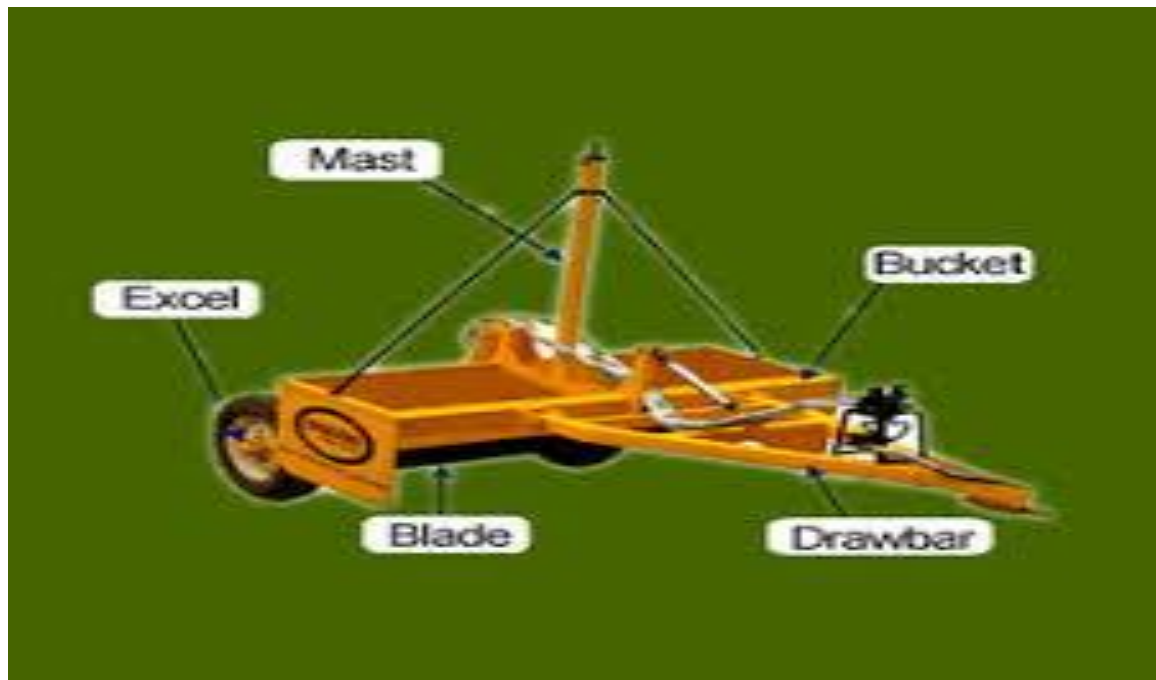


Figure: 2 Labels of PLL Parts



Figure: 3- PLL mounted with Tractor Power

3 PROGRESS MONITORING

In this section, Project overall physical targets progress has been evaluated. Project physical construction activities started in July 2019 in KP and AJ&K, in September 2019 in the Punjab and Balochistan, in April 2021 in Islamabad Capital Territory and in March 2020 in GB. Component wise detail of work completed by end December 2022 is given below:

3.1 Delivery of Precision Laser Land Leveling (PLL) Units

During the Project period (5 years), a total number of 11,610 Precision Laser Land Leveling (PLL) Units were targeted to be delivered. By the end June 2023, 5,928 PLL Units have been delivered which are 51% of total project's (5 years) targets. This short fall is only 38% (100%-62%) in Punjab but 98% 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 5 and Figure 4 below:

Table-5: Provision of PLL Units: Achievements versus Project Targets by the End of June 2023

Zone/Unit	Project Targets	Targets Achievement by the end of June 2023	
		Physical Achievement	Per cent Achievement of
Punjab	9,500	5,844	62%
Khyber Pakhtunkhwa	600	50	8%
Balochistan	1,500	34	2%
Gilgit Baltistan	5	0	0%
AJ&K	5	0	0%
Total	11,610	5,928	51%

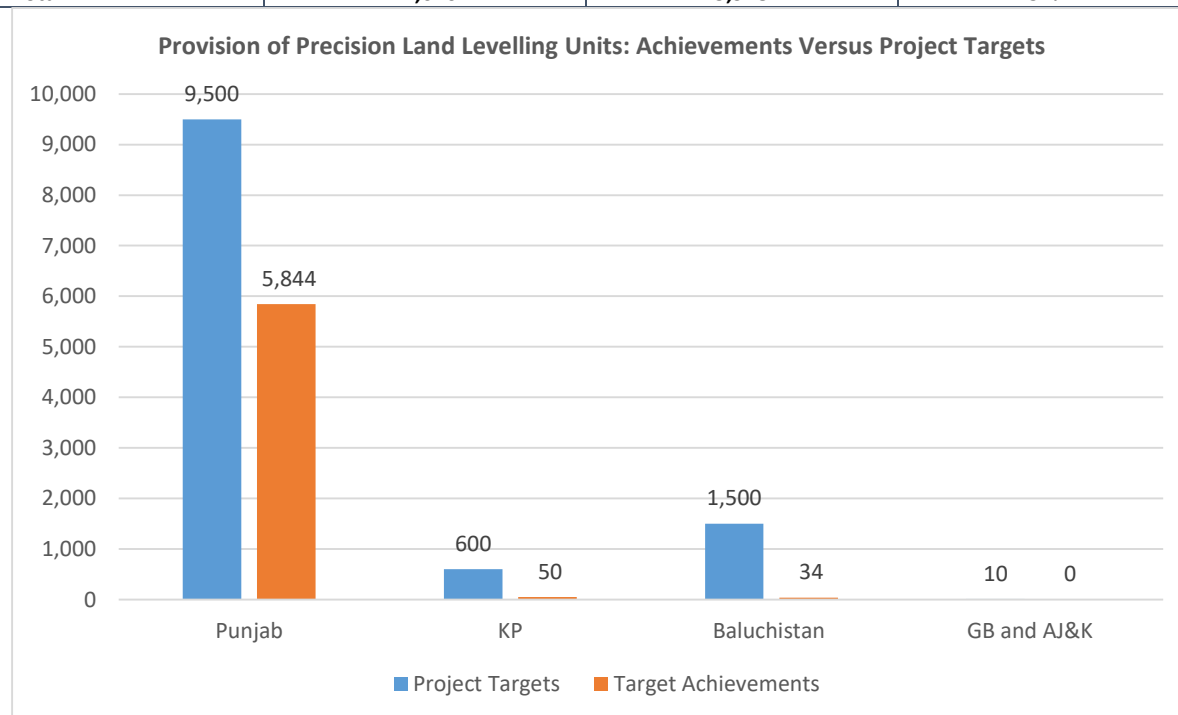


Figure 4: Delivery of PLL Units: Achievements versus Project Targets

3.1.1

3.1.1 Quality of Ground Water

Out of 421 sample watercourses, 362 (86%) fall in the sweet water area and 59 (14%) in Brackish water zone. Zone / Unit wise break up is given in **Table 6** below:

Table 6: Quality of Ground Water in Sample Watercourses

Zone/Unit	Total Sample Watercourses	Sweet Water	Brackish Water
Punjab	165	109	56
KP	152	149	3
Balochistan	61	61	0
AJK	36	36	0
ICT	7	7	0
Overall	421	362	59

3.1.2 Culturable Command Area on Sample Watercourses

Total Culturable Command Area of the sample watercourses is 78,808 acres or 177.7 acres per sample water-course. Zone / unit wise detail is given in **Table 7** below:

Table 7: Culturable Command Area (CCA) on Sample WC

Zone/Unit Wise	Total Sample WC	Total CCA	Per WC Average CCA
Punjab	165	63,269	383.4
KP	152	6,990	46.0
Balochistan	61	3,874	63.5
AJK	36	651	18.1
ICT	7	24	3.4
WC Type Wise			
Regular (New) WC	273	19,174	70.2
20 Years Old WC	8	216	27.0
Additional Lined WC	140	55,418	395.8
Overall	421	74,808	177.7

3.2 Profile of Sample Farmers

3.2.1 Distribution According to Size of Holding and Tenancy Status

During the selection, due consideration was given to the farm sizes and tenure of the farmers. Distribution of respondent growers according to size of holdings is given in **Table 8 & Figure 5**.

Table 8: Distribution of Farmers According to Size of Holding

Total Respondents	Distribution of Sample Farmers According to Size of Holding		
	Less than 12.5 acres	12.5 to 25 acres	More than 25 acres
990	720 (73%)	167 (17%)	103 (10%)
777	717 (92%)	53 (7%)	7 (1%)
216	172 (80%)	21 (10%)	23 (10%)
184	184 (100%)	0	0
7	7 (100%)	0	0
2,174	1800 (83%)	241 (11%)	133 (6%)

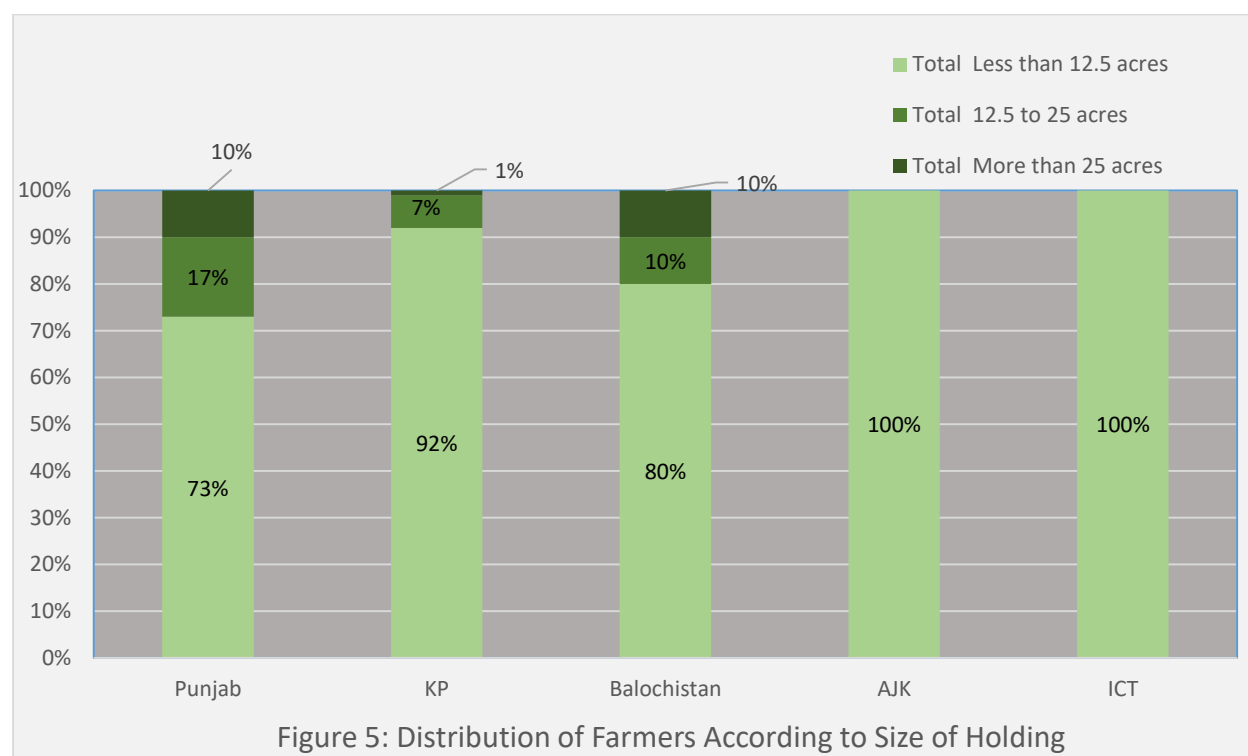


Figure 5: Distribution of Farmers According to Size of Holding

3.3. IMPACT EVALUATION OF PRECISION (LASER) LAND LEVELLER

This section is discussing about the Impact Evaluation of Component C4 (PLL) i.e., Delivery of Precision (Laser) Land Levelers (PLL), a sample of 160 PLL recipients was drawn randomly. In order to assess the agro- Economic impacts of PLL Units, Monitoring and Impact surveys were conducted after one year of their delivery using monitoring tool in **ANNEX-B**. For this purpose, these Monitoring and Impact surveys have to be conducted on a 5% sample basis under revised methodology. Thus, for 5,928 delivered PLL units up to June 2023, Monitoring and Impact sample size worked out to be 296 PLL units, out of which only 160 units have completed one year period after their delivery amongst the beneficiaries. Thus, the present report is covering the survey of only 160 PLL and the remaining sample of 136 PLL would be covered under the upcoming Phase II. A complete profile of these 160 sampled PLL and their owners is portrayed in the proceeding section:

3.4 Sample Size

For conducting Impact Evaluation Survey of PLL (Component C4), a sample of 160 beneficiaries was drawn at random. Sample required as per 5% of the delivered PLL, calculated 296 beneficiaries. However, as mentioned above 160 PLL covered one year after their delivery. Further details are given in **Table 9**.

Table 9: Sample Size for Monitoring Evaluation of Precision Land Levelers

Zone	Total PLL Delivered	% Sample Required	Sample Required	Actual Sample Drawn
Punjab	5,844	5%	292	148
KP	50	5%	3	5
Balochistan	34	5%	2	7
Overall	5,928	5%	296	160

3.5 Educational Profile of Sample Beneficiaries

Most of the beneficiaries (95%) found literate. About 15% beneficiaries are primary / middle level, 27% matric, 20% Intermediate, 25% Graduates and 9% postgraduate. Zone-wise break up is given in **Table 10 & Figure 6**.

Table 1: Educational Background of PLL Service Provider

Zone	Sample Size	Illiterate	Primary / Middle	Matric	FA	Graduate	Masters /Ph.D.
Punjab	148	5.3%	17.1%	29.7%	22.0%	18.4%	8.3%
KP	5	4.5%	0%	0%	0%	68.2%	27.3%
Balochistan	7	0%	0%	9.4%	12.5%	78.1%	0%
Overall	160	4.9%	15.2%	27.0%	19.7%	24.6%	8.6%

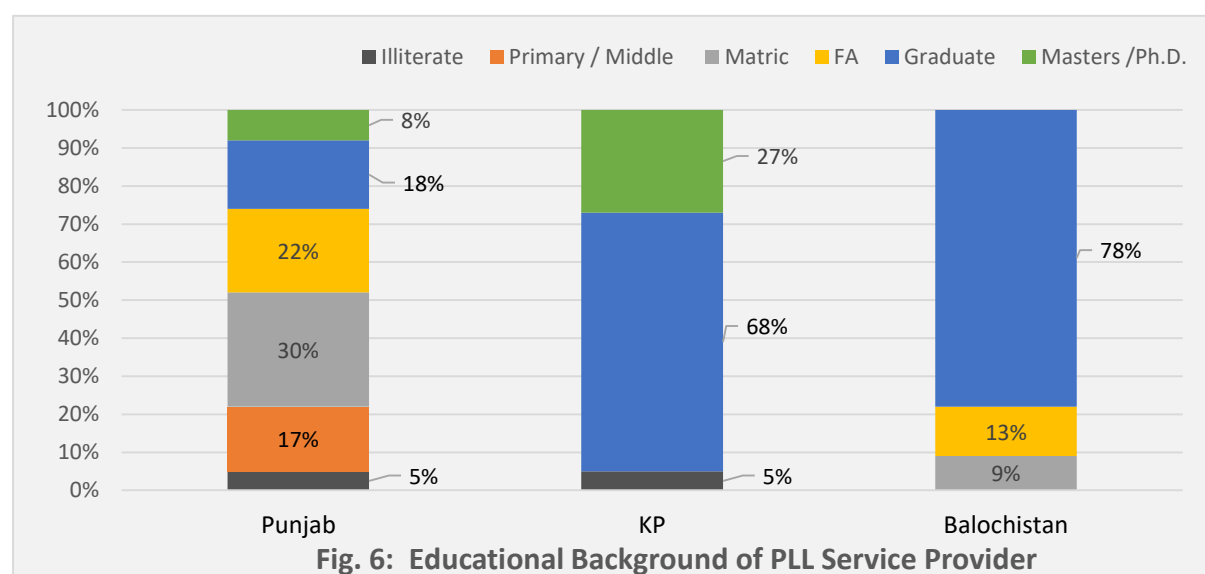


Fig. 6: Educational Background of PLL Service Provider

3.6 Suppliers of Precision (Laser) Land levelers

About 50% i.e., 80 PLL sample units were supplied by 4 Supply and Service Companies (SSCs), namely 21 by Crosfield Agro, 24 by Easy Farming, 14 by Modern Farming and 21 by Ruba Digital Laser. The other 80 sample units were supplied by other 16 different SSCs. Out of total 160 PLL units supplied, 148 were delivered in Punjab, 5 in KP and 7 in Balochistan. Further, SSC wise detail of PPL deliveries is given in **Table 11**.

Table 2: Supply and Service Companies for PLL Supplying to Service Provider

SSC	Punjab	KP	Balochistan	Total
Crosfield Agro	21	0	0	21
Easy Farming	24	0	0	24
Modern Farming	14	0	0	14
Ruba Digital Laser	20	1	0	21
Others SSCs	69	4	7	80
Total	148	5	7	160

3.7 Monitoring of PLL Units

3.7.1 Training of PLL Drivers

About 56% of PLL drivers were fully trained for running PLLs in the field. Around 41% were self-trained and the rest 3% were found un-trained during the monitoring survey. Zone-wise detail is given in **Table 12 & Figure 7 & 7.1**.

Table 3: Training of PLL Operators

Zone	Trained	Self-trained	Not trained
Punjab	57%	41%	2%
KP	80%	0%	20%
Balochistan	29%	57%	14%
Overall	56%	41%	3%

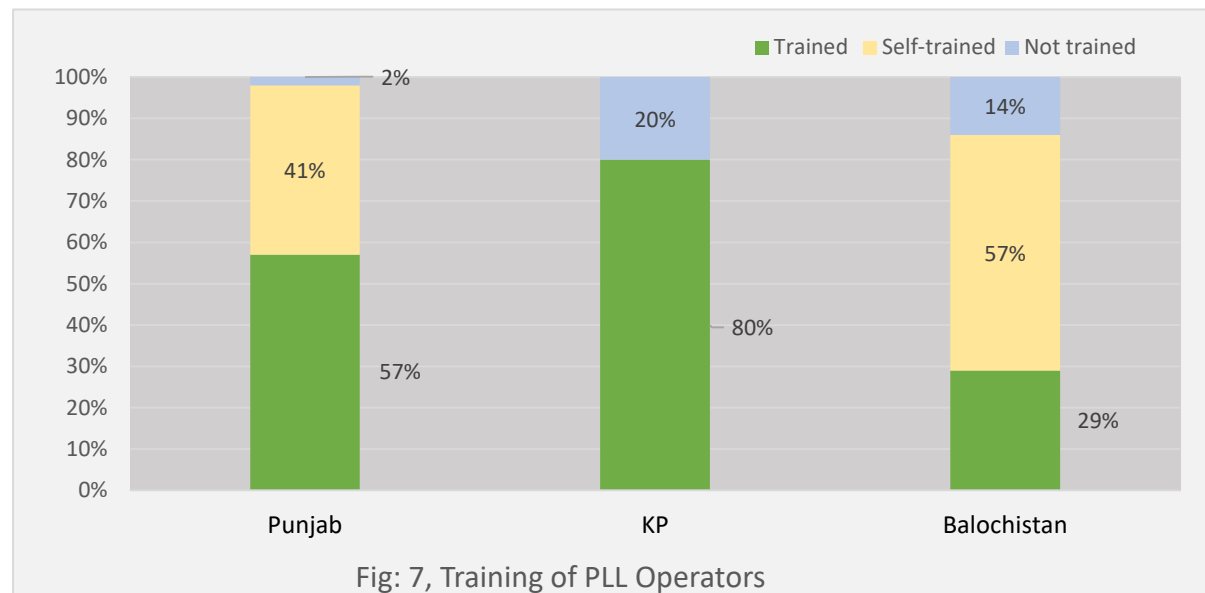


Fig. 7, Training of PLL Operators

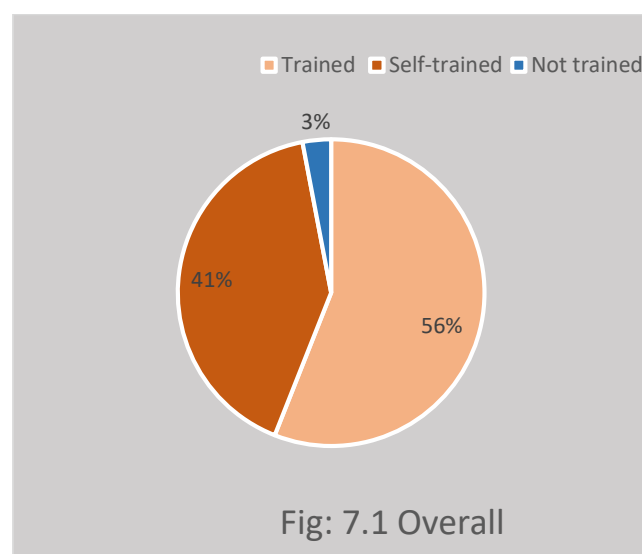


Fig. 7.1 Overall

3.7.2 Type of Training

There are three types of training for running PLL units. These include training for operation of PLL, Training for trouble shooting and repair & maintenance training. All the trained drivers in the all the three provinces were found to have got these trainings (**Table 13**).

Table 4: Type of Training to PLL Trained Operators

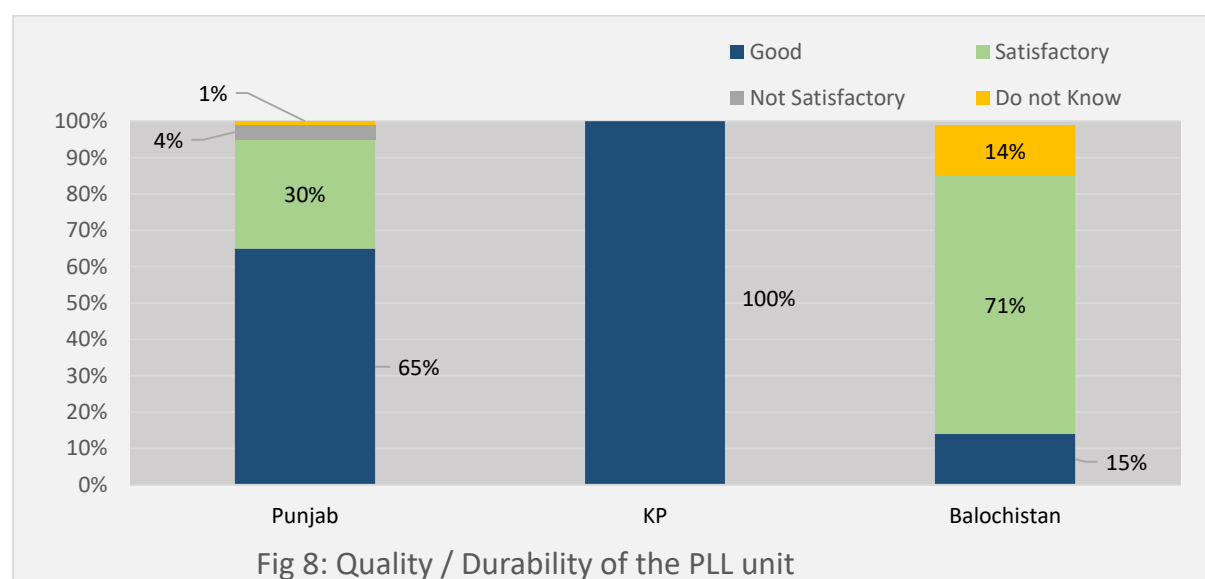
Zone	Training for Operation of PLL	Training of Trouble Shooting	Training of Repair & Maintenance
Punjab	100%	100%	100%
KP	100%	100%	100%
Balochistan	100%	100%	100%
Overall	100%	100%	100%

3.7.3 Quality / Durability of PLL units

The beneficiaries were also asked about the quality / durability of PLL unit. About 64% of respondents ranked these units as good, 30% as satisfactory and 4% as not satisfactory. About 1 to 2 percent responded that they do not know. It means that 95% of beneficiaries regarded the quality / durability of the delivered PLL units satisfactory at least. Zone wise detail is given in **Table 14 & Figure 8**.

Table 5: Quality / Durability of the PLL unit.

Zone	Good	Satisfactory	Not Satisfactory	Do not Know
Punjab	65%	30%	4%	1%
KP	100%	0%	0%	0%
Balochistan	15%	71%	0%	14%
Overall	64%	30%	4%	2%



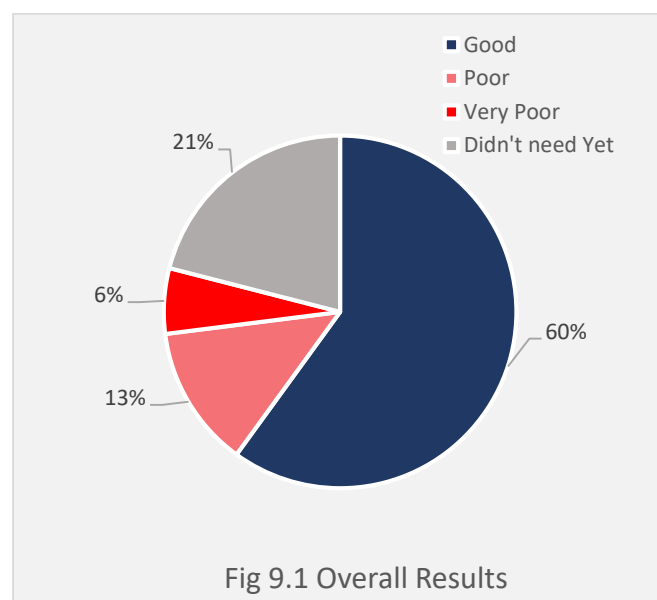
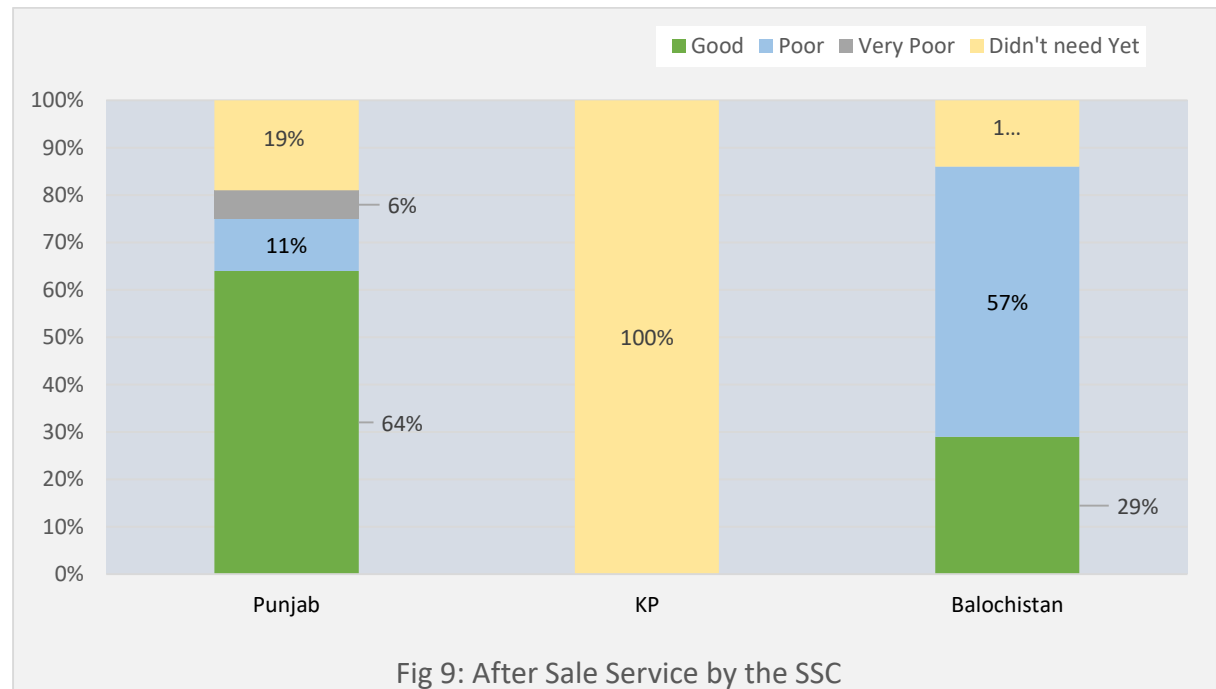
3.7.4 After Sale Service

Regarding after-sales service, 60% responded that it was good, 13% as poor, 6% as very poor and 21% responded that they do not know. Zone-wise details of after-sales service are shown in **Table 15 & Figure 9 & 9.1**.

Table 6: After Sale Service by the SSC

Zone	Good	Poor	Very Poor	Didn't need Yet
Punjab	64%	11%	6%	19%

KP	0%	0%	0%	100%
Balochistan	29%	57%	0%	14%
Overall	60%	13%	6%	21%



3.7.5 Complaints Attended by SSCs

About 53% of beneficiaries responded that the attending of complaints by SSCs has been prompt and 16% told that the complaints were not being attended promptly. The rest 31% informed that they do not know. Details may be seen in **Table 16 & Figure 10 & 10.1** below:

Table 7: Complaints Attended by SSCs

Zone	Promptly	Not Promptly	Didn't need Yet
Punjab	57%	17%	26%
KP	0%	0%	100%
Balochistan	15%	14%	71%
Overall	53%	16%	31%

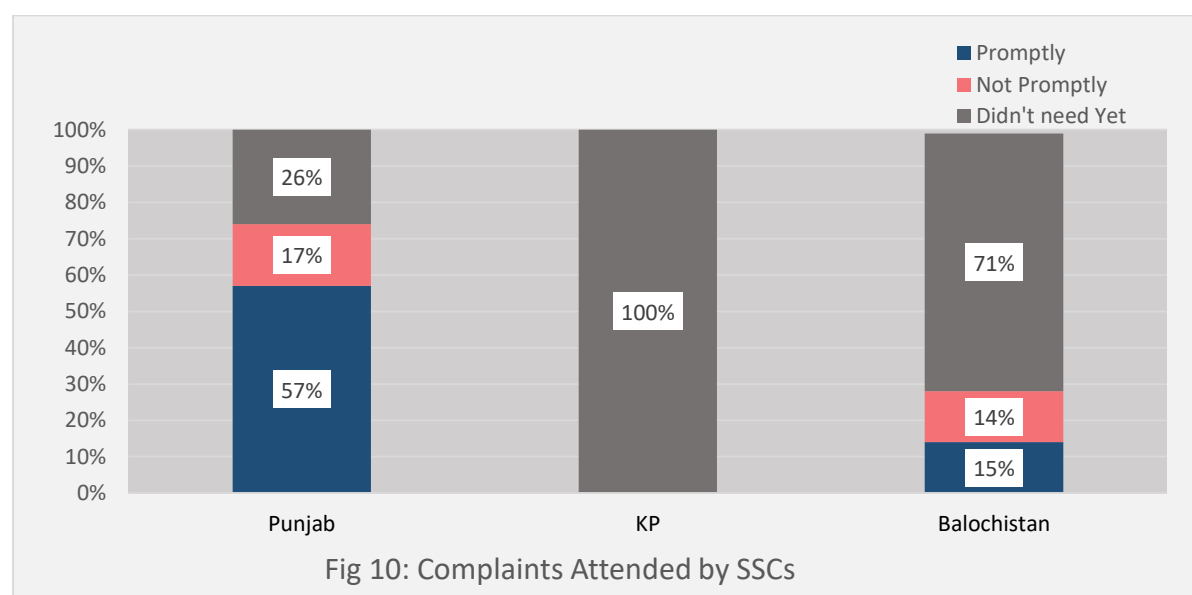


Fig 10: Complaints Attended by SSCs

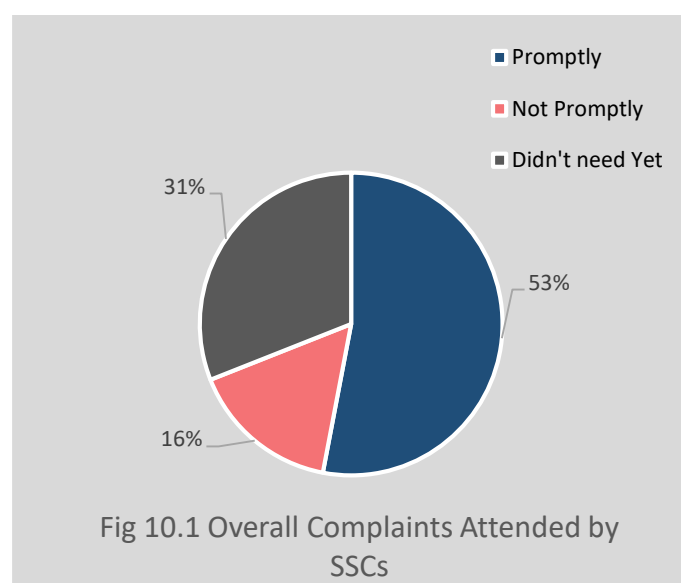


Fig 10.1 Overall Complaints Attended by SSCs

3.7.6 Prices of the PLL Units Charged by SSCs

As for the prices of PLL, 9% of respondent beneficiaries informed that the SSCs charged high prices, 54% reported that the prices were normal, while the rest 37% responded that they did not know. Zone-wise detail is given in **Table 17 & Figure 11 & 11.1**.

Table 8: Prices of the PLL Units Charged by SSCs

Zone	High	Normal	Don't Know
Punjab	9%	57%	34%
KP	0%	0%	100%
Balochistan	0%	43%	57%
Overall	9%	54%	37%

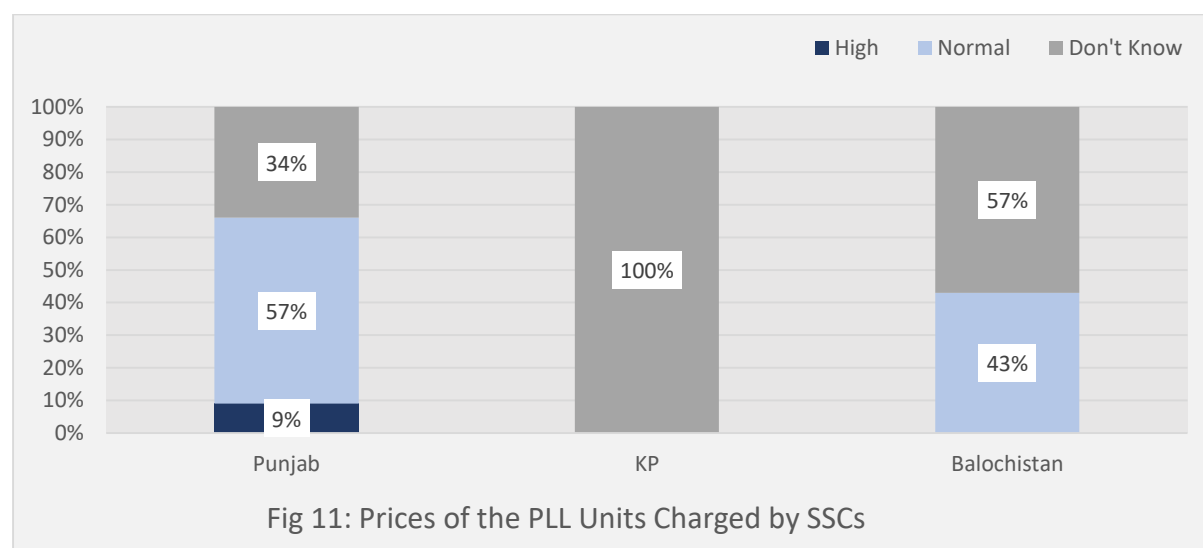


Fig 11: Prices of the PLL Units Charged by SSCs

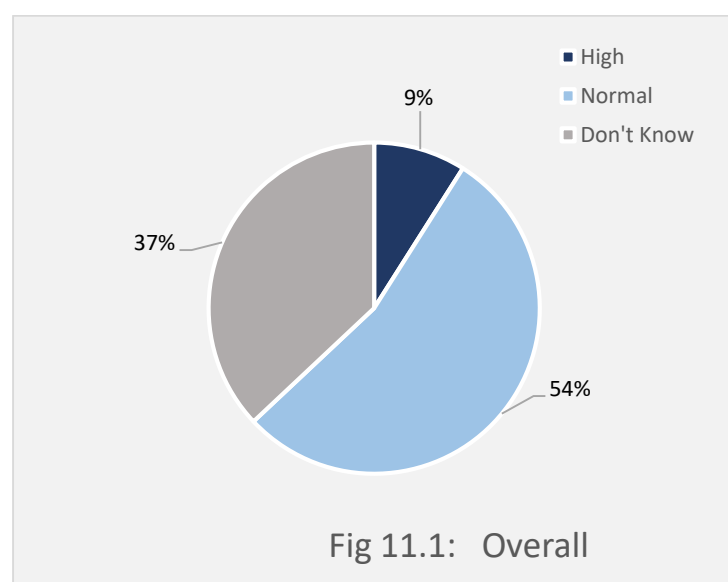


Fig 11.1: Overall

3.7.7 Availability of Spare Parts by SSCs

The respondents were also asked about the availability of spare parts by the SSCs. Out of total 160 respondents, 30% responded that spare parts were available with SSCs whenever required, 7% informed that it took time long time, whereas the rest 63% reported that they did not need these spare parts as yet. Zone wise detail is given in Table 18 Figure 12 & 12.1 below:

Table 9: Availability of Spare Parts with SSCs

Zone	When required	Takes Long Time	Didn't need Yet
Punjab	30%	7%	62%
KP	0%	0%	100%
Balochistan	43%	0%	57%
Overall	30%	7%	63%

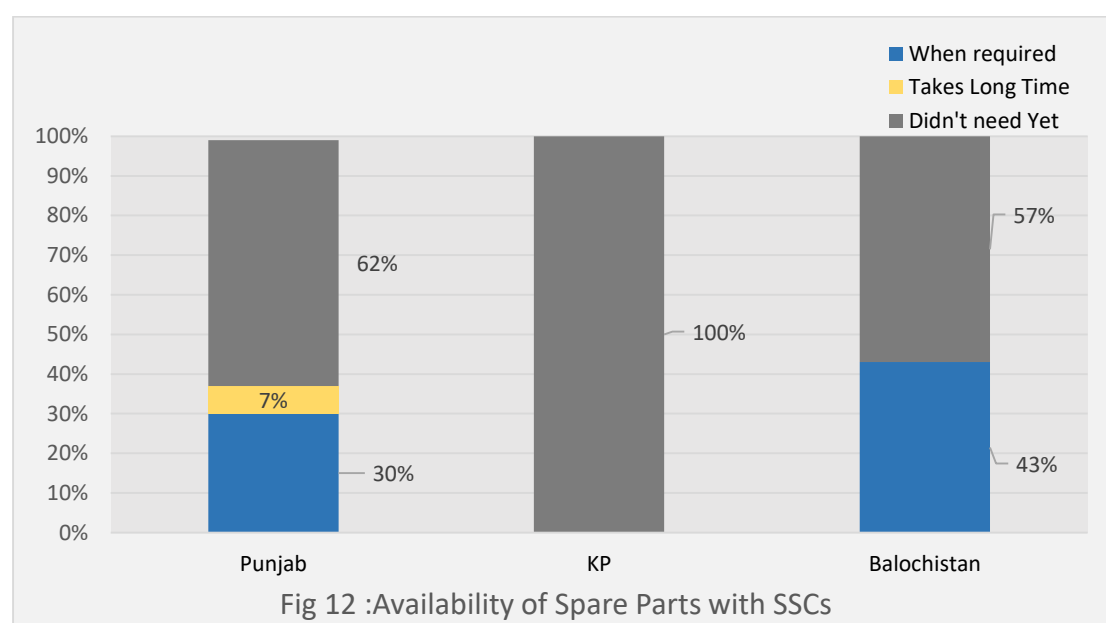


Fig 12 :Availability of Spare Parts with SSCs

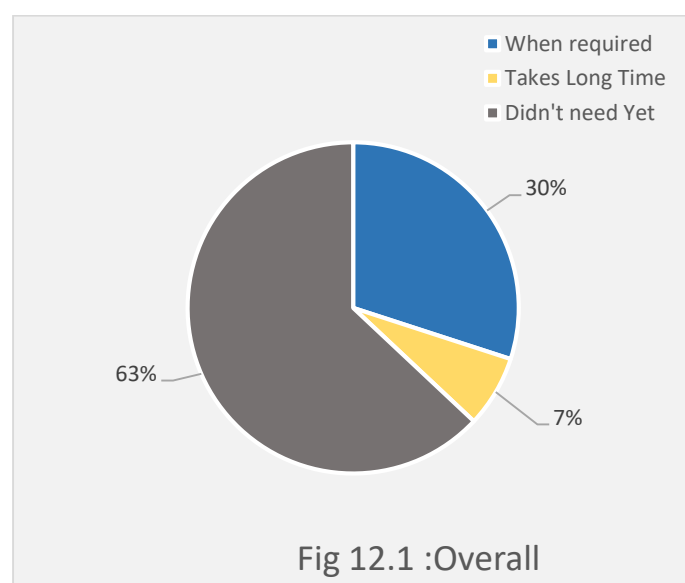


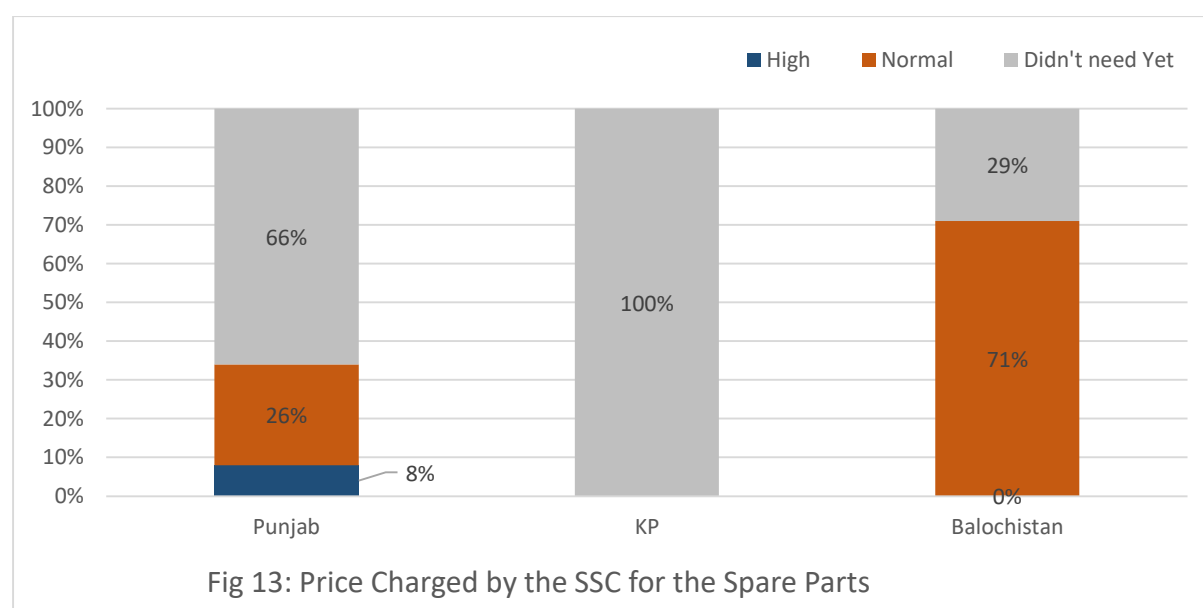
Fig 12.1 :Overall

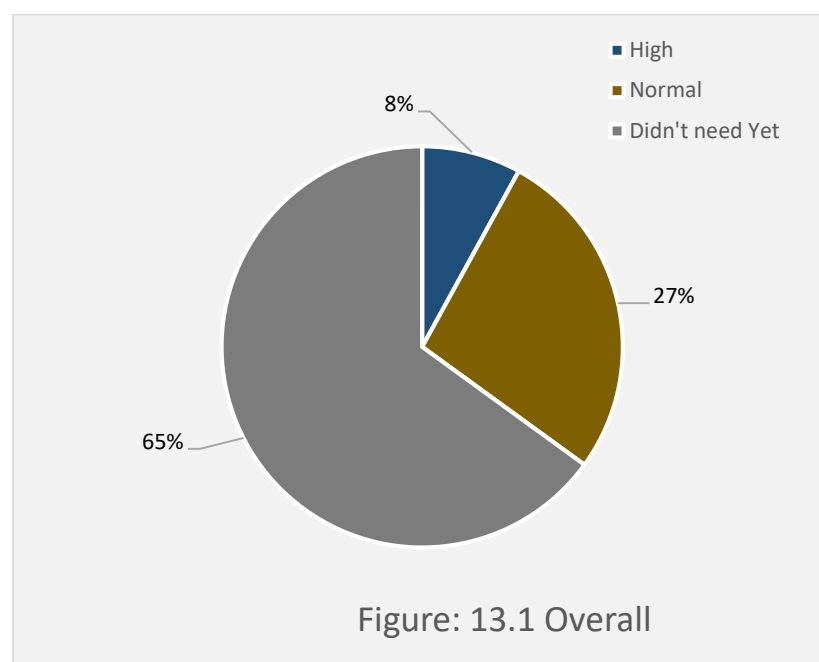
3.7.8 Price Charged for the Spare Parts

As for the prices of PLL spare parts charged by the SSCs, 8% of respondent beneficiaries informed that the SSCs charged high prices, 27% reported that the prices were normal, while the remaining 65% responded that they did not need these spare parts as yet. Zone-wise detail is given in **Table 19 & Figure 13 & 13.1**.

Table 10: Price Charged by the SSC for the Spare Parts

Zone/Unit	High	Normal	Didn't need Yet
Punjab	8%	26%	66%
KP	0%	0%	100%
Balochistan	0%	71%	29%
Overall	8%	27%	65%



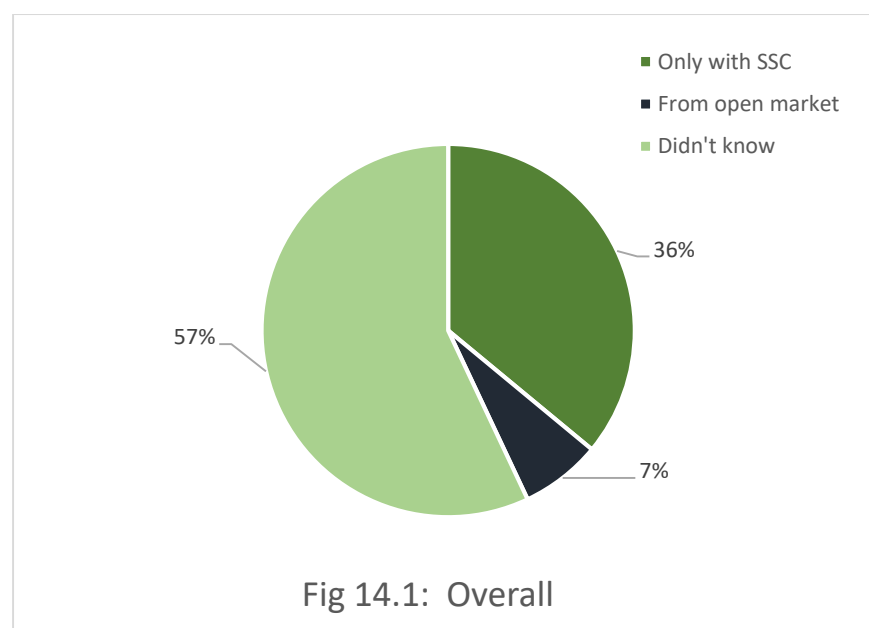
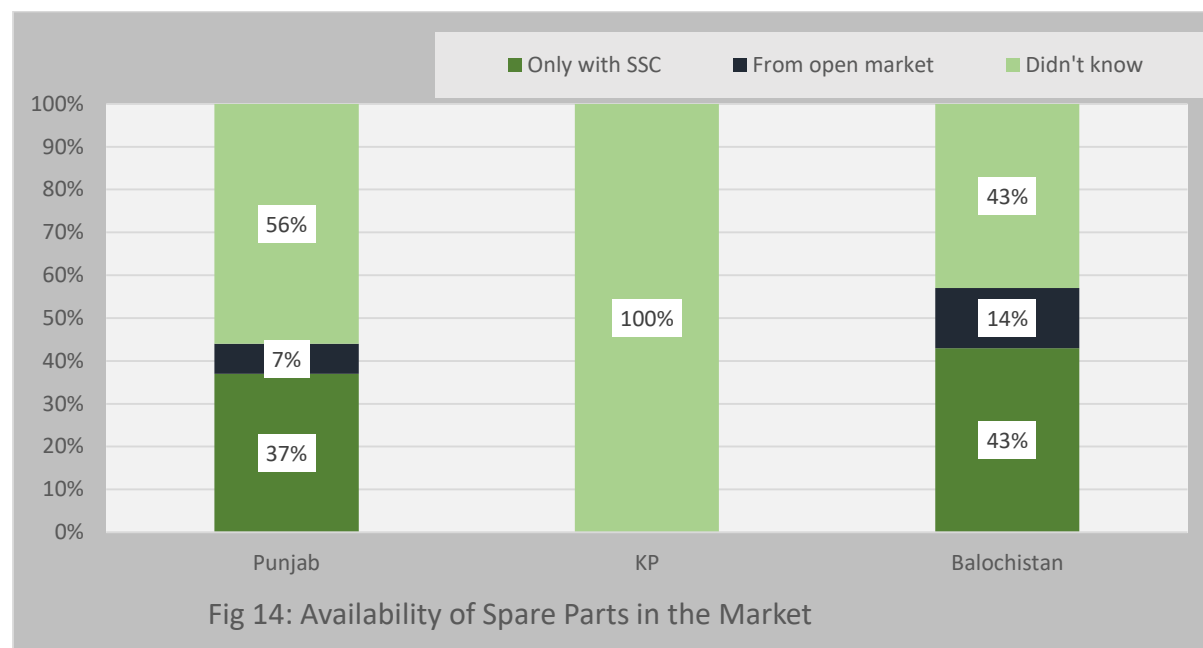


3.7.9 Availability of Spare Parts in the Market

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% reported that they did not know. Zone-wise detail is given in **Table 20 & Figure 14 & 14.1** below:

Table 20: Availability of Spare Parts in the Market

Zone/Unit	Only with SSC	From open market	Didn't know
Punjab	37%	7%	56%
KP	0%	0%	100%
Balochistan	43%	14%	43%
Overall	36%	7%	57%



3.8 Spot Checking of PLL

3.8.1 Purpose / Use of PLL

While spot checking, all 160 (100%) respondents were using PLL for agricultural purposes. No respondent was found using this equipment for non-agricultural purposes. Details may be seen in **Table 21**.

Table 21: Purpose / Use of PLL

Zone/Unit	Total PLL	Use for Agriculture Purpose	
		No	%
Punjab	148	148	100%

KP	5	5	100%
Balochistan	7	7	100%
Overall	160	160	100%

3.8.2 Spot Checking at Site

The PPLs were also spot checked with respect to 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. Zone-wise detail may be seen in **Table 22 & Figure 15**.

Table 22: Spot Checking at Site

Zone/Unit	Found at Location	Rented Out to other location	Condition / Upkeep of the unit		
			Good	Satisfactory	Poor/ Un-Satisfactory
Punjab	145	3	59%	36%	5%
KP	5	0	100%	0%	0%
Balochistan	4	3	25%	50%	25%
Overall	154	6	60%	35%	5%

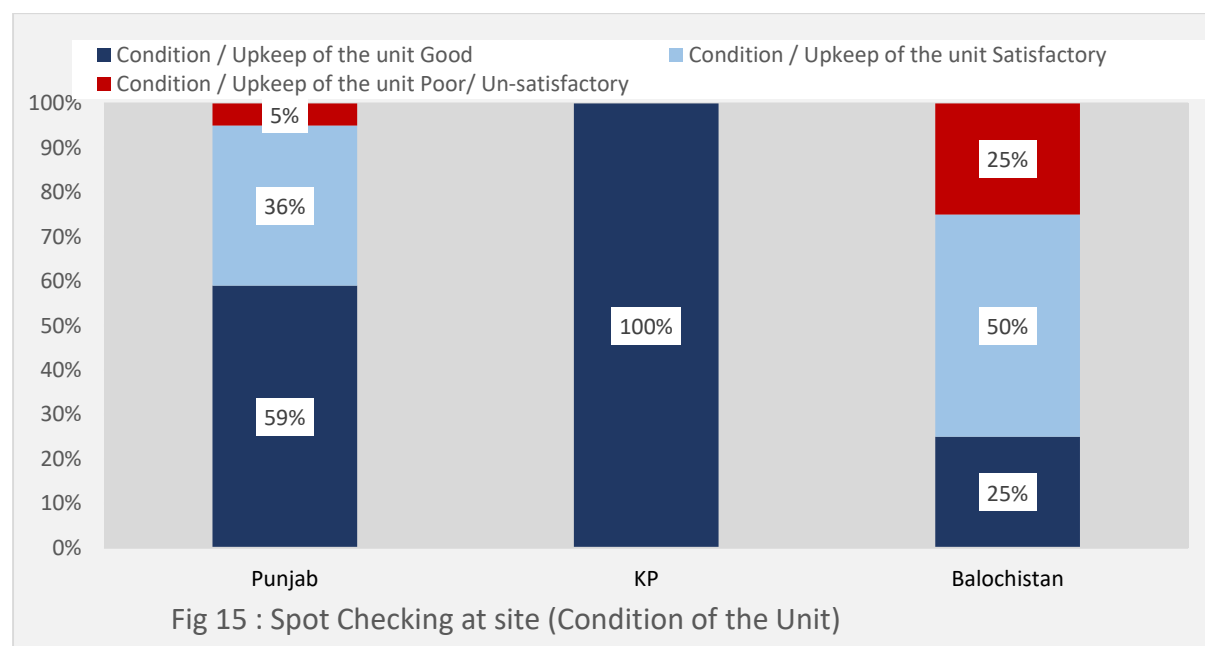


Fig 15 : Spot Checking at site (Condition of the Unit)

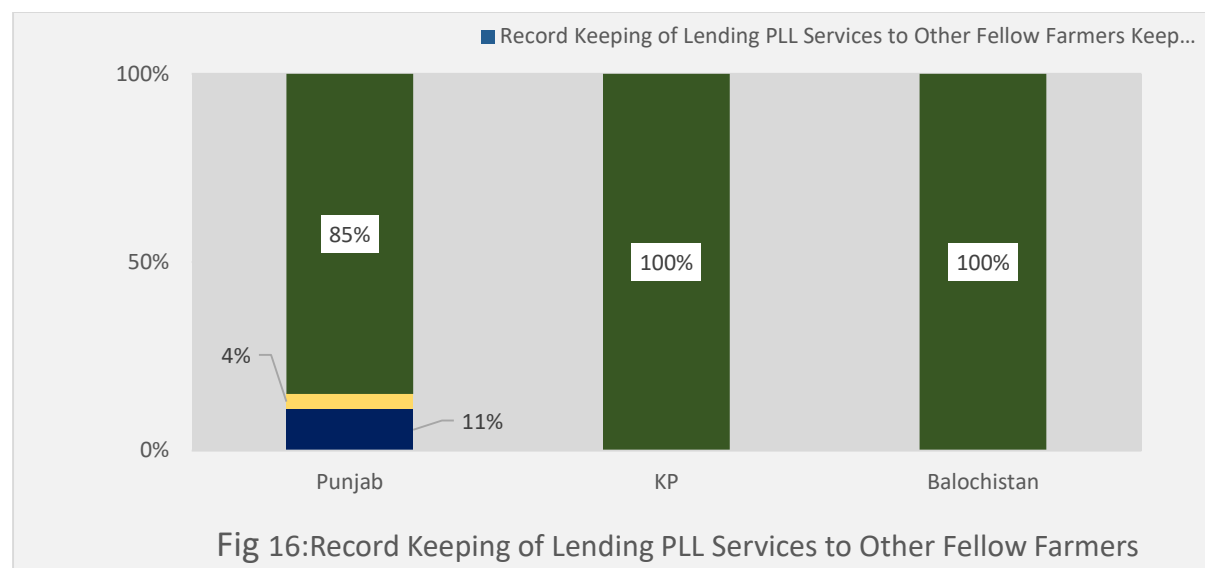
3.9 Agro-Economic Monitoring Impact Evaluation of PLL Units

3.9.1 Record Keeping of Laser Land Leveling Services to Other Farmer

About 97% of PLL owners provide laser leveling services 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 record on logbooks, 36% on loose papers. Details may be seen in **Table 23 & Figure 16**.

Table 23: Record Keeping of Laser Land Leveling Services to Other Farmer

Zone/Unit	Provide service to other farmers	Record Keeping of Lending PLL Services to Other Fellow Farmers					
		Keep Record			Keep Record in		
		Complete	Partial	No	logbook	Loose papers	Not in Writing
Punjab	99%	11%	4%	85%	55%	36%	9%
KP	80%	0%	0%	100%	0%	0%	0%
Balochistan	57%	0%	0%	100%	4%	0%	0%
Overall	97%	10%	4%	86%	55%	36%	9%

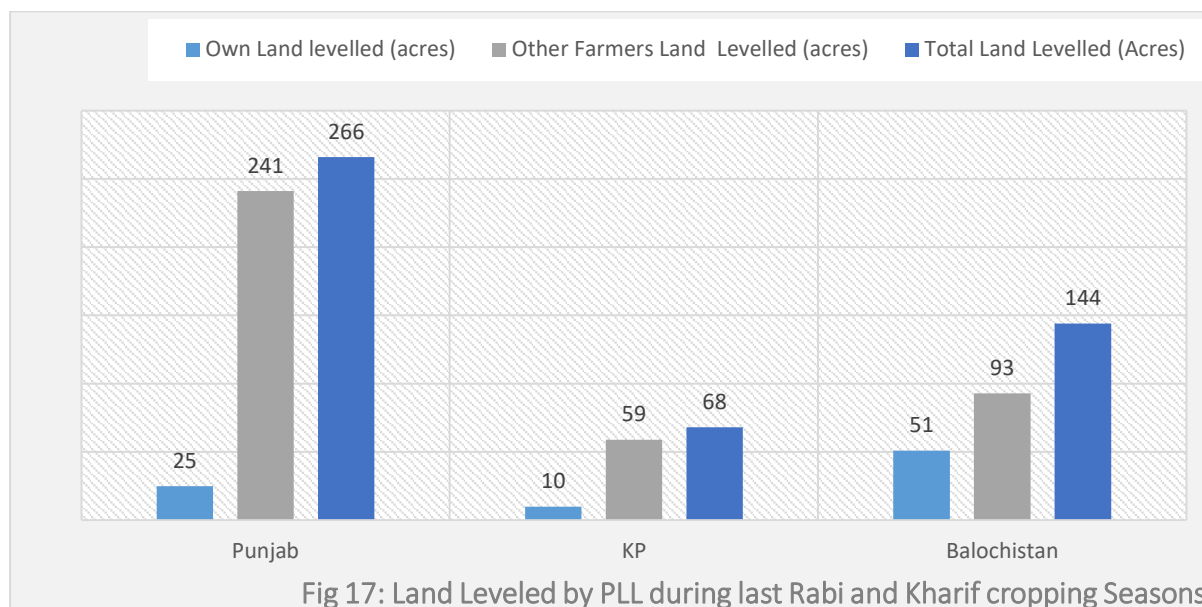


3.9.2 Land Levelled during the last Rabi and Kharif Cropping Seasons

Total laser land levelled by the 160 respondent PLL owners during 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) was owned land, and **36,619** acres (229 acres per equipment) were laser levelled on rental hiring services on the fields of other fellow farmers. Further detail on the zone basis may be seen in **Table 24** as well as in **Figure 17** below:

Table 24: Land Levelled during last Rabi and Kharif cropping Seasons

Zone/Unit	PLL Numbers	Own Land levelled (acres)		Other Farmers Land Levelled (acres)		Total Land Levelled (Acres)	
		Total	Per PLL	Total	Per PLL	Total	Per PLL
Punjab	148	3,685	25	35,675	241	39,360	266
KP	5	48	10	294	59	342	68
Balochistan	7	359	51	650	93	1,009	144
Overall	160	4,092	26	36,619	229	40,711	254



3.9.3 PLL Beneficiaries

Total annual PLL beneficiaries calculated to the tune of 11,331 farmers including the owners themselves or 71 farmers per equipment. The same details according to the project's zones are given in **Table 25** below.

Table 25: PLL Beneficiaries

Zone/Unit	Owner Beneficiaries		Other Beneficiaries		Total Beneficiaries	
	Total	Average Per PLL	Total	Average Per PLL	Total	Average Per PLL
Punjab	148	1	11,033	75	11,181	76
KP	5	1	92	18	97	19
Balochistan	7	1	46	7	53	8
Overall	160	1	11,171	70	11,331	71

3.9.4 Impact of PLL on Crop yields

Impact of PLL on crop yield was also assessed through the farmers' perception. The growers were of the view that the use of PLL increases yields of various crops ranging from 8% to 14% averaging at 11% on the whole. Crop-wise detail is given in **Table 26**. The same trend of the conclusions has already presented in previous discussion from the secondary source of information.

Table 26: Impact of PLL on Crop yields

Crops	Crop Yields Before PLL	Crop Yields After PLL	Increase in Crop Yields Due to PLL	
	Maunds / Per acre			Percent Increase
Wheat	35.59	39.04	3.45	10%
Sugarcane	734.72	790.28	55.56	8%
Rice	41.64	46.4	4.76	11%
Cotton	16.23	18.31	2.08	13%
Maize	92.41	100.25	7.84	8%
Vegetables	502.21	550.42	48.21	10%
Other Crops	83.89	95.56	11.67	14%
Weighted average increase in crop yields				11%

3.9.5 Impact of PLL on Net Income / Benefits

The Benefits of PLL have also been estimated on the basis of yield increases at the same rate as estimated under watercourses improvement. The details in this regards may be reviewed from **Table 27**. Total Annual Net income or benefits of all the delivered PLL are estimated as 3,091 million PKR whereas, per PPL unit these works out as 521 thousand PKR per annum. The other details about the performance of PLL practices on the farmers' field is portrayed in the table below:

Table 27: Impact of PLL on Annual Net Income or Benefits

Total PLL delivered	No.	5,928
Area Levelled per PLL	Acres	254
Total area Levelled	1000 Acres	1,506
Net Benefits per acre as under watercourses improvement	PKR	4,053
Less Operating cost per acre	PKR	2,000
Net Benefits per PLL	1000 PKR	521
Total Net Benefits due to 5,928 delivered PLL	Million PKR	3,091

3.9.6 Water Saving Impact of PLL Units

Information was also asked for from the growers regarding the saving of water due to Precision Land Leveling operations. On an average 0.38 to 0.94 hours were reported per acre to be saved of water due to Precision Land Leveling depending upon the delta of water requirements of different crops as per see elaborated in the **Table---**. Overall weighted average per cent saving in water has been estimated as 25% on a particular farm with details shown in the table under discussion. Crop-wise detail is given in **Table 28**.

Table 28: Crop wise average irrigation time per acre (Hrs.)

Crops	Before PLL	After PLL	Saving	
	Hours / Acre		%	
Wheat	3.19	2.25	0.94	29%
Sugarcane	3.78	2.85	0.93	25%
Rice	3.35	2.62	0.73	22%
Cotton	2.15	1.65	0.50	23%
Maize	2.29	1.91	0.38	17%
Vegetables	1.69	1.20	0.49	29%
Other Crops	2.17	1.78	0.39	18%
Weighted Average increase saving in water				25%

3.9.7 Annual Water Savings due to Laser Land Levelling

Based on information, obtained through field surveys annual water savings due to Laser Land Levelling has been estimated and given in **Table 29**. Total water saved due to all 5,928 PLL units delivered amongst the beneficiaries is estimated as 752,856 acre-feet (AF), whereas it calculates as 127 AF per PLL unit. The complete details of water saved due to employing the practice of PLL is illustrated in the table below:

Table 29: Annual Water Savings due to Laser Land Levelling

PLL delivered	5,928
Area Levelled per PLL	254
Total Acres Levelled	1,505,712
Average Annual Water Requirement per acre (Inches)	24
Average Annual Water Requirement per acre (AF)	3,011,424
Saving due to Laser levelling (%)	25%
Total Saving due to Laser levelling under completed activities (AF)	752,856
Saving due to Laser levelling per PLL (AF)	127

4 MID TERM ECONOMIC ANALYSIS

4-1 Project Benefits

In the previous sections, it has been estimated the annual net income or benefits for each component, the mode of the targeted interventions viz., improvement of watercourses (WCs), construction of Water Storage Tanks (WSTs) and delivery of Precision Land Levelers (PLL). These are summarized in **Table 122**. Total annual projects benefits inclusive of all interventions are 24,285 million PKR. **Whereas, this report is focusing on the impact of water saved due to employing of PLL practices that is counted to the net income benefits worth of 3,091 million PKR.** The details of other interventions with its break up is presented in **Table 30**.

Table 30: Component wise Project Benefits

Project Components	Net Income of Benefits in Million PKR
Component C2 Improvement of Watercourses	19,414
Component C3 Construction of WSTs	1,780
Delivery of Precision Land Levelers (PLL)	3,091
Total tangible Project Benefits	24,285

4.4 Project Costs

Zone wise, year wise and category wise break up of Project cost / releases during the last 4 years has been shown in **Table 31**. Total project cost in last 4 years calculates as 35,030 million PKR.

Table 31: Zone wise and Year wise Project Expenditure / Cost (Million PKR)

Zone	Financial Year	ADP Cost	PSDP Cost	Total Cost	Community Share	Total Project Cost
Punjab	2019-20	797	1,385	2,182	826	3,008
KP	2019-20	652	675	1,327	331	1,658
Balochistan	2019-20	986	725	1,711	544	2,255
AJK	2019-20	0	325	325	8	333
ICT	2019-20	0	50	50	0	50
FPMC	2019-20	0	410	410	0	410
Punjab	2020-21	1,729	879	2,608	1,338	3,946
KP	2020-21	711	165	876	161	1,037
Balochistan	2020-21	800	330	1,130	243	1,373
AJK	2020-21	0	130	130	32	162
ICT	2020-21	0	60	60	6	66
FPMC	2020-21	0	815	815	0	815
Punjab	2021-22	5,212	724	5,936	2,422	8,358
KP	2021-22	903	373	1,276	345	1,621
Balochistan	2021-22	1,490	653	2,143	316	2,459
AJK	2021-22	0	107	107	48	155
ICT	2021-22	0	18	18	4	22
FPMC	2021-22	0	628	628	0	628
Punjab	2022-23	1,000	1,870	2,870	759	3,629
KP	2022-23	278	297	575	133	708
Balochistan	2022-23	501	802	1,303	30	1,332
AJK	2022-23	0	253	253	42	296
ICT	2022-23	0	12	12	0	12
FPMC	2022-23	0	697	697	0	697
Total		15,059	12,382	27,441	7,589	35,030

A zone wise and year wise summary of the above Project releases / cost is produced in **Table 32**. In 2019-20, an amount of 7,714 million PKR was incurred, in 2020-21, 7,399 million PKR, in 2021-22, 13,243 million PKR, in 2022-23, 6,673 million PKR and commuting 35,030 million PKR in all 4 years across all Zones/ Units of the project.

Table 32: A Summary of Zone wise and Years wise Project costs /Releases

Zone	2019-20	2020-21	2021-22	2022-23	Total
Punjab	3,008	3,946	8,358	3,629	18,941
KP	1,658	1,037	1,621	708	5,024
Balochistan	2,255	1,373	2,459	1,332	7,420
AJK	333	162	155	296	946
ICT	50	66	22	12	150
FWMC	410	815	628	697	2,549
Total	7,714	7,399	13,243	6,673	35,030

4.5 Benefit Cost Ratio

Benefit Cost Ratio is a ratio of Present Value of project benefits to the Present Value of Project costs. At 12% discount rate, Benefit Cost Ratio (BCR) has been calculated at 2.5 in **Table 33**.

Table 33: Calculation of Benefit Cost Ratio at 12% discount Rate

dis. Factor at 12% dis. Rate/year	Year	Current Annual Project Costs and Benefits				Discounted	
		Capital Cost	Recurring R&M Cost	Project Costs	Project Benefits	Project Costs	Project Benefits
1	0	0	0	0	0	0	0
0.892857143	1	7,714	0	7,714	0	6888	0
0.797193878	2	7,399	193	7,592	5,348	6053	4263
0.711780248	3	13,243	378	13,621	10,478	9695	7458
0.635518078	4	6,673	709	7,382	19,659	4692	12493
0.567426856	5		876	35,906	24,285	20374	13780
0.506631121	6		876	876	24,285	444	12304
0.452349215	7		876	876	24,285	396	10985
0.403883228	8		876	876	24,285	354	9808
0.360610025	9		876	876	24,285	316	8757
0.321973237	10		876	876	24,285	282	7819
0.287476104	11		876	876	24,285	252	6981
0.256675093	12		876	876	24,285	225	6233
0.22917419	13		876	876	21,194	201	4857
0.204619813	14		876	876	21,194	179	4337
0.182696261	15		876	876	21,194	160	3872
0.163121662	16		876	876	21,194	143	3457
0.145644341	17		876	876	21,194	128	3087
0.13003959	18		876	876	21,194	114	2756
0.116106777	19		876	876	21,194	102	2461
0.103666765	20		876	876	21,194	91	2197
Present Values of Project Costs and Project Benefits						51086	127907
Benefit Cost Ratio						2.50	

4.6 Internal Rate of Return (IRR)

Internal Rate of Return (IRR) is the rate of discount at which Net Present Value of both costs and benefits becomes equal or BCR that turns out a unity. It has been calculated at 50% in **Table 34**.

Table 34: Calculation of Internal Rate of Return (IRR)

dis. Factor at 50% dis. Rate/year	Year	Current Annual Project Costs and Benefits				Discounted	
		Capital Cost	Recurring R&M Cost	Project Costs	Project Benefits	Project Costs	Project Benefits
1	0	0	0	0	0	0	0
0.666666667	1	7,714	0	7,714	0	5143	0
0.444444444	2	7,399	193	7,592	5,348	3374	2377
0.296296296	3	13,243	378	13,621	10,478	4036	3104
0.197530864	4	6,673	709	7,382	19,659	1458	3883
0.131687243	5		876	35,906	24,285	4728	3198
0.087791495	6		876	876	24,285	77	2132
0.058527663	7		876	876	24,285	51	1421
0.039018442	8		876	876	24,285	34	948
0.026012295	9		876	876	24,285	23	632
0.01734153	10		876	876	24,285	15	421
0.01156102	11		876	876	24,285	10	281
0.007707347	12		876	876	24,285	7	187
0.005138231	13		876	876	21,194	4	109
0.003425487	14		876	876	21,194	3	73
0.002283658	15		876	876	21,194	2	48
0.001522439	16		876	876	21,194	1	32
0.001014959	17		876	876	21,194	1	22
0.000676639	18		876	876	21,194	1	14
0.000451093	19		876	876	21,194	0	10
0.000300729	20		876	876	21,194	0	6
Present Values of Project Costs and Project Benefits						18,970	18,898
Benefit Cost Ratio						1.00	

4.7 Project Development Objective Level Results

The midterm analysis shows that as the midterm physical targets are under achieved, some of the PDO Level Results are also lagging behind. However, a comparison between the midterm targets and achievements have been made in **Table 35**.

Table 35 : PDO Level Results Indicators under NPIWC-II

Sr. No.	PDO Level Results Indicators	Unit	Baseline	Mid term	
				Target	Achievement
1	Watercourses with an increase in watercourse conveyance efficiency of at least 15%.	Number	0	27,871	11,454
2	Direct project beneficiaries of watercourse improvements-households (number) ^(a)	Number	0	975,485	601,878
3	Construction of Water Storage Tanks	Number	0	8,472	5,390
4	Provision of Laser Land Leveling	Number	0	7,460	5,928
5	Increase in cropping intensity in Canal command areas (watercourses).	Percentage	168%	5%	8.4%
6	Increase in Cropping Intensity in non-canal command areas	Percentage	110%	24%	18.4%
7	Increase in Agriculture output per unit of water (watercourses)	PKR/M ³	8	3	7
8	Reduction in water losses in project area due to watercourse lining	% age	45%	33	30
9	Reduction in field application losses due to laser land leveling	% age	30%	33	25

Table 35 : PDO Level Results Indicators under NPIWC-II

Sr. No.	PDO Level Results Indicators	Unit	Baseline	Mid term	
				Target	Achievement
10	Increase in agriculture output per unit of water (laser leveling)	PKR/M³	8	3	3
11	Area benefited due to improvement of watercourses ^(b)	Acres	0	6,689,040	1,300,965
12	Area leveled by laser Land Leveling units	Acres	0	2,238,000	1,508,343
13	Area served by Water Storage Tanks ^(c)	Acres	0	69,894	53,657

REFERENCES

1. *Umbrella PC-I of NPIWC-II*
2. *Feasibility Study*
3. *Consolidated Baseline Survey Report*
4. *Various Monitoring and Impact Evaluation Surveys*
5. *SIAPEP Mid-term Impact Assessment*
6. *Various SIAPEP FFS Studies*
7. *Various SIAPEP KG Kits Studies*
8. *Various SIAPEP Baseline Studies on Watercourses Lining*
9. *Various SIAPEP Baseline Studies on High Efficiency Irrigation Systems*
10. *PLL SIAPEP Monitoring and Impact Report*
11. *PLL SIAPEP Monitoring and Impact Report*
12. *Various SIAPEP Flow Measurement Reports*
13. *Pakistan Economic Survey-----Various Issues*
14. *Agricultural Statistics of Pakistan-----Various Issues*

ANNEX-A: MONITORING LOG-FRAME

Project subcom- ponents	Targets	Activities	Outputs	Outcome-1	Outcomes-2	Goals / Impact	Methodology for measuring results
C1: Organization of Water Users' As- sociations (WUAs)	Reactivation of ex- isting / organization of water users' asso- ciations. Ensuring one on each target watercourse. Total WUAs ensured 47,278.	a) Community mobi- lization at 47,278 watercourses	a) Total 47,278 WUAs reac- tivated / estab- lished/registered	a) Right of way of 47,278 water- courses available b) Skilled and un- skilled labor re- quired for water- course improve- ment available. c) Construction ma- terial for civil works of watercourses procured. d) Alternate arrange- ment for water conveyance during construction made. e) Watercourse im- proved	a) Disputes among the water users settled. b) Farmers branched im- proved. c) Water allocation was made amica- bly. d) Maintenance of watercourses, WST and laser units done e) Cooperation among farmers increased	a) 47,278 water- courses improved and 15 percent- age points con- veyance losses re- duced. b) Litigation among farmers reduced.	a) The functioning of the WUAs will be established through sample interview surveys of WUAs mem- bers twice during the project period
C2: Watercourses Improvements	Improvement of 47,278 water- courses on cost sharing basis: 40% farmers in terms of labor, and 60% funded by project.	a) Establishment of 47,278 Water us- ers' associations (WUAs); b) Registration of 47,278 WUAs. c) Improvement and realignment of earthen section of	a) 47,278 WCAs were established. b) 47,278 WCAs reg- istered. c) 47,278 water- courses improved and lined.	a) Conveyance losses for im- proved water- courses de- creased by about 15 percentage points.	a) Increase in crop- ping intensity on improved water- courses by 5- 24%. b) Increase in crop yields. c) Increase in irri- gated area.	a) Increase in farm income. b) Increase in em- ployment for farm labor. c) Reduction in pov- erty. d) Enhanced food security for the country.	a) The water flow measurements will be carried out before and after watercourse improvement on 2-5% sample ba- sis. b) Agriculture sur- vey before and

Project subcom- ponents	Targets	Activities	Outputs	Outcome-1	Outcomes-2	Goals / Impact	Methodology for measuring results
		<p>47,278 water-courses.</p> <p>d) Lining of up to 50% length of 47,278 water-course either by:</p> <ul style="list-style-type: none"> • Precast concrete parabolic lining (PCPL) segments, or • Rectangular brick masonry, or any other method as approved by the project. 		<p>b) 1.654 million households benefited from the activity.</p> <p>c) 11.347 million acres served with improved water-courses</p>	<p>d) Increase in agriculture output per unit of water by about 37%</p>		<p>after watercourse improvement on 2-5% sample basis.</p> <p>c) The survey will determine:</p> <ul style="list-style-type: none"> • Cropping pattern before and after the improvement. • Cropping intensities before and after improvement. • Before and after crop yields. • Before and after employment. <p>d) The difference between before and after will be considered the result of the intervention after netting out the contribution of the growth pattern of the crop sector otherwise.</p>

Project subcom- ponents	Targets	Activities	Outputs	Outcome-1	Outcomes-2	Goals / Impact	Methodology for measuring results
C3: Construction of Water Storage Tanks (WSTs)	a) Construction of 14,932 water storage tanks	a) 14,932 small farmers mobi- lized to construct water storage tanks for irriga- tion. b) They agree to contribute 40% of the cost. c) Agree to first construct the tank with his/her own funds and then received subsidy at 40% on issuance of FCR	a) 14,932 WSTs were con- structed. b) 14,932 WSTs op- erated and main- tained	a) Water which was otherwise largely going to be wasted is saved. b) Irrigation is pro- vided at critical stages of the crops. c) Flexibility achieved for irri- gation	a) More area irri- gated. b) Increased crop- ping intensities	a) Increased crop yields b) Increased total crop output quantum. c) Increased farm in- come d) Increased farm employment	a) 2-5% sample of WSTs will be sur- veyed. b) A data collection form will be de- signed to meas- ure water saving due to WSTs. c) The forms used for baseline and im- pact surveys in case of water- courses will also be used for WSTs. d) Same data analy- sis will be carried out here as in case of water- courses.
C4: Provision of Land Leveling Units	a) Provision of 11,610 laser land leveling units to farmers and ser- vice providers on a cost sharing ba- sis: 50% by farmer / service provider and 50% by the project.	a) 11,610 laser units provided to farmers / service providers. b) Farmers trained in using the units.	a) 11,610 farmers / service providers received PLL units. b) Farmers / service providers re- ceived training in using the units.	a) Land levelled on Farmers' / ser- vice providers' farms. b) Land levelled on fellow farmers on rent. c) Total 3.483mil- lion acres lev- elled by 11,610 units.	a) Water applica- tion efficiency increased at field level. b) Even germina- tion of seed. c) Field application losses reduced by 10 percentage points. d) Water productiv- ity increased by 24%	e) Increased area under irrigated crops. f) Enhanced crop yields g) Increased farm income	a) The land leveling is expected to save irrigation water and result in bet- ter and even ger- mination of seeds which can en- hance crop yields. The crop yields thus affected will be reflected in ag- riculture sample surveys.

Project subcom- ponents	Targets	Activities	Outputs	Outcome-1	Outcomes-2	Goals / Impact	Methodology for measuring results
							<ul style="list-style-type: none"> b) 2-4% of sample units will be visited by ME&IE Consultants teams after one year of delivery. c) The unit will be verified. d) Area treated during the year will be collected. e) Farmers' feedback collected on quality of the unit, quality of the after-sale service, etc.

ANNEX-B: FIELD SURVEY SCHEDULE - ZONE/UNIT WISE

PLL FIELD SURVEY SCHEDULE - ZONE/UNIT WISE

Zone/Unit	District	Date of Survey	Name of Service Provider	Father Name	Company name
Punjab	Bahawalnagar	04/06/2022	Abdul Ghafoor	Khan Muhammad	Crosfield Agro
Punjab	Bahawalnagar	31/05/2022	Ahsan Zahoor	Zahoor Ahmad	Al-Inyat & Sons
Punjab	Bahawalnagar	30/05/2022	Dildar Hussain	Shair Muhammad	Easy Farming
Punjab	Bahawalnagar	28/05/2022	Muhammad Aslam	Shah Ali	Easy Farming
Punjab	Bahawalnagar	02/06/2022	Muhammad Hussain	Abdul Rehman	Easy Farming
Punjab	Bahawalnagar	30/05/2022	Muhammad Sarwar	Bashir Ahmad	Al-Inyat & Sons
Punjab	Bahawalnagar	31/05/2022	Muhammad sharif	Muhammad Yaqoob	Easy Farming
Punjab	Bahawalnagar	02/06/2022	Muhammad Sohna	Ali Muhammad	Easy Farming
Punjab	Bahawalnagar	02/06/2022	Noor Ahmad	Jani	Easy Farming
Punjab	Bahawalnagar	02/06/2022	Saif Ur Rehman	Zahoor Ahmad	Easy Farming
Punjab	Bahawalnagar	04/06/2022	Sultan Mehmood	Ghulam Muhammad	Haji Sons International
Punjab	Bhakkar	16/06/2022	Ameer iqbal Asif	Naseer Ahmad	Ali Bhai Engineers
Punjab	Bhakkar	17/06/2022	Hassan Abbas	Akhtar Hussain	Modern Farming
Punjab	Bhakkar	18/06/2022	Muhammad Asad Khan	Muhammad Ismail	Modern Farming
Punjab	Bhakkar	01/05/2022	Muhammad Shahid	Mushtaq Ahmad Shaheen	Modern Farming
Punjab	Bhakkar	18/06/2022	Muhammad Younus	Muhammad Yousaf	Crosfield Agro
Punjab	Dera Ghazi Khan	24/05/2022	Abdul Majeed	Kareem Baksh	Crosfield Agro
Punjab	Dera Ghazi Khan	24/05/2022	Ghulam Hussain	Abdul Razaq	Hanzla Traders
Punjab	Dera Ghazi Khan	24/05/2022	Ghulam Hussain	Abdul Razzaq	Hanzla Traders
Punjab	Dera Ghazi Khan	25/05/2022	Lalan Mai	Raheem Buksh	Modern Farming
Punjab	Dera Ghazi Khan	24/05/2022	Muhammad Aslam	Ibrahim Baksh	Crosfield Agro
Punjab	Dera Ghazi Khan	24/05/2022	Muhammad idrees	Ghulam Muhi din	Falcon Traders
Punjab	Dera Ghazi Khan	23/05/2022	Muhammad Zahid	Abdul Sattar Hasrat	Hanzla Traders
Punjab	Dera Ghazi Khan	24/05/2022	Muzzaffar Qasim	Muhammad Qasim	Crosfield Agro
Punjab	Faisalabad	21/01/2023	Abdul Rauf	Fatah Muhammad	Falcon Traders

Zone/Unit	District	Date of Survey	Name of Service Provider	Father Name	Company name
Punjab	Faisalabad	21/01/2023	Allah Ditta	Akbar Ali	Pioneer Agro Laser Land Level Services
Punjab	Faisalabad	21/01/2023	Arbab Saif Ullah	Saif Ullah	Ruba Digital Laser
Punjab	Faisalabad	20/01/2023	Arif Hussain Gill	Faqeer Hussain Gill	Easy Farming
Punjab	Faisalabad	21/01/2023	Bashir Ahmed	Sadar Din	Modern Farming
Punjab	Faisalabad	20/01/2023	Jamat Ali	Nawab Din	Ruba Digital Laser
Punjab	Faisalabad	20/01/2023	Mahe wal	Noor Muhammad	Falcon Traders
Punjab	Faisalabad	21/01/2023	Muhammad Anwar	Sardar Muhammad	Ruba Digital Laser
Punjab	Faisalabad	20/01/2023	Muhammad Khan	Muhammad Akram	Falcon Traders
Punjab	Faisalabad	21/01/2023	Muhammad Zubair	Muhammad Ali	Easy Farming
Punjab	Faisalabad	21/01/2023	Touqeer Abbas	Abbas Ali	Falcon Traders
Punjab	Gujranwala	21/01/2023	Akhtar Hussain	Fateh Muhammad	Bahawal Engineering
Punjab	Gujranwala	21/01/2023	Fayaz Ahmad	Muhammad Khan	Ruba Digital Laser
Punjab	Gujranwala	21/01/2023	Muhammad Asif	Muhammad Khan	Modern Farming
Punjab	Gujranwala	21/01/2023	Muhammad Farooq	Muhammad Hussain	Crosfield Agro
Punjab	Gujranwala	21/01/2023	Nadeem Raza	Muhammad Khan	Next Level
Punjab	Gujranwala	21/01/2023	Rafaqat Ali	Saif Ali	Crosfield Agro
Punjab	Gujranwala	21/01/2023	Tariq Hussain	Talib Hussain	Ruba Digital Laser
Punjab	Gujrat	22/01/2023	Aftab Ahmad	Muhammad Naeem Ullah	Maqbool Surviving Store
Punjab	Gujrat	22/01/2023	Faisal Nawaz	Muhammad Nawaz	Maqbool Surviving Store
Punjab	Gujrat	22/01/2023	Naeem Sohail	Nazeer Ahmad	Ruba Digital Laser
Punjab	Gujrat	22/01/2023	Nazar Hussain	Muhammad Din	Ruba Digital Laser
Punjab	Gujrat	22/01/2023	Orangzaib	Muhammad Razaq	Ruba Digital Laser
Punjab	Gujrat	22/01/2023	Qayyum Sarwar Qamar	Muhammad Sarwar	Ruba Digital Laser
Punjab	Hafizabad	23/01/2023	Allah Rakha	Muhammad Iqbal	Al-Inyat & Sons
Punjab	Hafizabad	23/01/2023	Mumtaz Ahmad	Abdullah	Falcon Traders
Punjab	Hafizabad	23/01/2023	Samia Baig	Iftikhar Ahmad (Husband)	Modern Farming
Punjab	Hafizabad	23/01/2023	Shahid Iqbal	Munir Ahmad	Easy Farming
Punjab	Hafizabad	23/01/2023	Usman Afzal Chatta	Muhammad Afzal Chatta	Ali Bhai Engineers
Punjab	Jhang	23/01/2023	Ajmal Nadeem	Shamir khan	Next Level

Zone/Unit	District	Date of Survey	Name of Service Provider	Father Name	Company name
Punjab	Jhang	23/01/2023	Bilal Hussain	Muhammad Ashraf	Next Level
Punjab	Jhang	23/01/2023	Hanif Tahir	Muhammad Ramzan	Easy Farming
Punjab	Jhang	23/01/2023	Shamir Khan	Muhabat Ali	Next Level
Punjab	Jhang	23/01/2023	Umar Hayat	YASEEN	Crosfield Agro
Punjab	Kasur	21/01/2023	Abid Hussain	Fareed Din	Rehman Agro Engineers
Punjab	Kasur	21/01/2023	Ali Asgar	Muhammad Din	Modern Farming
Punjab	Kasur	21/01/2023	Bashir Ahmad	M.Shafi	Farm Power International
Punjab	Kasur	21/01/2023	Ch.Muhabbat Ali	Rehmat Ali	Crosfield Agro
Punjab	Khanewal	23/01/2023	Amjad Hussain	Muhammad waryar	Hanzla Traders
Punjab	Khanewal	23/01/2023	Asghar Ali	Muhammad Anwar	Green Land Laser
Punjab	Khanewal	23/01/2023	M.Abid khan	Khalil Ahmad	Waseer Agrics
Punjab	Khanewal	23/01/2023	M.Ibrahim	M.Ismail	Green Land Laser
Punjab	Khanewal	23/01/2023	Muhammad Sharif	Muhammad Iqbal	Easy Farming
Punjab	Khanewal	23/01/2023	Syed Asad Ali	Syed Shaheen Haider	Rehman Agro Engineers
Punjab	Khanewal	23/01/2023	Zia Ullah khan	Haq nawaz khan	Waseer Agrics
Punjab	Khushab	25/01/2023	Ghulam Akbar	Atta Muhammad	Pioneer Agro Laser Land Level Services
Punjab	Khushab	25/01/2023	Khushi Muhammad	Atta Muhammad	Ruba Digital Laser
Punjab	Khushab	25/01/2023	Mansab Dar	Ahmad Khan	Crosfield Agro
Punjab	Khushab	25/01/2023	Muhammad Ramzan	Muhammad Khan	Ruba Digital Laser
Punjab	Khushab	25/01/2023	Muhammad Safdar	Shah Muhammad	Ruba Digital Laser
Punjab	Khushab	01/01/2021	Muhammad Shameer	Muhammad Ameer	Crosfield Agro
Punjab	Khushab	25/01/2023	Sher Khan	Ahmad Khan	Ruba Digital Laser
Punjab	Khushab	25/01/2023	Umer Daraz	Muhammad Raza	Pioneer Agro Laser Land Level Services
Punjab	Lodhran	25/01/2023	Abdul Malik	Azam Ali	Ruba Digital Laser
Punjab	Lodhran	25/01/2023	Haq Nawaz	Peera datta	Modern Farming
Punjab	Lodhran	25/01/2023	Haq Nawaz	Peera datta	Modern Farming
Punjab	Lodhran	25/01/2023	Hazoor Ahmad	Pearinditta	Modern Farming
Punjab	Lodhran	25/01/2023	Javeed Iqbal	M Sharif	Next Level
Punjab	Lodhran	25/01/2023	Mushtaq Hussain	Kamal pur jatyal	Ali Bhai Engineers

Zone/Unit	District	Date of Survey	Name of Service Provider	Father Name	Company name
Punjab	Lodhran	25/01/2023	Talha Naeem	M.Afzal	Hanzla Traders
Punjab	Lodhran	25/01/2023	Umar Farooq Khan	Shaib yar	Hanzla Traders
Punjab	Multan	24/01/2023	Ali Ahmad	Bashir Ahmad	Crosfield Agro
Punjab	Multan	24/01/2023	Ghulam Rasool	Nawab Din	Pioneer Agro Laser Land Level Services
Punjab	Multan	24/01/2023	Khuda Bukhsh	Muhammad Bukhsh	Crosfield Agro
Punjab	Multan	24/01/2023	M.Arif	M.Suleman	Farm Power International
Punjab	Multan	24/01/2023	Muhammad Aslam	Allah Dad	Farm Power International
Punjab	Multan	24/01/2023	Muhammad Iqbal	Bashir Ahmad	Pioneer Agro Laser Land Level Services
Punjab	Multan	24/01/2023	RIAZ HUSSAIN	M.Sharif Bajwa	Al-Inyat & Sons
Punjab	Multan	24/01/2023	Shoukat Hussain	Ameer Bukhsh	Crosfield Agro
Punjab	Nankana Sahib	19/01/2023	Abdul Sattar	Sardar Muhammad	Easy Farming
Punjab	Nankana Sahib	19/01/2023	Aitazaz Hussain Bhatti	Nazir Ahmad	Crosfield Agro
Punjab	Nankana Sahib	19/01/2023	M.imran	M.Sharif	Crosfield Agro
Punjab	Nankana Sahib	19/01/2023	Muhammad Asim	Muhammad Saleem	Rehman Agro Engineers
Punjab	Nankana Sahib	19/01/2023	Zafar Iqbal	Nazeer Ahmad	Easy Farming
Punjab	Okara	27/01/2023	Haji Muhammad Ashraf	Fazal Karim	Easy Farming
Punjab	Okara	27/01/2023	Khan Muhammad	Wali Muhammad	Crosfield Agro
Punjab	Okara	27/01/2023	Maqbool Ahmed	Sardar Muhammad Zafar	Easy Farming
Punjab	Okara	27/01/2023	Muhammad Akram	Muhammad Ali	Ruba Digital Laser
Punjab	Okara	27/01/2023	Muhammad Ramzan	Taj ud Din	Easy Farming
Punjab	Okara	27/01/2023	Muhammad Younas Bhatti	Salamat Ali Bhatti	Ruba Digital Laser
Punjab	Okara	27/01/2023	Sabir	Abdul Ghani	Easy Farming
Punjab	Rahim Yar Khan	04/07/2022	Muhammad Aslam Sohail	Ghulam Mustafa Sohail	Hanzla Traders
Punjab	Sahiwal	26/01/2023	Abdul Farooq	Peer Muhammad	Easy Farming
Punjab	Sahiwal	26/01/2023	Ali Rizwan Khan	Zahoor Khan	Waseer Agrics
Punjab	Sahiwal	26/01/2023	Muhammad Ibrar	M.Adrees	Easy Farming
Punjab	Sahiwal	26/01/2023	Muhammad Nawaz	Noor Muhammd	Waseer Agrics
Punjab	Sahiwal	26/01/2023	Muhammad Ramzan	Karam Ali	Easy Farming
Punjab	Sahiwal	26/01/2023	Nazar Muhammad	Muhammad Nawaz Khan	Waseer Agrics

Zone/Unit	District	Date of Survey	Name of Service Provider	Father Name	Company name
Punjab	Sahiwal	26/01/2023	Noor Muhammad	Muhammad Ameer	Waseer Agrics
Punjab	Sahiwal	26/01/2023	Usman ali	Arshad Akhter	Pioneer Agro Laser Land Level Services
Punjab	Sargodha	24/01/2023	Ahmad Hussain	Noor Hussain	Maqbool Surving Store
Punjab	Sargodha	24/01/2023	Allah Dad	Muhammad Khan	Modern Farming
Punjab	Sargodha	24/01/2023	Muhammad Safdar	Shah Muhammad	Farm Power International
Punjab	Sargodha	24/01/2023	Muhammad Sher	Ahmad Khan	Maqbool Surving Store
Punjab	Sargodha	24/01/2023	Nouman Mumtaz	Muhammad Mumtaz	Next Level
Punjab	Sargodha	24/01/2023	Saleh Muhammad	Allah Yar	Maqbool Surving Store
Punjab	Sheikhupura	20/01/2023	Asad ullah	Denar Ahmad	Crosfield Agro
Punjab	Sheikhupura	20/01/2023	Ghulam Muhi-ud-DIN	Hassan Din	Modern Farming
Punjab	Sheikhupura	20/01/2023	M.Akhtar	Niyamat Ali	Al-Inyat & Sons
Punjab	Sheikhupura	20/01/2023	Mubarak Ali	Ghulam nabi	Bahawal Engineering
Punjab	Sheikhupura	20/01/2023	Muhammad Akram	Khushi Muhammad	Crosfield Agro
Punjab	Sheikhupura	20/01/2023	Sajjad Ahmad	Nazir Ahmad	Al-Inyat & Sons
Punjab	Sheikhupura	20/01/2023	Shafqat Ali	M Shafee	Bahawal Engineering
Punjab	Sialkot	20/01/2023	Amjid Mehmood	Muhammad Sharif	Bahawal Engineering
Punjab	Sialkot	20/01/2023	Muhammad Naveed	Muhammad Mushtaq	Bahawal Engineering
Punjab	Sialkot	20/01/2023	Muhammad Zakaullah	Sana Ullah	Bahawal Engineering
Punjab	Sialkot	20/01/2023	Munir Ahmad	Barkat Ali	Bahawal Engineering
Punjab	Sialkot	20/01/2023	Wahid Ali	Muhammad Ismail	Crosfield Agro
Punjab	Toba Tek Singh	24/01/2023	Akram ul Haq	Muhammad Boota	Ruba Digital Laser
Punjab	Toba Tek Singh	24/01/2023	Chawa	Ghulam Muhammad	Next Level
Punjab	Toba Tek Singh	24/01/2023	Ghulam Murtaza	Akbar Ali	Easy Farming
Punjab	Toba Tek Singh	24/01/2023	Ijaz Ahmed	Muhammad Sharif	Modern Farming
Punjab	Toba Tek Singh	24/01/2023	Muhammad Ali	Abdul Hayee khan	Ruba Digital Laser
Punjab	Toba Tek Singh	24/01/2023	Muhammad Jameel	Rukan Din	Al-Inyat & Sons
Punjab	Toba Tek Singh	24/01/2023	Umar Hayat	Noor Muhammad	Ruba Digital Laser
Punjab	Toba Tek Singh	24/01/2023	Zafar Iqbal	Muhammad Aslam	Ruba Digital Laser
Punjab	Vehari	25/01/2023	Ashraf Ali	Ali Muhammad	Rehman Agro Engineers

Zone/Unit	District	Date of Survey	Name of Service Provider	Father Name	Company name
Punjab	Vehari	25/01/2023	Karam Elahi	Haji Allah Baksh	Crosfield Agro
Punjab	Vehari	25/01/2023	Master Basir Ahmed	Atta Muhammad	Hanzla Traders
Punjab	Vehari	25/01/2023	Muhammad Banyameen	Muhammad Sarwar	Easy Farming
Punjab	Vehari	25/01/2023	Muhammad Nasrullah	Ghulam Nabi	Ali Bhai Engineers
Punjab	Vehari	25/01/2023	Muhammad Saleem	Rehmat Ullah	Amjad Brothers Zarai Industries
Punjab	Vehari	25/01/2023	Muhammad Yaqoob	Sajwara	Easy Farming
Punjab	Vehari	25/01/2023	Sajjad Mehmood	Bashir Ahmed	Hanzla Traders
KP	Dera Ismail Khan	20/01/2023	Junaid Ahmad Khan	Jamshaid Ahmad khan	Cross Field Agro
KP	Dera Ismail Khan	20/01/2023	Malik Muhammad Bhawal	Muhammad Afzal	Cross Field Agro
KP	Dera Ismail Khan	20/01/2023	Muhammad Arif	Malik khuda Baksh	Ruba Digital Laser
KP	Dera Ismail Khan	20/01/2023	Muhammad Arshad	Muhammad Yaqoob	Cross Field Agro
KP	Dera Ismail Khan	21/01/2023	Muhammad Ramzan	Muhammad Hashim	Modern Farming PLL Services
Balochistan	Jafarabad	23/01/2023	Ejaz Ali	Mohammed Azeem	Amjad Brothers Zarai Industries
Balochistan	Jafarabad	23/01/2023	Javeed Ali	Mohabbat Khan	Amjad Brothers Zarai Industries
Balochistan	Jafarabad	23/01/2023	Mohammed Kaleem	Haji Ameer Bux	Amjad Brothers Zarai Industries
Balochistan	Jafarabad	23/01/2023	Sher Khan	Ghulam Haider	Amjad Brothers Zarai Industries
Balochistan	Sohbatpur	24/01/2023	Ghulam Sabir	Abdul Rehman	Amjad Brothers Zarai Industries
Balochistan	Sohbatpur	24/01/2023	Mohammed Hassan	Noor Mohammed	Amjad Brothers Zarai Industries
Balochistan	Sohbatpur	24/01/2023	Mohiudin	Sabir	Amjad Brothers Zarai Industries

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ANNEX-C: MONITORING TOOLS FOR PLL

MTs Laser Land Leveling

Precision Laser Land Leveling	
DB.#	Questions
Identification	
1	Province?
2	Division?
3	District?
4	Tehsil?
5	Select survey date?
6	Name of Service Provider?
7	Father name
8	Contact number
9	CNIC number
10	Do you own Agriculture land?
1	Yes
2	No
If selected "Yes" in Q.# 10 then continue with Q.# 11	
Otherwise go to Q.# 12	
11	Area of land? (Acres)
12	Education of the service provider?
1	Illiterate
2	Primary / Middle
3	Matric
4	Intermediate
5	Graduate
6	Masterss/Ph.D.
13	Company name providing Laser Land Levelling?
14	Make and Model of the Machine?
15	Delivery date?
Monitoring	

16	Picture of Laser Land Levelling unit?	
17	Coordinates	
18	The unit is in physical possession of service provider verified by ME&IE team?	
1	Yes	
2	No	
If selected "Yes" in Q.# 18 then continue with Q.# 19		Otherwise go to Q.# 20
19	Condition / Upkeep of the unit?	
1	Good	
2	Satisfactory	
3	Not Satisfactory	
20	reason?	
1	The service provider did not allow to see the unit	
2	It was told that unit was sent for Land Levelling and SP disagree to take the team at workplace	
3	Any other please specify _____	
21	Do you have trained operator for your equipment?	
1	Yes (Operator available)	
2	Yes (My Self)	
3	No one is trained	
22-a	The operator has been given trainings in operation of LLL	
1	Yes	
2	No	
22-b	The operator has been given trainings in trouble shooting	
1	Yes	
2	No	
22-c	The operator has been given trainings in Repair and maintenance	
1	Yes	
2	No	
22-d	Define any other trainings	
Feedback		
23	Quality / Durability of the unit?	
1	Good	
2	Satisfactory	
3	Not Satisfactory	

4	Do not Know
24	After sale service of the SSC?
1	Good
2	Poor
3	Very Poor
4	I did not need yet
25	Complaints attended by SSC?
1	Promptly
2	Not Promptly
3	I did not need yet
26	Rates charged by SSC to provide the after sale service?
1	Costly
2	Normal
3	I did not need yet
27	Availability of spare parts?
1	When required
2	Takes long time
3	I did not need yet
28	Price charged by the SSC for the spare parts?
1	Costly
2	Normal
3	I did not need yet
29	Spare parts are available?
1	Only with SSC
2	From open market
3	I did not need yet
Leveled Land Data	
30	Do you provide service to other farmers?
1	Yes
2	No
31	Level of record keeping?
1	Complete record
2	Partial

3	Not keeping any record
32	Method of record keeping?
1	Keeps records in log book
2	On loose papers / thing
3	Not in Writing
33	Land leveled during the last crop season (Rabi / Kharif)?
1	Own land (acres) _____
2	Other's land (acres) _____
3	Number of farmers served (No.) _____
4	Duration in months (No.) _____
34	Rates per hour?
1	Rabi (Rs.) _____
2	Kharif (Rs.) _____
35	Hours per Acre?
1	Rabi (hr.) _____
2	Kharif (hr.) _____
Impact	
<div style="display: flex; justify-content: space-between;"> <div style="background-color: #00b050; color: white; padding: 5px; text-align: center;">If selected "No" in Q.# 10 then continue with Q.# 36</div> <div style="background-color: #ff0000; color: white; padding: 5px; text-align: center;">Otherwise go to Q.# 39</div> </div>	
36	Beneficiary name? (If Service Provider has no land)
37	Beneficiary's owned land?
38	Beneficiary's leveled land?
1	Rabi (Acres) _____
2	Kharif (Acres) _____
Cultivated Area	
39	Total Cultivated Area?
1	Before (Acres) _____
2	After (Acres) _____
40	Select crops
1	Wheat
2	Sugarcane
3	Rice
4	Cotton
5	Maize (Grains)

6	Vegetables
7	Other Crops
41	Crop irrigation time per acre?
1	Before (hrs) _____
2	After (hrs) _____
42	Crop yield per acre?
1	Before (mound) _____
2	After (mound) _____
43	Supervisor Confirmation?
44	Select Submission Status?
45	Comments of interviewer (if any) (optional)